E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

NAGAPATTINAM – 611 002. TAMILNADU, INDIA

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(Accredited by NAAC with 'A' Grade and NBA)

Email: principal@egspec.orgwebsite: www.egspec.orgPh: 04365-251112

BE CIVIL ENGINEERING

1902CE401	BUILDING MATERIALS AND MANAGEMENT	L	T	P	C
		3	0	0	3

UNIT I	BUILDING MATERIALS	9 Hours

Lime, Brick, Timber and its Products, Floor and Wall Tiles, Pozzolanas, Ferrous metals, Thermal Insulation Material. Finishing Materials: Glass, Timber, Aluminum, Plastics, Paints, Varnishes, Distemper, Waterproofing and Damp Proofing Materials, Ferrocement and its application, Fabre textiles – Geo membranes and Geotextiles for earth reinforcement.

UNIT II	BUILDING COMPONENTS	9 Hours

Partition wall and Cavity wall, Composite Masonry, Doors, Windows, Ventilators, Stairs, Lift, Ramps, Escalators, Anti Termite Treatment, Brick masonry- Bond- Jointing-Stone masonry
Temporary building structures - Site Clearance - Marking –Earthwork, Slip and moving forms, scaffolding, Plumbing and Sanitation, Fire Protection, Introduction to Building Maintenance, Acoustics and Sound Insulation.

UNIT III	SUB STRUCTURE AND SUPERSTRUCTURE TECHNIQUES	9 Hours

Techniques of box jacking- pipe jacking- under water construction of diaphragm walls and basement Tunneling techniques, caisson -sinking cofferdam, Dewatering and stand by plant equipment for underground open excavation, Launching girders, bridge decks, off shore platforms, braced domes and space decks.

UNIT IV	CONSTRUCTION EQUIPMENTS	9 Hours

Selection of equipment for earth work - types of earthwork equipment, Equipment for material handling and erection of structures, Equipment for dredging, trenching, tunneling, Equipment for compaction, batching and mixing and concreting, Equipment for foundation and pile driving.

UNIT V	MANAGEMENT	9 Hours

Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management.

	Total:	45 Hours

COURSE OUTCOMES:

1. Summarize the most common and advanced materials used for construction.
2. Illustrate the construction process of various building components.
3. Explain the various construction methods and techniques involved in sub structure and super structure.
4. Choose the appropriate modern construction tools and equipment in various construction activities.
5. Choose the appropriate method of management for materials.

REFERENCES:

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2012.
2. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3.Gambhir.M.L., "Concrete Technology", 3rd Edition, Tata McGraw Hill Education, 2004
4. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.
5.Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
6.Gambhir. M.L., &NehaJamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.

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1902CE505		ENVIRONMENTAL ENGINEEERING	L	T	P	C
			3	0	0	3

Course Objectives:

1. To examine the water supply system and conveyance system.
2. To create an ability to evaluate the water treatment and advanced water treatment system.
3. To train the students to analyze water distribution system and supply to buildings.
4. To understand the importance of planning and design of sewerage system.
5. To create an ability to design the waste water treatment system.
6. To impart the signification of disposal of Sewage.

Unit I **WATER SUPPLY SYSTEMS – SOURCE AND CONVEYANCE** **9 Hours**

Objectives – Population forecasting – Design period – Water demand –Sources of water – Source selection – Water quality parameters and significance –Standards – Intake structures – Conveyance – Hydraulics – Laying, jointing and testing of pipes – Pump selection –Appurtenances.

Unit II **DESIGN PRINