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

ENVIRONMENTAL ENGINEERING

W.E.F 2015

DEPARTMENT OF ENVIRONMENTAL ENGINEERING

Scheme of Teaching and Examinations
B. Tech. (ENVIRONMENTAL ENGINEERING)
W.E.F. 2015

DELHI TECHNOLOGICAL UNIVERSITY

(Formerly Delhi College of Engineering)

CONTENTS

Delhi Technological University
(Formerly Delhi College of Engineering)
Shahbad Daulatpur, Bawana Road, Delhi – 110 042

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 ENVIRONMENTAL ENGINEERING

VISION

To create, disseminate, integrate, develop and transfer new & traditional knowledge and innovative applications of science and technology in the field of Environmental Engineering for improvement of the present day practices and create leaders for sustainable development for betterment of the human society.

MISSION

1. To establish high quality interdisciplinary research, leading to technological development and competency building in different areas related to Environmental Engineering.
2. By providing an intellectually challenging, supportive and welcoming environment that encourage and enable the students, faculty and staff to achieve their best in a diverse community.
3. To provide students with modern curriculum with revisions at regular interval to keep pace with modern developments as well as to identify potential research areas that are relevant from the perspective of India in particular and the world in general.
4. By providing excellent laboratory and computational facilities to accomplish the requirement of technological advancement of students and faculty members.
5. To mould students towards research and profession oriented career through incubation of ideas, product development and entrepreneurship.

DEPARTMENT OF ENVIRONMENTAL ENGINEERING
BACHELOR OF TECHNOLOGY (ENVIRONMENTAL 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.	CE251	Building Material & Construction	AEC	4	3	0	2	3	0	15	25	20	40	-
2.	EN 201	Strength of Materials	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	EN203	Engineering & Environmental Surveying	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	EN205	Environmental Chemistry & Microbiology	DCC	4	3	0	2	3	0	15	25	20	40	
5.	EN207	Engineering Analysis & Design	DCC	4	3	1	0	3	0	25	-	25	50	-
6.	HU201	Engineering Economics	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.	CE252	Structural Analysis	AEC	4	3	1	0	3	0	25	-	25	50	-
2.	EN 202	Geotechnical Engineering	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	EN204	Water Engineering: Design & Application	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	EN206	Engineering Geology, GIS & Remote Sensing	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	EN208	Fluid Mechanics & Hydraulic Mechines	DCC	4	3	0	2	3	0	15	25	20	40	
6.	MG201	Fundamentals of Management	HMC	3	3	0	0	3	0	25	-	25	50	
Total				**23**										

III Year: Odd Semester

S.N0	Code	Title	Area	Cr	L	T	P	TH	PH	CWS	PRS	MTE	ETE	PRE
1.	EN301	Waste Water Engineering: Design and Applications	DCC	4	3	0	2	3	0	15	25	20	40	
2.	EN303	Instrumentation Techniques for Environmental Monitoring	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	ENxxx	Departmental Elective Course-1	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/ 0	30/ 25	40/ 50	
4.	ENxxx	Departmental Elective Course-2	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/ 0	30/ 25	40/ 50	
5.	UExxx	Open Elective Course	OEC	3	3	0	0	3	0	25		25	50	-
6.	HU303	Professional Ethics & Human Values	HMC	2	2	0	0	3	0	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.	EN302	Solid Waste Management	DCC	4	3	0	2	3	0	15	25	20	40	
2.	EN304	Air Pollution & Control	DCC	4	3	0	2	3	0	15	25	20	40	-
3.	EN306	Hydrology & Ground Water Engineering	DCC	4	3	1	0	3	0	25	-	25	50	-
4.	ENxxx	Departmental Elective Course-3	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/0	30 /25	40/ 50	
5.	ENxxx	Departmental Elective Course-4	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/0	30 /25	40/ 50	
6.	HU302	Technical Communication	HMC	2	2	0	0	3	0	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.	EN401	B. Tech Project-I	DCC	4										
2.	EN403	Training Seminar	DCC	2										
3.	EN405	Project Management	DCC	4	3	0	2	3	0	15	25	20	40	-
4.	EN407	Vibration Analysis & Control of Noise Pollution	DCC	4	3	1	0	3	0	25	-	25	50	-
4.	EN409	Industrial Waste Management	DCC	4	3	0	2	3	0	15	25	20	40	-
5.	EN4xx	Departmental Elective Course-5	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/ 0	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.	EN402	B. Tech Project -II	DCC	8										
2.	EN404	Environmental Impact Assessment & Audit	DCC	4	3	1	0	3	0	25	-	25	50	-
3.	EN4xx	Departmental Elective Course - 6	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/0	30/ 25	40/ 50	
4.	EN4xx	Departmental Elective Course- 7	DEC/ GEC	4	3	0/1	2/0	3	0	15/ 25	15/0	30/ 25	40/ 50	
Total				**20**										

List of Departmental Elective Courses

S.NO.	SUBJECT CODE	SUBJECTS	Elective No.
1.	EN-305	Soil Pollution & Remediation	DEC -1 ,2
2.	EN-307	Planning and Design of Environmental Enng. Works	
3.	EN-309	Water Resources System	
4.	EN-311	Climate Change & CDM	
5.	EN-313	Environmental Toxicology & Risk Assessment	
6.	EN-315	Ecology and Bio-monitoring Techniques	
7.	EN-308	Hazardous & Biomedical Waste Management	DEC-3,4
8.	EN–310	Surface & Ground Water Pollution	
9.	EN-312	Advance Surveying	
10.	EN–314	Green Technology	
11.	EN–316	Environmental Law and Policy	
12.	EN–318	Transportation and Traffic Engineering	
13.	EN-411	Occupational Hazards, Health & Safety	DEC-5
14.	EN-413	Water and Soil Conservation	
15.	EN–415	System Simulation & Modeling	
16.	EN-406	Advanced Open Channel Hydraulics	DEC-6,7
17.	EN-408	Risk and Reliability Analysis of Environmental System	
18.	EN-410	Irrigation and Drainage Engineering	
19.	EN-412	Environment and Sustainable Development	
20.	EN-414	Disaster Management	
21.	EN-416	Non-Conventional Energy Systems	

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: **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: **CE-251** Course Title: **Building Material and Construction**

2. Contact Hours : L: 3 T: 0 P: 2

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

4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0

5. Credits : 4

6. Semester : III

7. Subject Area : AEC

8. Prerequisite : NIL

9. Objective : To give concepts of different material used for civil construction

10. Details of Course :

S.No.	Contents	Contact Hours
1	**Building Materials:** Stone, Lime, Glass, Plastics, Steel, FRP, Ceramics, Aluminum, Fly Ash, Basic Admixtures, Timber, Plywood, Bricks and Aggregates: Classification, properties and selection criteria, IS specification.	8
2	**Cement:** Types, Composition, Properties, Uses and specifications. Tests on cement-normal consistency, initial setting, final setting, tensile and compressive strengths, unsoundness, fineness, heart of hydration. Aggregates: Classification, properties, porosity and absorption, bulking of sand, sieve analysis; grading curves, fineness modulus, impurities and tests on aggregates. Lime and Cement Mortars,	8
3	**Concrete:** Properties, workability-Slump Test, Compaction-factor test and Vee-Bee consistometer test; bleeding, shrinkage and creep, mixing and placing of concrete, compressive and tensile strengths, effects of water-cement ratio, compaction, age, curing temperature on strength of concrete, Modules of elasticity. Poisson's ratio, Design of concrete mixes: Proportioning of aggregates, IS, ACI and other methods of mix design.	9

4	**Building Construction:** Building byelaws, Loads on buildings. Types of foundations and selection criteria. Brick masonry, stone masonry, bonds. Types of walls, partition and cavity walls, design criteria. Prefabricated construction. Plastering and pointing. Dampness in buildings, its causes and effects. Damp proofing materials and techniques.	8
5	**FloorsConstruction:** Construction details and selection criteria. Types of roofs and roof covering, treatment for water proofing. Doors and windows: sizes and locations, materials. Stair and staircases: types, materials, and proportions. Lifts and escalators. White washing, colour washing, painting, distempering. Shuttering, scaffolding and centering. Expansion and construction joints. Acoustics & sound and fire proof construction, I.S. specifications.	9
Total		**42**

11. Suggested Books

1	Mamlouk and Zaniewski, “Materials for Civil and Construction Engineers, Pearson.
2	Arora, S. P. & Bindra, S. P., “A text book of Building Construction”, Dhanpat Rai & Sons, Delhi.
3	Jha, J. & Sinha, S. K., “Building Construction”, Khanna Publishers, Delhi.
4	Kulkarni, C.J., “A text book of Engineering Materials”, Ahmedabad Book Depot, Ahmedabad.
5	Kumar Sushil, “Engineering Materials”, Standard Publishers Distributors, Delhi.
6	Kumar Sushil, “Building Construction”, Standard Publishers Distributors, Delhi.
7	McKay W.B., “Building Construction, “Vol.1 to 4, Orient Longman Ltd.
8	Punmia, B. C., “A text book of Building Construction”, Laxmi Publications, Delhi, Madras.
9	Singh Surendra, “Engineering Materials”, Konark Publishers Pvt. Ltd.

1. Subject Code: **EN-201** Course Title: **Strength of Materials**

2. Contact Hours : L: 3 T: 0 P:2

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

4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0

5. Credits : 4

6. Semester : II

7. Subject Area : DCC

8. Prerequisite : NIL

9. Objectives : This course aims to describe the role of strength of materials. The aim of unit-1 is to study mechanical properties of materials and various types of stress and strains. The objective of unit-1 is to draw the shear force and bending moment diagrams. The aim of unit -3 is to calculate the deflection of the beam by various methods. The objective of unit-4 and unit-5 are to do the analysis of columns and torsion of the shaft.

10. Detail of Course:

S. No.	Contents	Contact Hours
1	**Stress and Strain:** Introduction, Mechanical properties, simple stress and stains, elastic constants, principal stress. Mohrs' circle, simple bending and shear of the beam.	7
2	**Bending Moment and Shear Force Diagrams:** Introduction, Shear force and bending moment diagrams of cantilever beams, simply supported beam, over hanging beams of different types of loadings.	10
3	**Deflection:** Introduction, Deflection due to bending, moment curvature relation, Double integration method, Macaulay's method, moment area method, and conjugate beam method.	10

4	**Columns and Struts:**Introduction, types of columns, Modes of failure of columns, Effective length, slenderness ratio, Eulers Theory, Rankines's theory.	7
5	Torsion of Shaft Introduction, Torsion of shafts: Introduction, Torsion of circular shafts, Assumptions, Resisting torque, Power transmitted, Design of shafts.	8
Total		**42**

11. Course Outcomes:

From unit-1, the student will learn the concept of mechanical properties of materials. Form unit-2. They will get knowledge of drawing the shear force and bending moment diagrams of beam. Unit-3, unit-4 & unit-5 give the concept of calculation of deflection of beam, column analysis and torsion of the shafts.

12. Suggested Books :

1. Mechanics of Materials, B. C. Punmia, Laxmi Publications
2. Strength of Materials, R. K. Rajput, S. Chand & Company
3. Strength of Materials, B. C. Punmia, Laxmi Publications

1. Subject Code: **EN-203** Course Title: **Engineering & Environmental Surveying**

2. Contact Hours : L: 3 T: 0 P: 2

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

4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0

5. Credits : 4

6. Semester : III

7. Subject Area : DCC

8. Pre-requisite : Nil

9. Objectives :

1. To introduce the definition, principle, importance and scope of surveying.
2. To introduce the Plane table surveying and leveling.
3. To introduce the different methods for the calculation of area and volume for plane and irregular boundaries.
4. To introduce the basic concepts of, types and operation of Theodolite.
5. To understand the principle and operation of Tacheometry surveying.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**Introduction to Surveying:** Introduction: Object & scope of surveying, classification of Surveying, principles of surveying, surveying instructions, Basic Surveying Techniques: Chain Surveying ; Instruments of chain surveying, corrections to measured lengths, measurement of offsets, limiting length of offsets, field work of chain surveying, booking of field notes, conventional symbols, obstacles in chain surveying, errors in chain surveying & their corrections. Compass surveying: instructions in compass surveying, system of recording the bearing, determination of meridian compasses, traversing & graphical method of adjustment.	7
2.	**Plain table Surveying and Leveling:** Plane table Surveying: Plane table and its accessories, methods of plane tabling, two point problem, three point problems by different methods. Leveling: Introduction, types of leveling, leveling instruments, operations and adjustments of levels, ordinary leveling, errors of leveling, effect of earth's curvature and atmospheric refraction in leveling , precise leveling, modern leveling instruments, contouring: characteristics and uses of contour, modern methods of depicting relief on map.	9
3.	**Areas and Volume:** Areas , Volume and Earthquake Computations : Different methods of determination of areas from plan, areas of irregular boundaries, areas of field notes by latitudes and departure methods, instrumental methods of determining areas, areas of cross section, determination of earthquake volumes.	9

4.	**Theodolite Traversing:** Theodolite Traversing : Transit theodolites, operation and adjustment of theodolites, horizontal angle by the method of repetition and reiteration, permanent adjustments of theodolite, theodolite traversing, traverse computations, sources of errors, check in a traverse, closing error and its adjustments, omitted measurements.	9
5.	**Tacheometric Surveying:** Tacheometric surveying : principle of stadia method, instrument constants, Anallatic lens, Distance and elevation of stations, subtense method, tangential method, errors, subtense bar and its use.	8
Total		**42**

12.Suggested Books:

1. Agor, R, “Surveying”, Vol. I & II, Khanna Publications, Delhi.
2. Arora, K.R., “Surveying”, Vol. I & II, Standard Book House, Delhi.
3. Bannister, A. and Baker, R., “Solving Problems in Surveying”, Longman Scientific Technical, U.K..
4. Kennie, T.J.M. and Petrie, G., “Engineering Surveying Technology”, Blackie & Sons Ltd, London.
5. Punmia, B.C., “Surveying”, Vol. I & II, Laxmi Publications, New Delhi.

1. Subject Code: **EN-205** Course Title: **Environmental Chemistry & Microbiology**

2. Contact Hours : L: 3 T: 0 P: 2

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

4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PR 0

5. Credits : 4

6. Semester : III

7. Subject Area : DCC

8. Prerequisite : NIL

9. Objectives:
    1. To learn basics of aquatic chemistry
    2. To learn about different pollutants of water and their effect over water quality
    3. To learn basics of atmospheric chemistry
    4. To learn basics of microbial structure and functions
    5. To learn the utilization of microbes in environmental remediation processes

10. Detail of Course:

S. NO.	Contents	Contact Hours
1	Aquatic chemistry Hydrological cycle, Chemical structure of water molecule, unusual properties of water, solubility of solids and gases in water, Carbonate cycle, pH of water, Chemical Equilibrium, Redox reactions. Application of principles of chemistry for solving environmental engineering problems.	9
2	Water Pollution Chemistry of pollution due to nutrients (CNP), Oxygen demanding wastes, salts, detergents, heavy metals, pesticides, hydrocarbons, PCBs, radioactive compounds.	6
3	Atmospheric Chemistry Composition of atmospheric layers, sources of air pollution, major pollutants of air, chemistry of photochemical smog formation, acid rain, ozone depletion; green house effect and global warming.	9
4	Environmental Microbiology Microbial taxonomy, Classification of morphological aspects of bacteria, algae, fungi, protozoa, and other aquatic micro flora; microbial growth and dynamics; pure and mixed cultures; Aerobic and Anaerobic metabolism; microbial transformation of organic matter (CNPS), acclimatization of waste; microbial inhibition mechanisms.	10
5	**Role of Microbes in Environment** Role of micro-organisms in wastewater treatment, and air pollution control (bio-scrubbers); microbial degradation of ligno-cellulosic material, pesticides, hydrocarbons; microbial precipitation of heavy metals.	8
Total		**42**

11. Course Outcomes

1. Theoretical knowledge and numerical calculations related to pH, equilibrium, solubility, dissociation etc.
2. Knowledge of sources and mechanisms resulting degradation of water quality
3. Understanding the direct and indirect processes related to air pollution
4. Identification of microbes, and regulation of microbial growth in lab
5. Application of microbes in waste treatment

12. Suggested Books and References:

1. Environmental Chemistry: by Colin Baird (Freeman)
2. Environmental Chemistry: by Manahan (CRC)
3. Environmental Chemistry: by Vanloon & Duffy (Oxford)
4. Microbilogy: by Pelczar (TataMcGraw Hill)
5. Introduction to Environmental Engg. and Science: by Gilbert Masters (Pearson)

1. Subject Code: **EN-207** Course Title: Engineering Analysis & Design

2. Contact Hours : L: 3 T: 1 P: 0

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

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

5. Credits : 4

6. Semester : III

7. Subject Area : DCC

8. Prerequisite : NIL

9. Objectives: This course aims to describe the role of RCC Structural Design. The object of unit-1 is to study different type of materials used in RCC construction and different type of beams used. Unit-2 tells about the design of columns. The aim of Unit-3 studies the idea of design of slab. The object of Unit-4 is to get concept of foundations. The aim of unit-5 is to study the design of steel structure elements.

10. Detail of Course:

S.No.	Contents	Contact Hours
1	**Design of Beam:** Reinforced Cement Concrete, concrete making materials, workability of the concrete, Types of steel reinforcement, types of concrete mixes, characteristics strength of steel and concrete, design principles, Limit state of collapse in flexure, shear and bond. Singly and doubly reinforced beam rectangular and T- Beam.	10
2	**Design of Column:** Introduction, classification of columns. Effective length of column, reinforcement in column, design of axially loaded short column, IS 456: 2000 specification of the columns.	8
3	**One Way and Two Way Slab :**Introduction, one way and two way slab, load distribution in a slab, IS 456: 2000 recommendations of the slab, design of one way and two way slabs	8
4	**Foundations:** Introductions, classifications of Foundations, analysis of isolated footings, design steps of isolated rectangular footings, Design of strip footings, design of combined footings	10
5	**Steel Structure :**Introduction, Steel elements, Riveted and Welded joints, Simple tension and compression member	6
Total		**42**

11. Course Outcomes:

From unit-1, the student will learn the various types of RCC materials and different types of beams used in practical. From unit-2, the student will get the concept of design of column, From unit-3 and unit-4, the student can do designs of slabs and foundations. The unit-5, the student will get the knowledge of steel structure elements.

12. Suggested Books:

1. Fundamentals of RCC, M. L. Gambhir, PHI Learning Pvte Ltd.
2. Reinforced concrete, Ashok K. Jain, Nem chand and Bros, Roorke
3. Design of RCC, N. Subramanian, OXFORD University Press

1. Subject Code: **CE 252** Course Title: **Structural Analysis**

2. Contact Hours : L: 3 T: 1 P: 0

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

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

5. Credits : 4

6. Semester : IV

7. Subject Area : AEC

8. Pre-requisite : NIL

9. Objectives : To familiarize the students with the concepts of the subject and its related applications in Civil Engg.

10. Details of Course:

S. No.	Contents	Contact Hours
1	Classification of Structures, Stress Resultants, Degree of Freedom per node, Static and Kinematic degrees of indeterminacy. Work and Energy. Strain energy of deformable systems, Betti's theorem of reciprocal work and Maxwell's theorem. Principle of virtual work and complementary virtual work, Principle of total minimum stationary potential energy, Stable and unstable equilibrium, Castigliano's Theorem I and II.	09
2	Analysis of determinate beams and plane frames. BM, SF and Axial thrust diagrams, Rolling loads, Influence lines diagrams Reaction, SF, BM, for determinate beams. Floor beams. ILD for Slope and Deflections in simple beams.	08
3	Classification of pin jointed determinate trusses. Analysis of plane, complex, compound and simple space trusses. Method of tension coefficient, graphical method of substitution. Maxwell's diagram to analyse simple trusses.	08
4	Deflection due to bending: The moment curvature relation, Macaulay's method, Moment area and Conjugate beam method, Deflection of determinate plane frames using strain energy and unit load method, Elastic curve sketch).	08

5	Analysis of arches: Linear arch, Eddy's theorem, three hinged parabolic arch, Spandrel braced arch. Influence line diagrams for Horizontal thrust, BM RSF,NT. Stability of Columns: Study of ideal rigid columns,two bar and three bar systems. Euler's formula for long columns, Columns with eccentric axial loads, Rankine's formula.	09
Total		**42**

11. Suggested Books:

1.	Theory of Structures, Stephen P. Timoshenko and D. H. Young McGraw-Hill international book editions (ISBN 10: 0070648689 ISBN 13: 9780070648685), 1965
2.	Structural Analysis a unified classical and matrix approach, A.Ghali, A M Neville and T G Brown, SPON PRESS (In India by Replika Press Pvt. Ltd.) (ISBN 13-978-0-415-28092-1), 2003
3.	Intermediate Structural Analysis, C K Wang,Tata McGraw-Hill Education Pvt. Ltd., 2014 ISBN 10: 0070702497 / ISBN 13: 9780070702493, 2014
4.	Elementary Structural Analysis, J B Wilbur, C H Norris, S Utku, Tata McGraw-Hill Publishing Company Limited, New Delhi, ISBN 0-07-058116-9 , 2003
5.	Strength of Materials, Vol. I: Elementary Theory and Problems Paperback – 2004 ,S. TimoshenkoCBS Publishers & Distributors Pvt. Ltd., New Delhi,2004
6.	Strength Of Materials,3E, Vol II Timoshenko S.CBS Publishers & Distributors Pvt. Ltd., New Delhi (2002) ISBN 10: 8123910770 ISBN 13 : 9788123910772,2002
7.	Mechanics of Materials 8th Edition by James M. Gere and Stephen P. TimoshenkoCBS Publishers Pvt. Ltd., New Delhi (2004)ISBN 10: 8123908946 ISBN 13: 978812390894,2004

1. Subject Code: **EN-202** Course Title: Geotechnical Engineering
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0
5. Credits : 4

6. Semester : IV

7. Subject Area : DCC

8. Prerequisite : NIL

9. Objectives : To understand basic fundamentals of soil properties and their determination.

   1. To understand the phenomenon of flow through soils.
   2. To understand the consolidation and compaction behavior of soils.
   3. To understand shear strength properties and slope stability analysis for soils.
   4. To understand earth pressure, bearing capacity, and deep foundations.

10. Details of Course

S. No.	Contents	Contact hours
1.	Phase Diagram and Functional Relationships, Index properties and their determination, Soil classification systems, Soil Water, Effective and Neutral Stresses.	8
2.	Permeability and its laboratory determination, Seepage Analysis and Flow Nets, Design principles of Filters. Stress Distribution in Soil Mass due to surface loading.	8
3.	One dimensional consolidation, Terzaghi's theory Consolidation test and analysis, Consolidation settlement, Compaction, Laboratory test, Field compaction and control.	9
4.	Shear Strength of Soil: Theory and Laboratory tests, cohesive and Non-cohesive soils. Stability of slopes: analysis of finite and infinite slopes.	8
5.	Theories of Earth Pressure including graphical methods, Bearing capacity of Shallow Foundations, Pile Foundations including pile groups and well foundations., and deep foundations.	9
Total		**42**

Suggested Books:

1. Das, B. M. (2011). *Principles of Geotechnical Engineering.* Cengage Learning.
2. Murthy, V. N. S. (2011). *Textbook of Soil Mechanics and Foundation Engineering.* CBS Publishers and Distributers Pvt. Ltd.
3. Punmia, B. C. (2005). *Soil Mechanics and Foundations.* Laxmi Publications Pvt Ltd.
4. Singh, Alam (2014). *Soil Engineering: Volume 1: Fundamentals and General Principles.* CBS Publishers and Distributers Pvt. Ltd.

1. Subject Code : EN-204 Course Title: **Water Engineering: Design & Application**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0
5. Credits : 4
6. Semester : IV
7. Subject Area : DCC
8. Pre-requisite : Nil
9. Objectives :

1. To introduce basic concepts of water engineering and design.
2. To understand the meaning and standards of Characteristics of Water
3. To introduce the definition, principle, types and design of sedimentation tank.
4. To introduce the definition, principle, types and design of Filtration.
5. To introduce the O & M of Water treatment plants

10. Details of Course

S. No.	Contents	Contact Hours
1	Water supply engineering : water demand, design period, population forecasting, source of water, hydrological concepts, ground water and its development, conveyance of water, pipe materials, corrosion, laying of pipes, pipe appurtenances , pumps for water supply, distribution system, planning of water supply projects.	9

2	Characteristics of Water: Physical, Chemical and Microbiological quality parameters. Drinking water quality criteria and standards.	7
3	Coagulation, common coagulants and coagulant aids and their reactions. Mixing and flocculation basin design. Sedimentation, design principles, discrete and flocculant suspensions, sedimentation tank details.	9
4	Filtration, gravity and pressure filters, single and multimedia filters. Water softening by chemical precipitation and ion exchange. Aeration of water to remove iron and manganese and taste and odour. Disinfection, disinfectants, chlorination of water supplies. Miscellaneous methods of water treatment	9
5	O & M of Water treatment plants, Domestic & Industrial water treatment.	8
Total		**42**

11. Course Outcomes:
    1. Students can learn the basic fundamentals of water engineering and design
    2. Students will know that how the population forecasting calculates.
    3. Students will understand the factors which effect the water properties.
    4. Students will learn the procedure to design sedimentation tank.
    10. Students will know the miscellaneous methods of water treatment.

12. Suggested Books:
    1. Peavy, Rowe and Tchobanoglous: Environmental Engineering
    2. Garg: Water Supply Engineering (Environmental Engineering Vol.-I)
    3. Punmia: Water Supply and Wastewater Engineering
    4. Steel and McGhee: Water Supply and Sewerage.
    5. Birdie: Water Supply and Sanitary Engineering

1. Subject Code: **EN-206** Course Title: **Engineering Geology, GIS & Remote Sensing**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0

5. Credits : 4

6. Semester : 4

7. Subject Area : DCC

8. Prerequisite : NIL

9. Objectives :

   1. Introduce Geology and its importance in engineering.
   2. To familiarize students with different rocks, ores, and minerals that are important to environmental engineers, and also the effect of various geological agents on them.
   3. To familiarize students with various structural components of rocks and their engineering importance, also the interaction of ground water with various rocks.
   4. To introduce the fundamentals, components and application of GIS.
   5. To familiarize students about basics of remote sensing, its multi concepts as well as its applications.

10. Detail of Course:

S. No.	Contents	Contact Hours
1	**Introduction to Geology:** Introduction: Definition, scope and importance of geology, branches of geology, origin, age and interior of earth, earth movements: continental drift and plate tectonics.	8
2	**Minerals and Rocks:** Minerals: Definition, Physical and optical properties, sources, Groups of rock & ore forming minerals. Study of rocks: igneous, sedimentary, and metamorphic. Geological Agencies. Weathering, erosion by running waters, glaciers, wind, and oceans and their engineering importance.	8
3	**Structural Geology and Geo Chemistry:** Structural Geology: Dip, strike, folds, faults & joints and their engineering aspects. Geo Chemistry: Sources of salinity in groundwater, Effect of rocks and minerals on the quality of ground water	8
4	**GIS :** Introduction and Definition of GIS, Components of GIS, GIS Data Types, Data Representation, Geo-referencing of GIS Data, Spatial Data Models, Raster Geoprocessing, Vector Geo-processing, GIS Database and Database Management System, Spatial Data Analysis, GIS Software Packages, GIS Applications	9

5	**Remote Sensing:** Introduction to Remote Sensing, Remote Sensing System, Multi-Concept of Remote Sensing, Electromagnetic Radiation, Remote Sensors, Data Reception, Transmission and Processing, Digital Data Products, Image Interpretation, Digital Image Processing, Application of Remote Sensing	9
Total		**42**

11. Course Outcomes:

1. Student will learn about basics of Geology and its importance in engineering.
2. Student will be able to understand the properties of rocks, minerals and its application and importance in environmental engineering.
3. Student will learn the various effects of rocks and minerals on the quality of ground water.
4. The unit of GIS will create a clear cut understanding among students about geographical information system, its components, DMS and its various applications in real life.
5. Student will be able to attain thorough knowledge about remote sensing, electromagnetic spectrum, and its diverse applications.

12. Suggested Books:

1. Annadurai, R. Nagalakshmi, R. (2016). *Textbook of Engineering Geology.* Ane Books Pvt. Ltd..
2. Billings, M. P. (1990). *Structural Geology.* Prentice-Hall of India Pvt. Ltd..
3. Singh, Parbin (2008). *Engineering and General Geology.* S. K. Kataria & Sons.
4. Todd, D. K., Mays, L. W. (2005). *Groundwater Hydrology.* Wiley India Pvt. Ltd.
5. Varghese, P. C. (2012). *Engineering Geology for Civil Engineers.* PHI Learning Pvt. Ltd..
6. Fundamentals of Remote Sensing – George Joseph, University Press, Hyderabad, India.
7. Remote Sensing and Geographical Information System – AM Chandra & SK Ghosh, Narosa Publishing House, New Delhi.
8. Concepts and Techniques of Geographic Information Systems – C. P. Lo & Albert K.W. Yeung, PHI Learning Private Limited, New Delhi.
9. Geographic Information System – Kang Tsung Chang, Tata Mc Graw hill, Publication Edition, 2002.

1. Subject Code: **EN 208** Course Title: **Fluid Mechanics & Hydraulic Machines**

2. Contact Hours : L: 3 T: 0 P: 2

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

4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0

5. Credits : 4

6. Semester : IV

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objectives : To familiarize the students with the concepts of fluids and hydraulics machines concepts. The object unit 1 is to understand the properties and laws of fluids. The other unit objects are the different types of flow and the concepts of turbines and pumps.

10. Details of Course :

S.No	Contents	Contact Hours
1	**Introduction**: Properties of fluids, types of fluids and continuum principle.	3
2	**Fluid Statics:** Basic definition, hydro statics law, Pascal's law, manometers, hydro statics forces on submerged surfaces, buoyancy.	6
3	**Kinematics of flow:** Types of flow, streamline, pathline, principle of conservation of mass, velocity, acceleration, velocity potential and stream function, vorticity and circulation.	6
4	**Fluid dynamics:** Euler;s equation, Bernoulli's equation, and its application, Pitot tube, venturimeter, Orifices and mouth pieces.	5
5	**Laminar and turbulent flow in pipe:** Laminar flow through pipes, velocity distribution, turbulent flow, Reynolds equation, prandtl's mixing length theory, velocity distribution in pipe flow and plate flow, Darcy's weisbach equation, friction factor, water hammer.	7

6	**Dimensional analysis and models:** Dimensional homogeneity, Rankines and Buckingham'a pie theorem, dimensionless numbers, Types of models and model analysis.	5
7	**Boundary layer theory:** Concept of boundary layer, laminar and turbulent boundary layers, boundary layer thickness, laminar sub-layer, hydrodynamically smooth and rough boundaries, cavitations.	4
8	**Hydraulic Machines:** Introduction, Dynamics forces on curved and bends, Elements of hydroelectric power plants, head and efficiencies of hydraulic turbines, classification of turbines, Pelton wheel turbine, working proportions of Pelton wheel, DESIGN OF Pelton wheel runner, study and design Francis turbine, Draft tube theory, Kaplan turbine, working proportions of Kaplan turbine, Efficiency, specific speed and unit quantities, centrifugal and reciprocating pumps.	6
Total		**42**

11. Course Outcomes:
    1. The students will learn the fluids and its properties.
    2. The unit -2 gives the understanding of hydro-static laws and hydro-static forces.
    3. The students get the ideas of kinematic of fluids.
    4. Unit-4 tells the Bernoulli;s equations and its applications.
    5. Unit-5 and unit-6 gives the Laminar and Turbulent flow through pipes and Dimensional analysis and models.
    6. Unit-7 and unit-8 gives the concepts of understanding the Boundary layer theory and Hydraulic Machines.

12. Suggested Books:

S.N.	Name of Books/ Authors /Year of Publication
1	Bansal, R.K. "Fluid Mechanics and hydraulics machines", Laxmi Publications(P) Ltd. (ISBN 81 7008 311 7),2008
2	Garde, R.J. and Mirajgaoker, A.G. "Engineering fluid Mechanics", Nem Chand & Bros. (ISBN 81 88429 01 5),2000
3	Som, S.K. and Biswas, G., "Fluid Mechnics" Tata pMcGraw Hill. (ISBN 21 345 24561),2004

4	Kumar, K.L., "Engineering fluid Mechanics", Eurasia Publishing House (P) LTD. (ISBN 81 219 0100 6),2000
5	Ojha, C.S.P., "Fluid Mechanics and Machinery, OXFORD, University Press. (ISBN 01 19 569963 7),2010
6	Rajput, R. K., "Fluid Mechanic", S. CHAND & COMPANY LTD. (ISBN 81 219 1667 4),2004

1. Subject Code: **EN-301** Course Title: **Wastewater Engineering: Design and Applications**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0
5. Credits : 4
6. Semester : V
7. Subject Area : DCC
8. Prerequisite : NIL
9. Objectives:
   1. To educate the student on the working principles and design of various physical, chemical, and biological treatment systems for water and wastewater, including sludge.
   2. To educate the students about the various modes of conveyance of wastewater from the source of its generation to the treatment plant.
10. Detail of Course:

S.NO	Contents	Contact Hours
1	Design of various primary units in a Sewage Treatment Plant, Coarse screens, Fine screens, Oil & Grease Trap, Grit Chamber, Primary Sedimentation Tank	8
2	Design of secondary treatment units, Activated sludge process, Trickling filter, Oxidation ditch, oxidation pond.	8

3	Design of Imhoff Tank, Septic Tank, RBC etc. Upflow Anaerobic Sludge Blanket	8
4	Design of sludge digestion, Incineration etc. Application of the concepts of nonlinear optimization to waste water treatment design.	9
5	Design of sewer networks & optimization.	9
Total		**42**

11. Course Outcomes:
    1. To make them understand the fundamentals of waste water treatment .To learn about the various Pollutants in water and waste water and also to study about their characteristics.
    2. To understand in detail about the design principles of various physical treatment processes of wastewater.
    3. To understand in detail about the design principles of various chemical treatment processes of wastewater.
    4. To understand in detail about the design principles of various biological treatment processes of wastewater.
    5. To improve the knowledge on the Selection of unit operation and processes and to study the design oriented aspects of sand filters and other treatment processes.
    6. To understand about the design principles of conveyance systems of wastewater.

12. Suggested Books:

    1. Manual on Sewerage and Sewage disposal-CPHEEO, Govt. of India.
    2. Metcalf and Eddy, Wastewater Engineering: Treatment, disposal, and reuse. TMH, New Delhi.
    3. Wastewater Treatment Concept and design approach – G.L. Karia and R.A. Christian, PHI Publications
    4. Fiar, G.M., and Geyer, J.C., Water and Wastewater engineering, Vol-I & II, John Wiley and sons, New York.
    5. Anaerobic Sewage treatment by Van Haandel and Lettinga, John Wiley & Sons Publication
    6. Eckenfelder, Activated sludge treatment of industrial wastewater
    7. Steel, E.W, and Mc Ghee, T.J., Water Supply and Sewerage. Mc Graw Hill Book Co., New York.
    8. Hammer, M.J., Water and Wastewater Technology. John Wiley and sons-Inc, New York.
    9. Garg, S.K., Water Supply Engineering- Vol-I, Khanna Publishers, New Delhi.

1. Subject Code: **EN-303** Course Title : **Instrumentation Techniques for Environmental Monitoring**

2. Contact Hours : L: 3 T: 0 P: 2

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

4. Relative Weightage : CWE: 15 PRS: 25 MTE: 20 ETE: 40, PRE:0

5. Credits : 4

6. Semester : V

7. Subject Area : DCC

8. Prerequisite : NIL

9. Objectives:
   1. Fundamentals of functional elements of measuring system, Classification and calibration.
   2. Estimation of errors in measurement and minimization, measurement of pressure, temperature and flow etc.
   3. Introduction of Sepctro-analytical Methods
   4. Understanding of Chromatographic Methods
   5. Learn the Electro Analytical Methods and continuous measurement methods.

10. Details of Course:

S.No	Subject Code	Contact Hours
1.	Fundamentals: The Significance and Application of Measurement. Functional Elements of Generalized Measuring System. Classification of Measuring Instruments, Introduction of Microprocessors and advantages of Microprocessor based instrumentation. Management of Data in quantitative analysis: Accuracy, precision, types of errors, Minimization of error, statistical analysis and curve fittings.	09
2.	Standards of Measurement and its classification. Calibration of instruments and its importance. Transducers, measurement of non electrical quantities like pressure, temperature, flow and level etc.	08

3.	Spectro-analytical Method: Colorimetry, Speetophotometor, Flurometry, Nephlometry, Turbidimetry, Flame Photometry, Atomic, absorption and emission Spectrophotometer.	09
4.	Chromatography Method: Classification, Principal and application of Chromatography –Gas chromatography, GC-MS, HPLC, Ion Chromatography, Paper chromatography and thin layer Chromatography	08
5.	Electro Analytical Method: Conductometry Potentiometry, Coulometry and Polarography.Continuous Monitoring instruments and their principals: NDIR for CO, Chemiluminescence analysis for NO_X and fluorescence analysis for SO_2	08
TOTAL		**42**

11. Course Outcome
    1. Learned fundamentals of Measuring system, classification and calibration.
    2. Learned about Management of Data and measurement of non electrical quantities.
    3. Can Use Spectro-analytical Methods.
    4. Able to use Chromatography Methods.
    5. Have the idea about Electro Analytical Methods and Continuous Monitoring Methods.

12. Suggested Books:
    1. Instrumentation and Mechanical Measurement by Prof. A. K. Tayal
    2. Hand Book of Analytical Instrumentation by R. S. Khandpur
    3. Instrumentation Measurement and Analyst by B. C. Nakra and K K Chaudhry

1. Subject Code: **EN-302** Course Title: **Solid Waste Management**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0
5. Credits : 4
6.. Semester : VI

7. Subject Area : DCC

8. Prerequisite : NIL

9. Objective : To educate the students on the principles involved in the management of municipal solid waste from source identification up to disposal.

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**UNIT – I** Sources, Composition & Properties of Municipal solid waste. Handling & Separation of solid waste, Municipal Waste (Management & Handling Rules, 2000), Integrated solid waste management (SWM) System, Hierarchical approach for SWM. Solid Waste Collection & Transportation: Types of collection systems (Hauled- container system & Stationary container system), Collection routes & their Layout, Solid waste transfer stations.	10
2	**UNIT – II** Solid waste generation and collection rates; Waste handling and separation, storage and processing at source, solid wastes collection methods, separation, processing, and transformation of solid wastes, transfer and transport of solid wastes	10
3	**UNIT – II** Methods of Disposal of Municipal Solid Waste Landfills: Classification, Types & methods, Site selection, Site preparation, Composition, Characteristics, Generation, & Control of Landfill gases; Composition, Formation, Movement & control of leachate in landfills; landfill design. Re-vegetation of closed landfill sites, Long term post closure plan, Groundwater monitoring during & after closure.	11
4	**UNIT – IV** Transformation and recycling of waste materials; Composting: Theory of composting, Manual and mechanized composting, Design of composting plan, Recovery of bioenergy from organic waste. Thermal Conversion Technologies: Incineration, Pyrolysis & Gasification Systems. Types & design of Incinerators.	11
Total		**42**

11. Course Outcomes:

1. To make the students understand the fundamentals of solid wastes and also the types, need and sources of solid wastes.
2. To understand about the methods of waste characterisation and source reduction and to study the various methods of generation of wastes.
3. To understand in detail about the storage, collection and transport of wastes and also to study about the methods used for handling and segregation of wastes.
4. To know about the basics of the waste disposal options and also a detailed study on the disposal in landfills and also to learn about landfill remediation.
5. To understand about the waste transformation and material/energy recovery technologies with regard to municipal solid wastes

12. Suggested Books:

1. George Tchobanoglous, Hilary Theisen, Samuel A. Viquel, “Integrated Solid Waste Management: Engineering, Principles & Management issues”, McGraw-Hill-International Edition.
2. CPHEEO Manual on Municipal Solid Waste Management.
3. Michael D. LaGrea, Phillip L. Buckingham, Jeffrey C. Evans, “Hazardous Waste Management and Environmental Resource Management”, McGraw-Hill- International Edition.
4. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, “Environmental Engineering”, McGraw-Hill- International Edition.
5. Mackenzige L. Davis, David A. Cornwell, “Introduction to environmental engineering”, McGraw-Hill- International Edition.
6. Arcadio P. Sincero, Gregoria A. Sincero, “Environmental Engineering, A Design Approach”, Prentice Hall India.
7. William P. Cunningham, Mary Ann Cunningham, “Principles of Environmental Science”, TMH. India.
8. Richard T. Wright, “Environmental Science”, Pearson Education.
9. Bala Krishnamoorthy, “Environmental Management, Text Book and Cases”, PHI Publication.

1. Subject Code: **EN-304** Course Title : **Air Pollution & Control**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE) (Hrs.) : Theory: 3 Hrs. Practical: 0 Hrs
4. Relative Weightage : CWE: 15 PRS: 25 MTE: 20 ETE: 40 PRE:0
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Prerequisite : NIL
9. Objectives :
   1. Introduction to Air Pollution and its effects, Sampling and measurement.
   2. Study the Property of Atmosphere, Metrological Variables and plume behavior.
   3. To Develop an understanding of the pollution control methods of particulate matter.
   4. Gaseous pollution control methods and Automobile pollutions.
   5. To give the concept Air population legislation in India and current topics.
10. Details of Course:

Sr. No.	Contents		Contact Hours
1.	**Unit-I**	Sources and classification of Air Pollution Effects of Air Pollution on Human health, plants, Animals and Property. Sampling and measurement in ambient, Work Place and stack.	8
2.	**Unit-II**	Meteorology- Concept of Atmosphere, wind movements, Windrose Diagram and Measurement of Meteorological Variables. Atmospheric lapse rates, Adiabatic lapse rate and their consequences, Plume behavior. Plume rise-equation, estimation of stack height.	8
3.	**Unit-III**	Pollution control Method of a Particulate matter: Types of Particulate control methods-Settling chambers, cyclone separators, scrubbers, filters and Electrostatic precipitators-Mechanism, Their design and application.	9

4.	**Unit-IV**	Gaseous Pollution control method and Automobile Pollution: Types of gaseous Pollution Control method- absorption, adsorption and combustion process. Automobile pollution- Sources of pollution, composition of auto exhaust & control method.	8
5.	**Unit-V**	Air Pollution Legislation and Global Problem: Air Quality Standard, Ambient Air Quality Standard and Emission standard. Air Pollution, legislation and regulation in India. Air Pollution Indices. Global problem of air pollution and its remedial measure. Air Pollution from major Industrial Operations- Case study	9
Total			**42**

11. Course Outcome
    1. Learned about Air Pollution, its effects and measurement.
    2. Understanding of the Metrological concept and Plume behavior
    3. Understanding of control of particulate Matter by Different Methods.
    4. Learned about Control of Gaseous Pollutants and automobile Pollution.
    5. Awareness of Air Pollution Legislation in India and current topic.

12. Suggested Books and References:
    1. **Air Pollution**:- M.N. RAO and H.V. RAO , M C Graw Hill Education.
    2. **Introduction to Environmental Engineering and Science**: - G. M. Masters

1. Subject Code: **EN-306** Course Title: **Hydrology & Groundwater Engineering**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Tutorial 0 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DCC
8. Pre-requisite : Nil

9. Objectives :

1. To understand the meaning, importance and scope of the hydrology.
2. To introduce the hydrological equations
3. To introduce the basic concept of Evaporation and methods of estimation of evaporation and infiltration
4. To introduce the concept of hydrographs and stream gauging for measuring the runoff
5. To introduce the different methods for plotting the Unit hydrograph
6. To understand the meaning of flood and methods of calculating the future flood
7. To introduce the concept of ground water

10. Details of Course

S. No.	Contents	Contact Hours
1.	**UNIT I:** Precipitation Precipitation: Scope of hydrologic cycle, World water balance, India's water balance, Types and forms of precipitation, Measurement of precipitation, Types of rain gauges, Adequacy of rain gauges, Adjustment and filling in of missing dada, Average rainfall over an area, Basic statistics and frequency analysis.	7
2.	**UNIT II:** Evaporation Evaporation: Evaporation and its measurements, Estimation of evaporation. Formulae of Penman, Thornthwaite and Blaney-Criddle method. Evaporation control. Infiltration: Factors affecting infiltration, Infiltrometers, Infiltration indices.	9
3.	**UNIT III:** Run Off Run Off: Surface run off, factors affecting run off, Hydrographs, flow rating curves and flow duration curves. Mass curve. Rainfall run-off relationship. Stream gauging, measurement of stage and velocity.	9
4.	**UNIT IV:** Unit Hydrograph Unit Hydrograph: Unit hydrograph. Derivation of unit hydrograph. Synthetic UH, IUH. Floods: Flood flow formulae, Frequency analysis using external type and log pearson type III distribution, flood routing through reservoirs.	9

5.	**UNIT V:** Ground Water Ground Water: Elements of Ground Water modeling:-Darcy's law, unconfined and confined aquifers, and their properties, steady and unsteady flow in wells, ground water quality, sources of pollution, remedial and preventive measures, ground water budgeting and recharging of ground water.	8
Total		**42**

11. Course Outcomes:
    1. Students can learn the basic fundamentals of hydrology and Ground water.
    2. Students will know that how the precipitation, evaporation, infiltration and runoff calculate.
    3. Students will understand the factors which effect the hydrological equations.
    4. Students will learn the procedure to calculate and plot the hydrograph and unit hydrograph.
    5. Students will know the difference between confined aquifer and unconfined aquifer.

12. Suggested Books Suggested:
    1. Engineering Hydrology by K. Subramanya, Tata Mc Graw Hill.
    2. Water Resources Engineering by Wurbs and James, PHI Publications.
    3. Engineering by H. Raghunath & Willey-Eastern.
    4. Water Resources & Ground water by M.C. Chaturvedi, Tata Mc Graw Hill.
    5. Engineering Hydrology by J. Rami Reddy, Laxmi Publication.

1. Subject Code: **EN401** Course Title: **B.Tech Project-I**
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 : 4
6. Semester : VII
7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objectives : 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: **EN-403** Course Title: **Training Seminar**

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 : 2

6. Semester : VII

7. Subject Area : DCC

8. Pre-requisite : NIL

9. Objectives : To familiarize the students to work in industry and working culture of the industrial system. He should also be able to write and present the work done during the course.

1. Subject Code: **EN-405** Course Title: Project Management

2. Contact Hours : L: 3 T: 0 P: 2

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

4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0

5. Credits : 4

6. Semester:VII

7. Subject Area: DCC

8. Prerequisite: NIL

9. Objectives:
    1. To have an understanding about estimates their types and method of preparation.
    2. To have an understanding about how to do analysis of rate of different building and infrastructure items and planning of resources and valuation
    3. To understand about the project planning and management through preparation of network and their analysis
    4. To understand about the project monitoring, cost planning and time value of money
    5. To understand about the legal aspects, contract and tender.

10. Details of Course:

S. N.	Contents	Contact Hours
1	**Unit-1:** Importance of estimation, different types of estimates, specification: general and detailed. Methods of estimation, Estimates of RC works, Estimates of building.	8
2	**Unit-2:** Analysis of rates, prime cost, work charge establishment, quantity of materials per unit of work for major civil engineering items, Resource planning through analysis of rates, market rates, PWD schedule of rates and cost indices for building material and labour. Introduction to valuation.	8
3	**Unit-3:** Project cycle, organization, planning, scheduling, monitoring, updating and management system in construction Bar chart, Milestone chart, Work down structure and preparation of networks. Application of network, Techniques like PERT, GERT,CPM, AON and AOA techniques.	8
4	**Unit-4:** Project monitoring; cost planning, resources allocation through network techniques. Time value of money, present economy studies, Equivalent concept, financing of projects, economic comparison, present worth method, equivalent annual cost method, discounted cash flow method, depreciation and break even cost analysis. Quality Control, Productivity, Operation Cost.	9

5	**Unit-5:** Legal aspects of contracts, their relative advantages and disadvantages, Different types of contracts, their relative advantages and disadvantages, Elements of tender preparation, process of tendering, pre-qualification of contracts, Evaluation of tender preparation, process of tendering, Evaluation of tender, contract negotiation and award of work, Land acquisition, Labour safety and welfare.	9
Total		**42**

11. Course Outcomes:
    1. Estimate the buildings and RC work
    2. Prepare quantities, rate and resource planning
    3. Plan, schedule, monitor, update through management system in construction and prepare the project network
    4. Monitor Project, cost planning, resources allocation, time value of money, quality control
    5. Make contract documents, prepare tender and award the work, Land acquisition

12. Suggested Books and References:

1. Estimating and costing by B.N.Datta.
2. PERT and CPM principle and application by L.S.Srinath.
3. PERT and CPM principle and application by B.C.punamia.
4. Construction planning and management by U.K.Srivastva.
5. Estimating, costing and Valuation in Civil Engineering by M. Chakraborty.
6. Construction, planning, equipment and method by R.L. Peurify.
7. Network analysis techniques by S.K.Bhatnager.

1. Subject Code: **EN- 407** Course Title: **Vibration Analysis & Control of Noise Pollution**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Tutorial 0 Hrs

4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DCC
8. Prerequisite : NIL
9. Objectives:
    1. To develop basic knowledge about sound and noise
    2. To aware the current scenario of noise in India as well as in other countries along with different monitoring techniques.
    3. To aware about the traffic noise generation process, its effects and its modelling part.
    4. To create a clear understanding about the train and aircraft noise as well as its modelling part.
    5. To generate the skill to control the different noise generation from different sources

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**UNIT –I** Basics of Sound, Sound propagation in air, Indoor sound propagation, Fundamentals of Noise, Difference between sound and noise, Sound Power, Sound Intensity, Sound Pressure Levels, Measurement of noise, Sources of noise, Outdoor and Indoor Noise Propagations, Ambient noise level standards	8
2	**UNIT –II** Noise pollution in India, Factors Affecting Noise Pollution, Road Traffic Noise Monitoring, Ambient Noise Monitoring, Occupational Noise Monitoring, Vibration monitoring, traffic noise data analysis, health effects of noise	8
3	**UNIT –III** Highway Traffic Noise: noise from vehicles, effects of operating conditions on vehicle noise levels, individual sources of vehicle noise, assessment of road traffic noise, traffic noise rating, practical aspects of traffic noise measurement, prediction of noise levels due to highway traffic	9

4	**UNIT –IV** Train Noise: introduction, elements of train noise, diesel engine noise, transmission noise, rail-wheel interaction noise, vibration from railway vehicles, modelling of train noise Aircraft Noise: introduction, assessment of community reaction to aircraft noise, sources of aircraft noise, aircraft noise prediction, control of aircraft noise	9
5	**UNIT –V** Noise Control Measures, Industrial noise control, Principles of Noise Pollution Control, Sound Absorption, Basics about Noise Barrier, Design of Noise Barrier, Vibration Damping, Muffling, Green Belt for Noise Attenuation	8
Total		**42**

11. Course Outcomes:

    1. The student will understand the basics about sound and noise
    2. They will be able to understand the worldwide scenario of noise pollution and different monitoring techniques.
    3. The student will have a clear cut understanding about traffic noise, its adverse effects and its modelling part.
    4. The students will have a clear understanding about the train and aircraft noise as well as its modelling part.
    5. They will be able to suggest the control measures to different noise generated from different sources.

12. Suggested Books:

    1. S.K. Agarwal (2009). Noise Pollution. ISBN No. 817648833X.
    2. S.P. Singal .Noise Pollution and Control Strategy. ISBN No. 81-7319-645-1.
    3. Lawrence K. Wang, Norman C. Pereira, Yung-Tse Hung. Advance air and noise pollution control, Vol. 2., eISBN 1-59259-779-3.
    4. Charles E. Wilson. Noise Control: Measurement, analysis and control of sound and vibration. ISBN 0-06-047155-7.

1. Subject Code: **EN - 409** Course Title: **Industrial Waste Management**

2. Contact Hours : L: 3 T: 0 P: 2

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

4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0

5. Credits : 4

6. Semester : VII

7. Subject Area : DCC

8. Pre-requisite : Nil

9. Objectives : The overall aims of the course are for students to acquire theoretical knowledge of industrial processes, operations, manufacturing. It includes study of liquid, solid and air discharges from industries, waste characteristics. Also their management, treatment and disposal.

10. Details of Course

Sr. No.	Contents	Contact Hours
1.	**UNIT – I** Properties of Water, Polar & Non-polar Solvents, True Solutions, Emulsification, Colloidal Suspensions, and Mixtures made stable by Chelating Agents. **Management of Industrial Wastes*:***Solid, Liquid and Gaseous waste, Management of Industrial Wastewater, Management of Solid Wastes from Industries, and Management of Discharges to the Air.	9
2.	**UNIT – II** Waste Characterization Study, Wastes Audit, Characteristics of Industrial Wastewater, Characteristics of Discharges to the Air, Characteristics of Solid Waste Streams from Industries.	7

3.	**UNIT – III** **Wastes from Industries*:*** Textile Wastes; Dairy wastes; Slaughterhouse, Poultry and fish processing waste; Tannery Wastes; Sugar Mill Wastes; Pulp and Paper Mill Waste; Fermentation Industry Waste; Engineering Industry Waste; Petroleum and Petrochemical wastes; Fertilizer and Pesticides Industry waste; Wastes from vegetable, food and allied industries, Rubber Waste.	9
4.	**UNIT – IV** **Pollution Prevention*:***General Approach, Source Reduction, Waste minimization, strength and volume reduction, segregation, reuse, recycle, material conservation, recovery, Benefits of Pollution Prevention. **Methods for Treating Wastewaters from Industry*:***Wastewater Treatment Mechanisms, Waste Equalization, pH Control, Chemical Methods of Wastewater Treatment, Biological Methods of Wastewater Treatment, Physical Methods of Wastewater Treatment.	10
5.	**UNIT – V** **Treatment and Disposal of Solid Wastes from Industry*:***Landfilling, Incineration, Composting Industrial Wastes, Solidification and Stabilization of Industrial Solid Wastes. **Methods for Treating Air Discharges from Industry*:*** Reduction at Source, Containment, Treatment.	7
Total		**42**

11. Course Outcome:

1. Introduction to types of industrial waste, characterization and management.
2. Study of manufacturing processes and wastes generated in various industries.
3. Discovering the scope of prevention, treatment and disposal of solid, liquid and gaseous waste.

12. Suggested Books:

1. Nemerow NL () Industrial Waste Treatment: Contemporary Practice and Vision for the Future, Butterworth-Heinemann,
2. Nemerow NL (1978) *Industrial Water Pollution: Origins, Characteristics, and Treatment*, Addison-Wesley, ISBN 10: 0201052466 / ISBN 13: 9780201052466
3. Frank Woodard (2001) *Industrial Waste Treatment Handbook,* Butterworth–Heinemann, ISBN 0-7506-7317-6

4. WEF Manual of Practice No. FD-3, *Industrial Wastewater Management, Treatment, And Disposal,* Water Environment Federation, Third Edition, McGraw Hill
5. Zahid Amjad (2010) *The Science and Technology of Industrial Water Treatment*, IWA Publishing, CRC Press, ISBN 1843393115 ISBN13 9781843393115
6. Wun Jern NG (2006) *Industrial Wastewater Treatment*, Imperial College Press (ICP), ISBN 1-86094-580-5 ISBN 1-86094-664-X (pbk)
7. Office Of In U S Department Of Energ Bailly Rcg-Hagler () *Industrial Waste Gases: Utilization and Minimization*, CRC Press, ISBN: 0877627746 ISBN-13: 9780877627746
8. Eckenfelder W. Jr. (1999) *Industrial Water Pollution Control*, Environmental Engineering and Water Resources Series, 3rd Edition, McGraw-Hill Science/Engineering/Math, ISBN-13: 978-0070393646, ISBN-10: 0070393648
9. Willem Rudolfs (1953) *Industrial Wastes: Their Disposal and Treatment*, Reinhold Publishing
10. Azad HS (1976) *Industrial wastewater management handbook*, McGraw-Hill, ISBN 0070026610
11. Patwardhan AD, *Industrial Waste Water Treatment*, PHI Learning Private Ltd, India, ISBN 9788120333505

1. Subject Code: **EN-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. Objectives : 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: **EN - 404** Course Title: **Environmental Impact Assessment & Audit**

2. Contact Hours : L: 3 T: 1 P: 0

3. Examination Duration (ETE) (Hrs.) : Theory: 3 Hrs. Tutorial: 0 Hrs

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

5. Credits : 4

6. Semester : VIII

7. Subject Area : DCC

8. Pre-requisite : Nil

9. Objectives : The overall aims of the course are for students to acquire understanding of the principles, process, and the necessary techniques for environmental impact assessment, mitigation and monitoring. It also includes analysis and prediction of impact on resources and environment caused due to development projects.

10. Details of Course

Sr. No.	Contents	Contact Hours
1	**UNIT-I** Definition and history of environmental impact assessment, related law necessary for EIA, Objectives of Environmental Impact Assessment, Process for EIA, TOR, IEE, Components of EIA Reports.	9
2	**UNIT-II** Tools for assessment of environmental impacts: checklist, networks, matrices, overlays, baseline study, scoping & scales, network overlays, index methods. Planning of environmental Factors.	10

3	**UNIT-III** Prediction and assessment of impacts on air and noise; soil and land use; water quantity and quality; biological: terrestrial ecology-forest and wildlife, aquatic ecology-plankton, nekton, benthos and importance of coastal habitat; human use, quality of life, socio-economic. Consideration of human values in design & execution of projects.	10
4	**UNIT-IV** Mitigation and Monitoring process for environmental impact assessment	5
5	**UNIT-IV** Environmental Impact Analysis-laws & statuses in India, Elements of Environmental Auditing, Impact Analysis of hydropower, thermal power projects, etc.	8
Total		**42**

11. Course Outcome:

    1. Acquiring knowledge on principle of EIA, definition, history and law related to EIA
    2. Study tools for evaluation of environmental impact.
    3. Assessment and prediction of environmental impacts on physical, biological, humans and quality of life.
    4. Learn Environmental auditing and Indian laws for EIA.

12. Suggested Books:

    1. Canter L.W. Environmental Impact Assessment. McGraw-Hill, Inc.
    2. Eccleston, H.C. 2000. Environmental Impact Statements. John Wiley & Sons, Inc.
    3. Lee, N. and C. George (editors). 2000. Environmental Assessment in Developing and Transitional Countries. John Wiley & Sons Ltd.
    4. Wathern P. 1995. Environmental Impact Assessment: Theory and Practice. Biddles Ltd, Guildford and King's Lynn.
    5. Westmman W. E. 1985. Ecology, Impact Assessment, and Environmental Planning. John Wiley & Sons, Inc.

DEPARTMENT ELECTIVE COURSES

1. Subject Code: **EN-305** Course Title: **Soil Pollution and Remediation**

2. Contact Hours : L: 3 T: 0 P: 2

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

4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PRE 0

5. Credits : 4

6. Semester : V

7. Subject Area : DEC

8. Prerequisite : NIL

9. Objectives : To have an understanding about Sources of subsurface contamination, Mechanisms of Soil contamination; Physical-chemical and biological interactions in soils; Effect of contamination on geotechnical properties

   1. To have an understanding about, selection of site for waste disposal, Leachate and Gas Generation, Waste characterization, waste containment principles.
   2. To have an understanding about types of Landfills, different types of liner material and capable of designing landfill elements.
   3. To have an understanding about construction, operation and performance monitoring of landfill site and capable of planning Environmental monitoring around landfills
   4. To have an understanding about detection, control and remediation of subsurface contamination, Various types of barrier systems; Reclamation of contaminated sites; economic analysis

10. Details of Course:

S. No	Contents	Contact Hours
1	**Soil pollution:** Introduction; Sources of subsurface contamination, Mechanisms of Soil contamination; Physical-chemical and biological interactions in soils; Effect of contamination on geotechnical properties.	8

2	**waste** characterization: Waste disposal on land, Site selection, Leachate and Gas Generation, Waste characterization, waste containment principles.	8
3	**Landfills:** Types of Landfills, natural attenuation landfill, Containment landfills, liner material and design of landfill elements.	9
4	**Landfill Construction:** Landfill construction, operation and performance monitoring. Environmental monitoring around landfills	8
5	**Control**: Detection, control and remediation of subsurface contamination, Various types of barrier systems; Reclamation of contaminated sites; economic analysis, Case Studies.	9
Total		**42**

11. Course Outcomes:

1. Understand different Sources of subsurface contamination
2. Understand Mechanisms of Soil contamination
3. Understand Physical-chemical and biological interactions in soils
4. Understand Effect of contamination on geotechnical properties
5. Capable of selecting of site for waste disposal
6. Understand Leachate and Gas Generation from waste
7. Capable of characterizing the waste
8. Understand about types of landfill and liner material
9. Capable of designing landfill elements
10. Understand about construction, operation and performance monitoring of landfill
11. Capable of planning Environmental monitoring around landfills
12. Understand about detection, control and remediation of subsurface contamination
13. Understand about various types of barrier systems
14. Understand about reclamation process of contaminated sites
15. Capable of doing economic analysis

12.Suggested Books :

1. Geo Environmental Engineering: Principles and Applications, L.N. Reddi and H.I.Inyang, Marcel Dekker, Inc. New York
2. Design, Construction and Monitoring of Landfills, Amalendu Bagchi, Ohn Willey and Sons, Inc.
3. Final Covers for solid waste landfills and abandoned dumps, R.M. Koerner and David E. Daniel, ASCE press
4. Geo Environmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies, Hari D. Sharma and Krishna R. Reddy,

1.	Subject Code: **EN-307**		Course Title: **Planning and Design of Environmental Engg. Works**
2.	Contact Hours	:	L: 3 T: 1 P: 0
3.	Examination Duration (ETE) (Hrs.)	:	Theory 3 Hrs. Tutorial: 0 Hrs
4.	Relative Weightage	:	CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5.	Credits	:	4
6.	Semester	:	V
7.	Subject Area	:	DEC
8.	Pre-requisite	:	Nil
9.	Objectives	:	The overall aims of the course are for students to acquire theoretical knowledge of planning involved in setting up, operation and management of environmental engineering works. Understand various parameters and considerations in designing various systems and planning of land-use, water plan.

10. Details of Course

S. No	Contents	Contact Hours
1.	**Environment and Human-Activity**: Resource, pollution, re-use & management. **Planning**: Short and long term planning, Master plan, per capita costs, expansion & extensions.	8
2.	**Land-Use Planning & Management:** Impact of land-use on human life, control of hazards in land use, management of land use, assessment of land as waste disposal sites.	8
3.	**Water plan optimization & allocation:** Analytical optimization techniques, simulation, growth, theories of settlement, over-crowding, slums, sporadic growth considerations, objective and growth with case studies.	8
4.	Design of conveyance system for source and fugitive, Design of cyclone and cyclone scrubbers, venture-scrubbers, packed towers and fabric filters. Design of control for volatile organic carbon compounds.	9
5	Management of private and public managed utilities, management of water supply and sewerage schemes, Environmental objectives and targets, utilities equipment maintenance and preventive maintenance.	9
Total		42

11. Course Outcome:

1. Importance of Planning, Resource management.
2. Understanding land-use planning and impacts of land-use change.
3. Design various systems of conveyance and control
4. Learn management techniques related to services and utilities

12. Suggested Books:

1. Arceivala, SJ, Asolekar, SR, *Environmental Studies*, Tata Mcgraw Hill
2. Christian N Madu, *Environmental Planning And Management*, ICP

3. Harland Bartholomew, *Land Uses in American Cities,* Harward University Press, ISBN 9780674866201
4. Birdie GS, Birdie JS, *Water Supply and Sanitary Engineering (including Environmental Engineering)*, Dhanpatrai & Sons,
5. N. C. Gautam (2004) *Landuse/Landcover and Management Practice in India*, BS Publications/BSP Books
6. Garg SK, *Water Supply Engineering Vol-1*, Khanna Publishers
7. Syed R Qasim, Edward M Motley, Guang Zhu (2000) *Water Works Engineering: Planning, Design And Operation*, Prentice Hall, ISBN-10: 0131502115, ISBN-13: 978-0131502116.

1. Subject Code: **EN-309** Course Title: **Water Resources System**
2. Contact Hours L: 3 T: 1 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory: 3 Hrs Practical: 0 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5. Credits : 4
6. Semester : V
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objectives:
   1. To introduce the principle importance and scope of water resource system relevant to Environmental Engineering.
   2. To introduce the concept of water system planning and its requirement.
   3. To learn application of linear and dynamic programming models in water resource systems.
   4. To understand importance of water quality in planning and management.
   5. To appreciate the role of ground water and contamination transport mechanism, basic equations and modeling.

10. Details of Course:

S. N.	Contents	Contact Hours
1.	**Water Systems:** Introduction of Water Systems engineering-scope and approach Issues and the systems planning approach, Water system dynamics, Water Resource [W.R.] development alternatives, Water systems planning objectives, Constraints and Criteria, Economic and Econometric principles, Cost and Benefit Curves.	9
2.	**Water Resource Planning:** Application of Linear programming [LP] and Dynamic programming [DP] models in Water Resource Engineering, Problem formulation for W.R. systems, Multi-objective Water Resource Planning, Non-inferior Solutions.	8
3.	**Water Quality Management:** Water quality managements planning and associated models, Regional planning models. Applications of Linear Programming in [1] Optimal Irrigation water allocation to multiple crops, [2] Multireservoir system for irrigation planning. [4] Reservoir operation for Hydropower optimization. Application of dynamic programming in - [1] Steady State Reservoir operating policy for irrigation, [2] Real-time Reservoir Operation for Irrigation.	8
4.	**Ground Water and Contamination** **Ground Water Movement and Contamination:** Introduction, Characteristics of Ground Water, Sources and Types of Ground Water Contamination, Principals of Ground Water Movement, General Flow Equations. **Contaminant transport mechanism:** Contaminant Transport Mechanism such as Advection, Diffusion and Dispersion, Sorption and De-sorption, Biodegradation, Mass Transport Equations, One Dimensional Models, Governing Flow and Transport equations, Analytical Methods.	9
5.	**Modeling** **Numerical Modeling of Contaminant Transport:** Introduction to Modeling Inorganic and Organic Solute Transport, Numerical Methods, Finite Difference Methods., Contaminant Transport Models. **Non-aqueous Phase Liquids (NAPLs):** Types of NAPL, Transport, Computational methods, Characterizing NAPLs at Remediation Sites.	8
Total		42

11. Suggested Books / References / Text Books / Reference Book:

1. Water Resources Systems Planning and Management, Sharad K. Jain, V.P. Singh, Elsevier, 2003
2. Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications, Daniel P. Loucks, Eelco Van Beek, 2005.
3. S.Vedula, P.P.Majumdar-Water Resources Systems, Tata Mcgraw Hill Publishing Company Ltd., ND
4. M.C. Chaturvedi, W.R.Systems-Planning and Management, Tata McGraw Hill Publications, New Delhi
5. Louks D Petal W.R.System Planning & Analysis, Prentice Hall-1981.
6. Bedient P.B., Rifai H.S., Newell C.J., "Groundwater Contamination- Transport and Remediation", Prentice Hall, New York.
7. Bear J. and Cheng A.H.D., "Modeling Groundwater Flow and Contaminant Transport (Theory and Applications of Transport in Porous Media)", Springer, New York.
8. American Society of Civil Engineers, "Groundwater Contamination by Organic Pollutants- Analysis and Remediation", Library of Congress Catalogue Card No.: 00-063966, USA.

1.	Subject Code: **EN – 311**	Course Title: **Climate Change and CDM**	
2.	Contact Hours	:	L: 3 T: 1 P: 0
3.	Examination Duration (ETE) (Hrs.)	:	Theory 3 Hrs Practical 0 Hrs
4.	Relative Weightage	:	CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5.	Credits	:	4
6.	Semester	:	V
7.	Subject Area	:	DEC
8.	Prerequisite	:	NIL

9. Objectives:

    1. Basic introduction about green house gases and their role in atmosphere.
    2. To aware students about global warming and its implications.
    3. To familiarize students with climate change and its effects on human life as well as on different atmospheric phenomenon.
    4. To introduce the fundamentals of carbon sequestration and different policies related to climate change.
    5. To give idea about clean development mechanism, ozone depletion and mechanism of CFCs degradation.

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**Green House Gases:** Introduction, Green House Effect, Green House Gases, Emission sources of green house gases, Green House effect as a natural phenomenon, Green House Effect due to anthropogenic activities, Recent role of green house effect	8
2	**Global Warming:** Concept of global warming, Factors responsible for global warming, Global warming potential, Past present and future scenario of global warming, Role of countries and citizens in containing global warming, Implications of global warming	8
3	**Climate Change:** Introduction, Worldwide observed impacts of climate change, Proposed impacts of climate change worldwide, Temperature rise, Sea level rise, Coastal erosion and landslides, Actions to stop global warming, Ways to prevent global warming	8
4	**Carbon Sequestration and Policies of Climate Change:** Concept of carbon sequestration, Carbon sequestration projects, Carbon sequestration modalities and procedures, Global carbon cycle, Carbon capture and storage, Carbon trading, Montreal protocol, Kyoto protocol, Carbon credits, Role and functions of IPCC, National and International action plan on climate change	9

5	**Ozone Depletion and Clean Development Mechanism:** Presence of ozone in the atmosphere, Depletion of stratospheric ozone layer, Chlorofluorocarbons, Mechanism of CFCs degradation, Effect of ozone depletion, Protection of ozone layer, Introduction about CDM, Its operation, Modalities and procedures for CDM, CDM project types	9
Total		**42**

11. Course Outcomes:

    1. The student will learn about basics of green house gases and its effects.
    2. The student will be able to understand the concept of global warming along with its effect on human life.
    3. The student will learn the role of climate change in different atmospheric phenomenon.
    4. The student will understand the significance of carbon credits, carbon sequestration along with the national and international policies related to climate change.
    5. Student will be able to attain thorough knowledge about ozone and chlorofluorocarbons. In addition to this they will also understand the concept of CDM and its operation.

12. Suggested Books:

    1. Air Pollution, KL Dorean, CBS Publishers & Distributers Pvt. Ltd. New Delhi.
    2. Principles and Practices of Air Pollution Control and Analysis, J.R. Mudakavi, I.K. international Publishing House Pvt. Ltd., New Delhi.
    3. Carbon Capture: Sequestration and Storage (Issues in Environmental Science and Technology), RE Hester and RM Harrison.
    4. Climate Change: causes, Effects and Solutions, John T. Hardy. Willy Publication, USA.

1. Subject Code: **EN - 313** Course Title: **Environmental Toxicology and Risk Assessment**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 4

6. Semester : V

7. Subject Area : DEC

8. Prerequisite : NIL

9. Objectives :

    1. To introduce the students to environmental toxicology
    2. To learn toxic effects of different chemicals
    3. To understand the basics of neurotoxicity, developmental, and genetic toxicology
    4. To understand the process and mechanism of carcinogenesis
    5. To learn the process of risk evaluation

10. Detail of Course:

S.NO	Contents	Contact Hours
1	Introduction: Definition and importance of Environmental toxicology, Types of toxicity, Toxic substances in air, water, soil and vegetation, mobilization, fate and behaviour of toxic substances, Ecosystems and Ecotoxicology: Bioaccumulation and Biomagnification, Case studies.	8
2	Health effects of environmental chemicals: Pesticides, PAHs, PCBs, Heavy Metals, MTBE, Diethylstilbestrol, Formaldehyde, smog, asbestos. Descriptive toxicology: median lethal dose, nonlethal measures of toxicity, Kinetics of exposure, Toxicosis, Irreversible toxicity.	8
3	Neurotoxicity: Neurotoxins, mechanism of neurotoxicity, Developmental toxicology: teratogens, basic principles of teratology, thresholds in developmental toxicology, teratology testing. Genetic toxicology: mutation, selection, and evolution, chromosomal abnormalities.	9
4	Carcinogenesis: Cancer and its origin, mechanism of carcinogenesis, Oncogenes, DNA repair. Carcinogenesis testing: Epidemiology, Bioassays (Ames assay, sister chromatid exchange assay, mouse micronucleus assay), Animal bioassays.	8

5	Risk Assessment: fundamentals of hazard, exposure, and risk. Elements of risk assessment: hazard identification, data collection and evaluation, exposure analysis, dose-response analysis, unit risk, evaluation of non-carcinogenic toxicity, risk characterisation and uncertainty analysis.	9
Total		**42**

11. Course Outcomes
    1. Knowledge of direct and indirect toxicity associated with contaminated environment
    2. Identification of toxicity based type of contaminant, and vice-versa
    3. Identification of defects associated with pre-natal exposure, and genetic deformities
    4. Thorough understanding of carcinogenesis
    5. Evaluation and characterisation of risk/toxicity associated with a chemical compound

12. Suggested Books:

    1. B. Magnus Francis (1994). Toxic substances in the environment. John Wiley & Sons, Inc., USA
    2. Pradyot Patnaik (2007) 3rd edition. A comprehensive guide of hazardous properties of chemical compounds. John Wiley & Sons, Inc., USA
    3. D. Kofi Asante-Duah (1998). Risk Assessment in Environmental Management: A Guide for Managing Chemical Contamination Problems. Wiley Publishers.
    4. Lorris G. Cockerham, Barbara S. Shane (1993) Basic Environmental Toxicology. CRC Press

1. Subject Code: **EN- 315** Course Title: **Ecology and Bio-monitoring Techniques**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 15 PRS 25 MTE 20 ETE 40 PR 0
5. Credits : 4
6. Semester : V
7. Subject Area : DEC

8. Prerequisite : NIL

9. Objectives :

1. To learn fundamentals of dynamics of an ecosystem
2. To understand the basics of biogeography
3. To introduce the students to basics of biodiversity
4. To understand the process and mechanism of conservation
5. To learn the basics of biomonitoring

10. Detail of Course:

S.NO	Contents	Contact Hours
1	Ecology: Definition and scope of ecology, types of ecosystem, abiotic and biotic environments, biotic – abiotic interactions, Population ecology: Population attributes, population changes, survivorship curves, growth models, demographic models, dispersion. Community ecology: Community structure, two-species interactions, food webs, succession, disturbance and succession, negative and positive feedbacks in succession. Energy flows, nutrient cycling.	8
2	Biogeography: Biogeographical zones of India; forest distribution and types; terrestrial, aquatic and wetland ecosystems; biomes. Global issues and human ecology: Greenhouse effect and climate change, ozone depletion, ecosystems responses to long-term climate patterns. Urban ecosystems and hierarchies.	8
3	Biodiversity: origin of new species; species, community and ecosystem diversity, genetic diversity; biological classification – phylogenetic relationships; classifying and naming species; biodiversity and livelihood, threats to biodiversity, and hot spots, IUCN protected area categories.	8
4	Introduction to conservation biology, values of biodiversity and conservation ethics, Patterns and process of biodiversity. Biological consequences of habitat fragmentation, covering barriers and isolation, crowding effect, local and regional extinctions, edge effects. Population genetics and conservation; community and ecosystem level conservation, Conservation reserves; Conservation outside protected areas. Control of invasive species. Significance of ecological restoration in conservation.	9

5	Introduction to Biomonitoring: theory, technique and application; Quantification of biodiversity and monitoring of condition and ecological function of terrestrial, aquatic and soil ecosystems; Invertebrates as biomonitors in post-disturbance habitat; Cutting-edge technologies in biological monitoring: non-invasive sampling and genetic monitoring; Assessment of water quality of wetlands and river systems; Restoration, rehabilitation and management of degraded aquatic ecosystems.	9
Total		**42**

11. Course Outcomes
    1. Understanding of ecosystem functions and their interrelationships
    2. Knowledge of effect of human activities on ecology
    3. Knowledge of biodiversity status
    4. Thorough understanding of conservation practices
    5. Evaluation and characterization of ecosystems based on bio-monitoring

12. Suggested Books:

    1. Navjot S. Sodhi & Paul R. Ehlrich (2010). Conservation Biology. Oxford University Press
    2. F. V. Dyke (2008) Conservation Biology: Foundations, Concepts, Applications, Springer
    3. T.M. Smith & R. L. Smith (2012). 8th Edition. Elements of Ecology. Pearson.
    4. Eugene Odum (2005). 5th Edition. Fundamentals of Ecology. Cengage Publishers

1. Subject Code: **EN -308** Course Title: **Hazardous & Biomedical Waste Management**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC

8. Prerequisite : NIL

9. Objectives: To educate the students on the principles involved in the management of several hazardous and biomedical wastes from source identification up to treatment, transformation, and disposal.

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**UNIT-I Hazardous Waste** Hazardous waste management: Definition and characteristics, Sources and type based categorization, Treatment technologies: Physico-chemical, thermal, biological, sea and land disposal, Hazardous Waste (Management & Handling) Rules, Basel convention.	7
2	**UNIT-II Waste treatment Technologies** Waste destruction technologies, Waste concentration technologies, TSDF cradle to grave concepts, Solidification and Stabilization Technologies, Biological Treatment, Biotreatment.	7
3	UNIT-III E-Waste E-Waste: Definition and sources, Environmental and health impacts, Treatment and management, E waste (Management & Handling) Rules.	7
4	**UNIT-IV Radioactive Waste** Nuclear or Radioactive Waste- Principles of radioactivity, Sources of radioactivity in environment, Characteristics of nuclear waste, Radioactive materials and its decay, Half-life, Health effects of ionizing Radiation, Factors affecting radiation doses, Safety standards.	7
5.	**UNIT-V Disposal and Analysis of radioactive waste** Detection and Analysis of radioactive materials, Mining and Recovery, Low-level Radioactive waste, High-level radioactive waste, transport of Radioactive Materials, Storage and Disposal of radio active waste, New waste reduction technologies.	7

6	**UNIT-VI Biomedical waste** Biomedical wastes: Definition, Sources, Characterization of biomedical waste, sources of biomedical waste, classification of biomedical waste, pathological wastes, sharp pharmaceutical wastes, Genetonic wastes, Chemical wastes, waste contaminated with heavy metals. Generation, Segregation and storage of biomedical waste, Packaging, Handling and Transport of wastes, Measures to reduce biomedical wastes, Treatment and disposal of biomedical wastes, Biomedical waste management in developed countries and in India – legal aspects. Biomedical Waste (Management & Handling) Rules.	7
Total		**42**

11. Course Outcomes:
    1. To make the students understand the fundamentals of hazardous wastes and also the types, and sources of hazardous as well as biomedical wastes.
    2. To understand about the characteristics of various types of hazardous and biomedical wastes.
    3. To understand in detail about the storage, collection and transport of hazardous and biomedical wastes, and also to study about the methods used for handling and segregation of wastes.
    4. To improve the knowledge on the waste processing techniques which includes incineration, solidification and stabilization of hazardous wastes
    5. To know about the basics of the waste disposal options and also a detailed study on the disposal in landfills and also to learn about landfill remediation.

12. Suggested Books:

    6. Waste and Disposal Panlk T. Williams. 2nd Ed. John Wiley & Sons.
    7. Environmental Science and Technology, By S. E. Manahan
    8. Freeman H.M. (1988) Standard Handbook of Hazardous Waste Treatment and Disposal, McGraw Hill. New York.
    9. Chaudhury, G.R., Biological degradation and Bioremediation of toxic chemicals, Dioscorides Press, Oregon, 1994.
    10. Martin.A.M, Biological degradation of wastes, Elsevier Applied Science, London, 1991.
    11. Lie DHF and Liptak B.G, Hazardous wastes and solid wastes, Lewis Publishers, New York, 2000
    12. La Grega M.D., Buckingham P.L. and Evan J.C, Hazardous waste Management, 2nd Ed, Mc Graw Hill International, 2001.

1. Subject Code: **EN -310** Course Title: **Surface and Groundwater Pollution**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 4
6. Semester : VI
7. Subject Area : DEC
8. Prerequisite : NIL
9. Objectives : To educate the students on the hydraulics related to contamination of ground and surface water and modelling of ground and surface water quality.

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**UNIT –I** **Introduction to groundwater hydrology**; Porous media, distribution of subsurface water, porosity and related properties of soils, subsurface hydrological cycle, hydrogeologic formations. **Darcy's law and continuity relations**; Darcy's law, hydraulic head and gradient, factors affecting hydraulic conductivity, heterogeneity and anisotropy, limitations to the validity of Darcy's law, Storage in confined aquifers, general continuity equation, continuity equation with a change in total stress. Groundwater management models. **Hydrologic Cycle and Flow net:** Hydrologic Cycle, Flow nets-Graphical construction, Flow nets by numerical simulation, steady state Regional Ground water Flow, Steady state hydrologic, budgets-Fluctuations in ground water levels.	7
2	**UNIT –II** Vadose zone and groundwater recharge : Soil water in vadose zone, soil water characteristics curve, Darcy's law and Richard's equation, Infiltration models, evaporation and desorption models, water balance and groundwater recharge	7

3	**UNIT –III** **Groundwater contamination** : sources of subsurface contamination, mass transport processes, general continuity equation, solute partitioning, degradation losses. **Solute transport by advection** : Potential theory, potential functions, stream functions, travel time along stream lines, residence time distribution theory, standard flow patterns	7
4	**UNIT –IV** **Solute transport by Diffusion** Fick's law, molecular diffusion coefficients, diffusion in porous media, diffusion in multiphase systems, application of diffusion equations to point and constant source of contamination, volatization losses of soil contamination.	7
5	**UNIT –V** **Advection Dispersion Transport and Models :** One dimensional flow and column experiments, transverse dispersion, mechanical dispersion tensor, moments of transport equation, analytical models of chemical spills, and contaminant plumes **Chemical Properties and Principles:** Constituents-chemical equilibrium- Association and Dissociation of dissolved species-effects of concentration gradients-Mineral dissolution and solubility-Oxidation and Reduction Process-Ion exchange and Adsorption	7
6	**UNIT –VI** Governing Equations for flow and transport in surface waters, chemical and biological process models, simplified models for lakes, streams, and estuaries. Model complexity: Selection and development, model resolution, coupled and uncoupled models, linear and nonlinear models, solution techniques, data requirements for calibration, application and evaluation of environmental control.	7
Total		**42**

11. Course Outcomes:

1. To make the students understand the fundamentals of Ground water and the various hydrologic cycles.
2. To make the students understand about the various steady state hydrologic budgets.
3. To make the students understand in detail about the development of Ground Water resources and Aquifers.
4. To know about the basics of the Transport process in solute transfer and hydro chemical behavior of contaminants in the ground water.
5. To know about the basics of the Transport process in solute transfer and hydro chemical behavior of contaminants in the surface water.

12. Suggested Books:

1. Randall J. Charbeneau, “Ground Water Hydraulics and Pollutant Transport “, 2000.
2. Allen Freeze, R. and John A. Cherry, “Ground Water “. Prentice Hall.Inc.1979.
3. B. K. Todd “Ground Water Technology”.
4. Thonana “Water Quality Modelling”.
5. Karanth ,” Ground Water Assessment, Development and Management” , McGraw
6. Hill Companies.
7. David Keith Todd and Larry W. Mays, “Groundwater Hydrology John Wiley and Sons.
8. K.R. Rushton ,”Groundwater Hydrology”, John Wiley & Sons, Ltd.

1. Subject Code : **EN-312** Course Title: **Advance Surveying**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : 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 :
    1. To introduce basic concepts of Triangulation Surveying.
    2. To understand the meaning, importance and scope of Triletration.
    3. To introduce definition, classifications and laws of accidental errors.
    4. To introduce the Field Astronomy.
    5. To introduce the definition, principle and types of Photogrammetry.

10. Details of Course

S. No.	Contents	Contact Hours
1.	**UNIT I: TRIANGULATION** Classification, figures, signals and towers. Indivisibility and height of stations. Satellite station, Base line measurement, corrections to the measured length. Trigonometrical levelling.	8
2.	UNIT II: TRILETRATION Definition and principle. General requirements and procedure. E.D.M. Instruments, project survey, route surveys. Survey for canals, high-ways, railways, and transmission lines. Setting out buildings, culverts, bridges, Tunnel, Hydrographic surveying..	9
3.	**UNIT III: ERRORS AND ADJUSTMENT** Definitions, Classifications and laws of accidental errors. Most probable value, Probable error, standard errors, laws of weight. Principle of least squares, Determination of most probable values by the method of normal equations and method of correlates. Station and Figure adjustment.	8
4.	**UNIT IV: FIELD ASTRONOMY** Spherical triangle and its solution. Coordination system, solution of astronomical triangle. Determination of time, azimuth and latitude.	8
5.	**UNIT V: PHOTOGRAMMETRY** Definition of terms used, terrestrial and aerial photographs. Scale of photographs, stereoscopy, parallax and relief displacement, Flight planning, plotting instruments. Use of photogrammetric and Remote sensing techniques.	9
Total		**42**

11. Course Outcomes:

1. Students can learn the basic fundamental, principle of Triangulation Surveying.
2. Students will understand the concepts of meaning, importance and scope of Triletration.
3. How the field astronomy is done.
4. Students will know the classifications and laws of accidental errors.
5. Students will learn the definition, principle and types of Photogrammetry.

12. Suggested Books:
    1. Agor, R, “Surveying”, Vol. I & II, Khanna Publications, Delhi.
    2. Arora, K.R., “Surveying”, Vol. I & II, Standard Book House, Delhi.
    3. Bannister, A. and Baker, R., “Solving Problems in Surveying”, Longman Scientific Technical, U.K..
    4. Kennie, T.J.M. and Petrie, G., “Engineering Surveying Technology”, Blackie & Sons Ltd, London.
    5. Punmia, B.C., “Surveying”, Vol. I & II, Laxmi Publications, New Delhi.

1. Subject Code: **EN -314** Course Title: **Green Technology**

2. Contact Hours : L: 3 T: 1 P: 0

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

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

5. Credits : 4

6. Semester : VI

7. Subject Area : DEC

8. Prerequisite : NIL

9. Objectives:
    1. To provide introductory knowledge about green technology and green innovations.
    2. To give a basic idea about greener nano particle synthesis and its characterization.
    3. To introduce about role of green energy and sustainable development in life.
    4. To aware and provide knowledge about green management
    5. To update students about the application of green process in different industries.

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**Unit-1:** Introduction of Green protocol: Need, Goal and Limitation of Green Technology, Principles of Green Technology with their explanations and examples. Green Innovation & Sustainability: Criteria for choosing appropriate green energy technologies, life cycle cost; the emerging trends – process/product innovation, technological/environmental leap-frogging; Eco/green technologies for addressing the problems of Water, Energy, Health, Agriculture and Biodiversity- WEHAB (eco-restoration/ phyto-remediation, ecological sanitation, renewable energy technologies, industrial ecology, agro ecology and other appropriate green technologies); design for sustainability.	9
	Unit-2: Green Nanotechnology: Nano particles preparation techniques, Greener Nano synthesis, Nanoparticle characterization methods, Green materials: biomaterials, biopolymers, bioplastics, and composites. Nano materials for Fuel Cells and Hydrogen; Generation and storage, Nano strcutures for efficient solar hydrogen production, Metal Nano clusters in Hydrogen Storage Applications, Metal Nano particles as Electro catalysts in Fuel Cells	9
3	**Unit-3:** Green Energy And Sustainable Development: The inseparable linkages of life supporting systems, biodiversity and ecosystem services and their implications for sustainable development: global warming; greenhouse gas emissions, impacts, mitigation and adaptation ; future energy Systems- clean/green energy technologies; International agreements/ conventions on energy and sustainability- United Nations Framework Convention on Climate Change (UNFCC); sustainable development.	8
4	**Unit-4:** Green Management: The concept of green management; evolution; nature, scope, importance and types; developing a theory; Definition green management in India; relevance in twenty first century, Green techniques and methods; green tax incentives and rebates (to green projects and Companies); green project management in action; Environmental reporting and ISO 14001; climate change business and ISO 14064; green financing; financial initiative by UNEP; green energy management; green product management	9

5	**Unit-5:** Green Industrial Processes: Pollution statistics from various industries, polymer industry, textile industry, greener approach of dyeing, eco friendly pesticides, pharmaceutical industry, waste water treatment	7
Total		**42**

11. Course Outcomes:

1. The student will be able to understand the basics of green technology and its applications.
2. Understanding about green nanotechnology and green materials.
3. Able to comprehend about the role of green energy and sustainable development in life.
4. The students will learn about the importance of green management in corporate as well as in industrial sector.
5. Learn about the application of green processes in various industries.

12.Suggested Books:

1. Kelliher, F., Reinl, L. Green Innovation and Future Technology. ISBN 978-1-137-47982-
2. Leo A. Meyer. The Green Energy Management. ISBN 0880690534.
3. Jadhav, Nilesh Y. Green and Smart Buildings. ISBN 978-981-10-1002-6.
4. Sengupta, Amretashis, Sarkar, Chandan Kumar. Introduction to Nano. ISBN 978-3-662-47314-6.
5. Kalia, Susheel, Kaith, B. S., Kaur, Inderjeet. Cellulose Fibers: Bio- and Nano-Polymer Composites. ISBN 978-3-642-17370-7.

1. Subject Code: **EN-316** Course Title: **Environmental Law and Policy**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory 4 Hrs Practica 0 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5. Credits : 4
6. Semester : VI

7. Subject Area : DEC

8. Prerequisite : NIL

9. Objectives:
   1. To explain the role of law, policy and institutions in the conservation and management of natural resources as well as pollution control
   2. To introduce the laws and policies both at the national and international level relating to environment
   3. To equip the students with the skills needed for interpreting laws, policies and judicial decisions

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**UNIT-I** An introduction to the legal system; Constitution, Acts, Rules, Regulations; Indian Judiciary, Doctrine of precedents, judicial review, Writ petitions, PIL– liberalization of the rule of *locus standi*, Judicial activism. Introduction to environmental laws in India; Constitutional provisions, Stockholm conference; Bhopal gas tragedy; Rio conference. General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine, Overview of legislations and basic concepts	9
2	**UNIT-II** Wildlife and Biodiversity related laws: Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence Statutory framework on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Project Tiger, Elephant, Rhino, Snow leopard.	8
3	**UNIT-III** Air, Water and Marine Laws: National Water Policy and some state policies Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards Ground water and law Judicial remedies and procedures Marine laws of India; Coastal zone regulations. Legal framework on Air pollution: Air Act,1981; EPA, 1986	9

4	**UNIT-IV** Environment protection laws and large ProjectsLegal framework on environment protection-Environment Protection Act as the framework legislation–strength and weaknesses; EIA; National Green tribunal The courts infrastructure projects.	8
5	**UNIT-V** Hazardous Substances and Activities Legal framework: EPA and rules; PLI Act, 199 Principles of strict and absolute liability. An introduction to International law; sources of international law; law of treaties; signature, ratification Evolution of international environmental law: Customary principles; Common but differentiated responsibility, Polluter pays.	8
Total		**42**

11. Course Outcomes
    1. Be familiar with the laws, policies and institutions in the field of environment
    2. Acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective
    3. Acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution

12. Suggested Books:
    1. Birnie P. (2009) et al., International Law and the Environment, 3rd ed., Oxford.
    2. Leelakrishnan P. (2006) Environmental Law Case Book, 2nd ed, Lexis Nexis, India.
    3. Sands P. (2002) Principles of International Environmental Law, 2nd ed, Cambridge

1. Subject Code: **EN-318** Course Title:**Transportation and Traffic Engineering**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practical 0 Hrs
4. Relative Weightage : 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. Objectives:
   1. To introduce basic concepts of Transportation and Traffic Engineering.
   2. To introduce the Highway.
   3. To introduce the Railways.
   4. To introduce the Traffic Noise
   5. To introduce the basic concepts of Airways .
   6. To introduce the definition and types Waterways

10. Detail of Course

S. No.	Contents	Contact Hours
1.	Unit-I Highway: Highway planning in India, Highway Alignment, Geometric design of highways. Highway construction materials: Bituminous and concrete (With emphasis on the use of environmental friendly industrial waste material) Design of flexible and rigid pavements,. Soil stabilized roads Highway drainage and maintenance Roads on hills: Alignment, Geometry, Drainage.	9
2.	Unit-II Railways: Introduction to rails, sleepers track, fitting and fastenings, Ballast, Formation, track drainage, soil stabilization by environmental friendly waste materials, points and crossings, turnouts. Railway signalling and interlocking Modernization of railway track for high speed.	8
3.	Unit-III Airways: Planning and design of runways. Aprons and Taxi-Track, Typical layout, marking and lighting,. Traffic Engg: Traffic characteristics and traffic study, Traffic operations and control devices. Design of intersections at grade and grade separated Highway Lighting.	9
4.	Unit-IV Traffic Noise- Measurement, Patterns and control, Traffic impact and Traffic Management.	8

5.	Unit-V Waterways: Types of developments, Open Channel and river developments, locks navigation, routes navigation requirements.	8
Total		**42**

11. Course Outcomes:

    1. Students can learn the basic fundamentals of Transportation and Traffic Engineering
    2. Students will know the design of highways, railways and airways.
    3. Students will understand the Traffic Noise- Measurement, Patterns, control and Traffic impact.
    4. Students will learn the procedure to design Waterways.
    5. Students will know the routes navigation requirements.

12. Suggested Books:

    1. Dr. L.R. Kadyali and Dr. N.B. Lal. Principles and Practices of Highway Engineering. Khanna Publishers. ISBN no.: 81-7409-165-3
    2. S.K. Khanna and C.E.G. Justo. Highway Engineering. Nem Chand & Bross, Civil Lines, Roorkee, India. ISBN No. 978-81-85240-63-3

1. Subject Code: **EN-411** Course Title : **Occupational Hazards, Health & Safety**
2. Contact Hours : L:3 T: 1 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory: 3 Hrs. Practical : 0 Hr
4. Relative Weightage : CWE: 25 PRS: 0 MTE: 25 ETE: 50 PRE: 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Prerequisite : NIL
9. Objectives :

1. Introduction to Occupational Hazards and Its Prevention.
2. To give the concept of legislation in India regarding Occupational safety and health
3. To develop an understanding of occupational Diseases.
4. To give the concept of Health protection and prevention of Occupational diseases.
5. To develop an understanding of occupational Hazards and safety management for different industries.

10. Details of Course:

Sr. No.	contents	Contact Hours
1.	Unit-I Occupational Hazards: Definition of Occupational Hazard, Different type of occupational Hazards such as Physical Hazard, Chemical Hazards, Biological Hazards, Radiational Hazard, Ergonomic Hazards psycho-social Hazard and their prevention.	08
2.	Unit-II Occupational safety and Health Act, Occupational Safety and Health Administration, Right to know laws, Indian Acts, Labour Act, Factories Act The Employes state Insurance Act, ILO Act, OSHA accident causation, Investigation method and Different model.	08
3.	Unit-III Occupational Diseases: Definition of Occupational Diseases, Different types of occupational Diseases silicosis, Anthrocosis, Byssinosis, Asbestosis, Farmer's Lungs, Lead Poisoning, occupational cancer, occupational dermatitis.	10
4.	Unit-IV Protection and Prevention: Measure for health protection of workers by nutrition, Environmental Sanitation. Health education, etc. Prevention of occupational disease by Medical measuring, Engineering Measure and legislation.	08
5.	Unit-V Assessment of hazards and health problem of different types of Industries- construction, textile, food processing, Agriculture industries, Pharmaceutical Industries and waste water treatment plant, .Survey of two industries for occupational hazards and safety management.	08
Total		**42**

11. Suggested Books and References:
    1. Principles of Occupational Health and Hygine: An Introduction :- By Cherilyn Tillman Allen & Unwin
    2. Environmental Pollution Health and Toxicology: S. V. S. Rana , Narosa Publication.
    3. Preventive and Social Medicine: K. Park.

1. Subject Code: **EN-413** Course Title: **Water and Soil conservation**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory: 3 Hrs Practical 0 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PRE 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Prerequisite : NIL
9. Objectives :
    1. To introduce various aspects of land resources
    2. To introduce various aspects of water resources
    3. To introduce the causes of land and water degradation
    4. To learn the monitoring and management practices

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**UNIT-I** Earth Resources: Atmosphere, lithosphere, hydrosphere Interior of Earth, geological work of wind and water, underground water, igneous, sedimentary and metamorphic rocks, mineral types, mineral resources of India, erosion and weathering, soil formation, soil profiles, types of erosion, estimation of soil loss, landuse and landuse planning, earth resource mapping and the use of remote sensing and GIS.	9

2	**UNIT-II** Water Resources: Hydrology, the hydrological cycle and its components, drainage systems, classification of water resources, characteristics of water resources. Surface run-off, stream flow estimation, problems of water and ground water resource depletion, watershed types and functions.	8
3	**UNIT-III** Causes & Improvement of degraded Soil: Release of salts from rocks & minerals, composition of rain water, river water, canal or reservoir water and sea water. Properties of different salts - Chlorides, carbonates, sulphates, bicarbonates & nitrates of calcium, magnesium, sodium & potassium. Role of soil slope, minerals, quality of irrigation water, climate and vegetation cover on salinity & alkalinity of soil. Reclamation of saline & sodic soils.	9
4	**UNIT-IV** Soil Loss Measurement: Soil losses due to erosion & extent of erosion - water and wind erosion. Estimation of soil losses - universal soil loss equation, causes of soil loss-soil erodability, rain fall erosivity, estimation of soil losses by wind erosion	8
5	**UNIT-V** Applications for management: Soil and water conservation measures, erosion control, case studies in water resource conservation and management, flood management and control, landslide control and mitigation measures, coastal zone management, watershed management and case studies, earthquake mitigation for buildings and dams, forest fire mitigation and management, RS and GIS techniques in forest fire mapping, management hazards such as controlled burns escaping.	8
Total		**42**

11. Course Outcomes

    1. Understanding of land resources of India
    2. Identification of problems related to water resources
    3. Identification of causes of land/soil degradation
    4. Designing of suitable management practices for soil and water conservation

12. Suggested Books:

1. Schwab, Fravert Edminster & Barnes (1981). Soil & water conservation engineering. John Wiley & Sons Publication.
2. Roy, A.B. (2010).Fundamentals of Geology. Narosa Publications.
3. Singh, Rajvir (2000). Watershed Planning and Management. Yash Publishing House.
4. Soil taxonomy, basic system of soil classification for making & interpreting soil survey. Agriculture Handbook No. 36, Nbss & Lup Publication New Delhi.
5. Ramarao, M.S.V. (1962). Soil conservation in India I.C.A.R. New Delhi.

1. Subject Code: **EN-415** Course Title: **System Simulation & Modeling**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (ETE) (Hrs.) : Theory: 3 Hrs. Practical 0 Hrs
4. Relative Weightage : CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5. Credits : 4
6. Semester : VII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objectives : The overall aims of the course are for students to acquire appropriate level of advanced theoretical knowledge required to interpret and analyze contemporary and past environmental data for modeling. Also develop an insight into modeling skills required to investigate the interrelationships between environmental variables, and to predict their responses to changing internal and external conditions.

10. Details of Course

Sr. No.	Contents	Contact Hours
1.	**UNIT – I: Environmental systems** Introduction, An overview of mathematical models applied to various environmental issues, Concept, Need, Scope and objectives of environmental modeling, Role of mathematical models in environmental quality management	9

2.	**UNIT – II: Model classification** Brief review of different types of models, Mathematical (Deterministic), Numerical, Stochastic and Physical Models. Different stages involved in model building, Calibration and verification of model, Limitations in modelling.	8
3.	**UNIT – III: Contaminant transport** Transport phenomenon, Diffusion, Dispersion, Advection, Adsorption, Conservative and non-conservative pollutants. Surface water quality modeling – River and streams, Estuaries and lakes.	8
4.	**UNIT – IV: Sub-surface flow models** Governing Equations for sub-surface flow and transport of pollutants, Simplified models for sub-surface plume movements. Case studies using appropriate software for sub-surface flow and transport of pollutants.	8
5.	**UNIT – V: Surface flow models** Dissolved oxygen models – DO sag model, BOD model, Streeter Phelps equation for point and distributed sources. Eutrophication models for lakes and flowing water; Use of QUAL2K and Water Quality Analysis Simulation Program (WASP). Application of Air pollution dispersion model.	9
Total		**42**

11. Course Outcome:
    1. Learning the fundamentals of environmental systems, Systems approach, Models and modelling.
    2. Understanding the modes of contaminant transport and their modelling.
    3. Study of groundwater flow models and contaminant transport.
    4. Modelling of surface water flow models. Modelling in computer based softwares.

12. Suggested Books:
    1. Ramaswami A. “Integrated Environmental Modelling”, John Wiley, New York.
    2. Chapra S.C., “Surface water quality modelling”, McGraw Hill., New York.
    3. Rumynin B.G., “Subsurface Solute Transport Model”, Springer, Netherlands.
    4. Schnoor J., “Environmental Modelling”, John Wiley, New York.
    5. Jacobson M.Z., “Fundamentals of Atmospheric Modelling”, Cambridge University Press, New York.

6. Schnelle K.B. and Dey P.R., "Atmospheric Dispersion Modelling Compliance (1999) Guide", McGraw-Hill, New York
7. Gordon Geoffrey, "System Simulation", Prentice Hall (Higher Education Division, Pearson Education)

1. Subject Code: **EN -406** Course Title: **Advanced Open Channel Hydraulics**
2. Contact Hours : L: 3 T: 0 P: 2
3. Examination Duration (Hrs.) Theory: 3 Practical 0 Hrs
4. Relative Weight : CWS: 15 PRS: 25 MTE: 20 ETE: 40 PRE: 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : NIL
9. Objectives : To familiarize the students with the concepts of open channel flows. The concepts of open channel are very useful in various types of flow.

10. Details of Course:

S. No.	Contents	Contact Hours
1	**Unit 1** **Introduction:** Types of flows in open channel, geometrical properties of channel sections, velocity distribution and pressure distribution in open channels, continuity equation.	6
2	**Unit II** **Uniform flows in open channels:** Chezy'sequation, Manning's formula, Manning's roughness coefficients, equivalent roughness, hydraulically efficient different channel sections. Normal depths and their computations.	10
3	**Unit III** **Energy depth relationships:** Specific energy, critical depth, concept of specific force, alternate depths, specific energy diagram. Application of momentum principle in hydraulic jump, properties of jumps.	10

4	**Unit IV** **Gradually varied flows:** Introduction, differential equation of GVF, different types of flow profiles. Flumes and their applications. Rapidly varied flow:	10
5	**Unit V** **Rapidly varies flow**: Introduction, Sharp crested weir, Ogee spillway, broad crested weirs, Critical depth flume, Sluice gate flow, Culvert hydraulics.	6
Total		**42**

11. Suggested Books:

S.N.	Name of Books/ Authors / Year of Publication
1	K Subramanya “Open channel flow”, McGraw HILL . (ISBN 10 0-7-008695-8), 2014
2	Rajesh Srivastava “Flow through open channel” Oxford University Press. (ISBN 0-19-569038-9), 2000
3	Vee T Chow ., “open channel flow” Tata pMcGraw Hill. (ISBN 21 345 24561), 2014

1. Subject Code: **EN-408** Course Title: **Risk and Reliability Analysis of Environmental System**

2. Contact Hours : L: 3 T: 1 P: 0

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

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

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Prerequisite : NIL

9. Objectives:

1. To introduce students with concepts of risk and its measurement with regard to environmental systems
2. To familiarize students with characterization of various types of environmental risk and their consequences, vulnerability of environmental hazards.
3. To familiarize students with various aspects of analysis of environmental risk assessment.
4. To familiarize students with various case studies environmental risks in various processes/indutries.

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**UNIT-I** **Introduction:** Sources of Environmental hazards, Environmental and ecological risks, Environmental risk assessment framework, Regulatory perspectives and requirements, Risk Analysis and Management and historical perspective; Social benefit v/s technological risks; Path to risk analysis; Perception of risk, risk assessment in different disciplines.	7
2	**UNIT-II** **Elements of Environmental Risk Assessment :** Hazard identification and accounting, Fate and behaviour of toxics and persistent substances in the environment, Properties, processes and parameters that control fate and transport of contaminants, Receptor exposure to Environmental Contaminants, Dose Response Evaluation, Exposure Assessment, Exposure Factors, Slope Factors, Dose Response calculations and Dose Conversion Factors, Risk Characterization and consequence determination, Vulnerability assessment, Uncertainty analysis.	7
3	**UNIT-III** **Different Analysis for Risk Assessment**: Cause failure analysis, Event tree and fault tree modeling and analysis, Multimedia and multipathway exposure modeling of contaminant migration for estimation of contaminant concentrations in air, water, soils, vegetation and animal products, Estimation of carcinogenic and non carcinogenic risks to human health.	7

4	**UNIT-IV** **Methods for Risk Assessment**: HAZOP and FEMA methods, Methods in Ecological risk assessment, Probabilistic risk assessments, radiation risk assessment, Data sources and evaluation.	7
5	**UNIT-V** **Risk Management**: Risk communication and Risk Perception, comparative risks, Risk based decision making, Risk based environmental standard setting, Risk Cost Benefit optimization and tradeoffs, Emergency Preparedness Plans, Emergency planning for chemical agent release, Design of risk management programs, risk based remediation; Risk communication, adaptive management, precaution and stake holder involvement.	7
6	**UNIT-VI** **Application:** Case studies on risk assessment and management for hazardous chemical storage, Chemical industries, Tanneries, Textile industries, Mineral processing and Petrochemical plants, Hazardous waste disposal facilities, nuclear power plants, contaminated site remediation, Case histories on Bhopal, Chernobyl, Seveso, Three Mile Island	7
Total		**42**

11. Course Outcomes:

5. Student will learn about basics of Geology and its importance in engineering.
1. Student will be able to understand the properties of rocks, minerals and its application and importance in environmental engineering.
2. Student will learn the various effects of rocks and minerals on the quality of ground water.
3. The unit of GIS will create a clear cut understanding among students about geographical information system, its components, DMS and its various applications in real life.
4. Student will be able to attain thorough knowledge about remote sensing, electromagnetic spectrum, and its diverse applications.

12. Suggested Books:

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff, Risk Assessment and Management Handbook, McGraw Hill Inc., New York, 1996.
3. Kofi Asante Duah, Risk Assessment in Environmental management, John Wiley and sons, Singapore, 1998.

4. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
5. Risks and Decisions for Conservation and environmental management, Mark Burman, Cambridge University Press.
6. Susan L Cutter, Environmental Risks and Hazards, Prentice Hall of India, New Delhi, 1999.
7. Joseph F Louvar and B Diane Louver, Health and Environmental Risk Analysis fundamentals with applications, Prentice Hall, New Jersey, 1997.

1. Subject Code: **EN- 410** Course Title: **Irrigation and Drainage Engineering**
2. Contact Hours : L: 3 T: 1 P: 0
3. Examination Duration (ETE)(Hrs.) : Theory 3 Hrs Practica 0 Hrs
4. Relative Weightage: CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5. Credits : 4
6. Semester : VIII
7. Subject Area : DEC
8. Pre-requisite : Nil
9. Objectives :
   1. To introduce basic concepts of Irrigation.
   2. To introduce the definition, principle and types of Irrigation.
   3. To introduce the Weir and Barrage.
   4. To introduce the basic concepts of Kennedy and Lacey theories.
   5. To introduce the definition, principle and types of cross-drainage works
10. Details of Course

S. No.	Contents	Contact Hours
1.	**UNIT I: INTRODUCTION** Irrigation Principles: Basic Soil-water plant relation, consumptive use, depth and frequency of irrigation, various methods of application of irrigation water, irrigation efficiency, principal Indian crops and their water requirements, Standards of irrigation water, use of seepage and waste water for irrigation. duty and delta, methods of improving duty, irrigation efficiencies.	9

2.	**UNIT II: DIVERSION HEAD WORKS** Weir and Barrage, component parts, Types of failures of floor, Bligh's theory, Lane's weighted theory, Khosla theory, Pressure calculations, corrections Design of sloping glacis Weir, impervious floor, Launching apron, Inverted filter, proportioning of bays in barrage, anal head regulator, Spillways, Under sluices portion and silt control devices.	9
3.	**UNIT III: Silt Theories And Design Of Irrigation Channel** Kennedy's theory, draw backs, Lacey regime theory, comparison between Kennedy and Lacey theories, Design of channel based on Kennedy and Lacey theories, Effect of silt factor, L-Section of canal, Balancing depths, Use of Garrets diagram in channel design, cross section of an irrigation channel. Channel breaches and their repair.	8
4.	**UNIT IV: WATER LOGGING, CANAL LINING & REGULATION WORK** Losses in canal, water logging, its causes and effects remedies of water logging. Lining of canal, advantages and disadvantages of lining, Types of lining. Design of lined canal. Necessity of canal falls, types of fall, Design of sarda type fall.	8
5.	**UNIT V: CROSS DRAINAGE WORKS** Types of cross-drainage works, selection of suitability of type of C.D. work. Design of transition when water depth is constant and when varied, design of surface and sub-surface drains, roadway and airport drainage.	8
Total		**42**

11. Course Outcomes:
    1. Students can learn the basic fundamental, principle and types of irrigation.
    2. Students will understand the concepts of Weir and Barrage.
    3. Students will know the Kennedy and Lacey theories.
    4. Students will learn the cross-drainage works.
    5. Students will learn Design of lined canal

12. Suggested Books:
    1. Design of Irrigation Works By R. S. Varshney.
    2. Irrigation Engg. & Hydraulic Structure by S. K. Garg.
    3. Irrigatio and Water Power Engg. By Dr. B. C. Punmia and Dr. Pande.
    4. Irrigation Engg. By Birdei and Dass.

1. Subject Code: **EN-412** Course Title: **Environmental and Sustainable Development**

2. Contact Hours : L: 3 T: 1 P: 0

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

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

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Prerequisite : NIL

9. Objectives:
   1. To provide basic introduction to sustainable development concepts, challenges of sustainable development and boundaries of sustainable development.
   2. To give a basic understanding of sustainable development framework, its pillars and application.
   3. To aware the students about various issues related to environmentally sustainable urban environment and different engineering tools assess and design them.
   4. To aware them about the role of technology towards environmental sustainability.
   5. To update students about the individual and social responsibilities and role of government towards sustainable development.

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**UNIT-I** Evolution of Ideas about sustainability, History of sustainability, Definitions of sustainability, Brundtland commission report, Principles of sustainable development, Objectives of sustainable development, Conceptualization of sustainability, Boundaries of sustainable development	9

2	**UNIT-II** Sustainable development framework, Pillars of sustainable development, Impediments to achieving sustainability, , Concept of environmentally sustainable development, Environmental dimensions of sustainability, Frameworks to measure sustainable development, Application of sustainability strategies	9
3	**UNIT-III** Issues of environmentally sustainable urban environment, Sustainable urban transport, Sustainable transport indicators, Engineering tools for assessment and design for environment and sustainability	8
4	**UNIT-IV** Strategies for promoting environmentally sustainable development technology role towards environmentally sustainable transport infrastructure, Importance of incorporating sustainability in design, Case studies of Sustainable design	8
5	**UNIT-V** Social and environmental, responsibilities towards environmentally sustainable development, Role of local Government, Sustainability in the Third World, Steps for adopting a sustainability approach	8
Total		**42**

11. Course Outcomes

    1. The student will be able to understand the basics about sustainable development & its concepts.
    2. Understanding about different dimensions of sustainability as well as its different applications.
    3. Able to identify the environmental sustainability of transport system and capable to suggest required steps for further enhancement.
    4. The students will learn about role of technology in sustainable development.
    5. Development of responsibilities towards the protection of environment and society.

12. Suggested Books:

    1. Abdul Malik, Elisabeth Grohmann. Environment protection strategies for sustainable development by. ISBN 978-94-007-1591-2.

2. Sylvie Faucheux, Martin O' Corner Jan van der strateen. Sustainable development: concepts, rationalities, and strategies, ISBN 978-94-017-3188-1.

3. Jennifer A. Elliott. An introduction to sustainable development. ISBN-13: 978-0415590730.

4. LEAD India (Editor) Rio to Johannesburg: India's Experience in Sustainable Development, Orient Longman, Hyderabad, 2002.

5. Chopra, K., and Kadekodi, G.K. (1999), Operationalisting Sustainable Development, SagePublication, New Delhi.

1. Subject Code: **EN-414** Course Title: Disaster Management

2. Contact Hours : L: 3 T: 1 P: 0

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

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

5. Credits : 4

6. Semester : VIII

7. Subject Area : DEC

8. Prerequisite : NIL

9. Objectives:
   1. To provide basic introduction about environmental hazards and disasters.
   2. To give a basic understanding about different hazards and disasters due to mankind.
   3. To aware students about various emerging approaches in disaster management.
   4. To aware them about the reduction and management methods of diverse kind of disasters.
   5. To update students about polices related to disaster management as well as role of different government agencies in remediation of disasters.

10. Detail of Course:

S.NO	Contents	Contact Hours
1	**UNIT-I** Natural Hazards and Disasters: Concept of Environmental Hazards, Environmental stress & Environmental Disasters. Types of Environmental hazards & Disasters: Natural hazards and Disasters, Volcanic Hazards/ Disasters, - Causes and distribution of Volcanoes, - Hazardous effects of volcanic eruptions, -Environmental impacts of volcanic eruptions, Earthquake Hazards/ disasters, - Causes of Earthquakes, -Distribution of earthquakes, - Hazardous effects of earthquakes, Earthquake Hazards in India, Human adjustment, perception & mitigation of earthquake, Cumulative atmospheric hazards/ disasters- Lightning, Hailstorms, Cyclones: - Tropical cyclones & Local storms, - Destruction by tropical cyclones & local storms (causes , distribution human adjustment, perception & mitigation), Cold waves, Heat waves, Floods, Causes of floods, Flood hazards in India, - Flood control measures (Human adjustment, perception & mitigation), Droughts: - Impacts of droughts, - Drought hazards in India, - Drought control measures	9
2	**UNIT-II** Man induced hazards & Disasters: Mechanics & forms of Soil Erosion, - Factors & causes of Soil Erosion, Conservation measures of Soil Erosion, Chemical hazards/ disasters— Release of toxic chemicals. nuclear explosion, Sedimentation processes, - Global Sedimentation problems, Regional Sedimentation problems, Sedimentation & Environmental problems, Corrective measures of 23 Erosion & Sedimentation, Biological hazards/ disasters, Population Explosion	8
3	**UNIT-III** Emerging approaches in Disaster Management- Three Satges: I. Pre-disaster stage (preparedness)-(a) Preparing hazard zonation maps, Predictability/ forcasting & warning, b) Preparing disaster preparedness plan, c) Land use zoning, d) Preparedness through (IEC) Information, education & Communication Pre-disaster stage (mitigation) Disaster resistant house construction, Population reduction in vulnerable areas, Awareness 2. Emergency Stage:- a) Rescue training for search & operation at national & regional level, b) Immediate relief;c) Assessment surveys 3. Post Disaster stage-Rehabilitation- a) Political Administrative Aspect, b) Social Aspect, c) Economic Aspect d) Environmental Aspect	8

4	**UNIT-IV** Natural Disaster Reduction & Management: a) Provision of Immediate relief measures to disaster affected people, b) Prediction of Hazards & Disasters, c) Measures of adjustment to natural hazards Mitigation-discuss the work of following Institution-(a) Meteorological observatory, (b). Seismological observatory, (c). Volcanology institution, (d). Hydrology Laboratory, (e.) Industrial Safety inspectorate,(f). Institution of urban & regional planners, (g). Chambers of Architects, (h). Engineering Council, (i) National Standards Committee, Integrated Planning- Contingency management Preparedness :-a) Education on disasters, b) Community involvement, c) The adjustment of Human Population to Natural hazards & disasters, Role of Media. Application of Geographical Information System(GIS) in Disaster risk management	9
5	**UNIT-V** Aregional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India, Ecological planning for sustainability & sustainable development in India-Sustainable rural development: A Remedy to Disasters, Role of Panchayats in Disaster mitigations. Environmental policies & programmes in India- Institutions & National, Centres for Natural Disaster reduction	8
Total		**42**

11. Course Outcomes
    1. The student will be able to get the fundamentals of disasters.
    2. Understanding about different factors responsible for natural and manmade disasters.
    3. Able to understand and capable to develop different management strategies to handle the disastrous effect of disasters.
    4. The students will learn about the reduction and management methods of various kinds of disasters.
    5. The understanding about polices related to disaster management.

12. Suggested Books:
    1. Savinder Singh Environmental Geography, Prayag Pustak Bhawan, 1997
    2. Kates,B.I & White, G.F The Environment as Hazards, oxford, New York, 1978
    3. R.B. Singh (Ed) Disaster management, Rawat-Piiblicatiion, New Delhi, 2000

4. R.B. Singh, Space Technology for Disaster Mitigation in India (INCED), University of Tokyo, 1994

5. A.S. Arya Action Plan For Earthquake,Disaster, Mitigation in V.K. Sharma (Ed)

6. 7 Disaster Management IIPA Publication New Delhi, 1994

7. R.K. Bhandani: An overview on Natural & Man made Disaster & their Reduction, CSIR, New Delhi

8. M.C. Gupta Manuals on Natural Disaster management in India. National Centre for Disaster Management,Il PA. New Delhi.

1. Subject Code: **EN-416** Course Title: **Non-Conventional Energy Systems**

2.	Contact Hours	:	L: 3 T: 1 P: 0
3.	Examination Duration (ETE)(Hrs.)	:	Theory 3 Hrs Practical 0 Hrs
4.	Relative Weightage	:	CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5.	Credits	:	4
6.	Semester	:	VIII
7.	Subject Area	:	DEC
8.	Pre-requisite	:	NIL

9. Objectives:

   1. To understand the meaning, importance and scope of the Non-Conventional Energy Systems.
   2. To introduce the principle of solar energy, wind energy, biomass energy, geothermal energy, hydro electric, tidal energy and nuclear energy.
   3. To introduce the basic concept of Energy scenario in India.
   4. To introduce basic concepts of Basic components of WECS.
   5. To introduce the concept of Types of biomass and biomass conversion technologies.

10. Details of Course

S. No.	Contents	Contact Hours
1	**UNIT I:-** Introduction; Conventional and Non-conventional sources; Global energy trends; Energy scenario in India. Solar Energy: Introduction; Measurement of solar radiation; Solar energy collectors-concentrating and non-concentrating; Principles and systems of solar photo-thermal and photovoltaic conversion; storage of solar energy	8
2	**UNIT II:-** Wind Energy: Introduction; Principles of wind energy conversion; Site-selection considerations; Basic components of WECS; Design considerations of horizontal and vertical-axis machines; Environmental implications of wind energy, Biomass Energy: Introduction; Potential in India; Types of biomass and biomass conversion technologies; Biogas generation; Design considerations and types of biogas plant; Energy plantation; Bio-hydrogen production; Environmental aspects of biomass energy	10
3	**UNIT III:** Geothermal Energy: Introduction; Nature and classification of geothermal fields; vapour-dominated and liquid-dominated systems; Limitations; Prospects in India	8
4	**UNIT IV:** Hydro-electric and tidal energy: Introduction; Principles of conversion; Classification and Components of conversion systems; OTEC; Advantages and limitations; Potential in India.	8
5	**UNIT V:** Nuclear Energy: Introduction; fission and fusion reactions, Principles and Components; Energy release rates, Advantages and limitations; present status and future possibilities	8
Total		**42**

11. Course Outcomes:
    1. Students can learn the basic fundamental, principle and types of Non-Conventional Energy Systems.
    2. Students will know Principle and systems of solar photo-thermal and photovoltaic conversion.
    3. Students will understand the concepts of Basic components of WECS and its design.
    4. Students will know Nature and classification of geothermal fields.
    5. Students will understand Advantages and limitations Non-Conventional Energy Systems.

12. Suggested Books:

1. Non-conventional Energy Sources by G. D. Rai.
2. Non-conventional energy sources & Utilization (Energy Engineering) by R. K. Rajput.
3. Non Conventional source of energy by Ankur Mathur.
4. Non conventional energy system by S. K. Agarwal
5. Non conventional & Renewable energy source by S. S. Thipse
6. Biogas Technology: Towards sustainable Development by R. S. Khoriyanbam.
7. Renewable energy: A Globle Review of Technologies, Policies & Markets by Dirk Assmann.
8. Solar Thermal Systems: successful planning & construction by Dr. Felix A. Peuser & Karl- Heinz Remmers.

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 Hrs
4.	Relative Weightage	:	CWS 25 PRS 0 MTE 25 ETE 50 PR 0
5.	Credits	:	3
6.	Semester	:	V
7.	Subject Area	:	OEC
8.	Pre-requisite	:	Nil
9.	Objectives	:	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

Sr. 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**

11. 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.

12. Suggested Books:
    1. G. Buttiglieri, T.P. Knepper, (2008), Removal of emerging contaminants in Wastewater Treatment: Conventional Activated sludge Treatment, Springer-Verlag Berlin Heidelberg, Hdb Env Chem, 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

1. Subject Code: **EN- 353** Course Title: **Occupational Health & Safety Management**

2. Contact Hours : L: 3 T: 0 P: 0

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

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

5. Credits : 3

6. Semester : V

7. Subject Area : OEC

8. Prerequisite : NIL

9. 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:

S.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**

11. 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.

12. Suggested Books:

    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.

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 Practical 0 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. 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:

S.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**

11. 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.

12. Suggested Books:

    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.

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

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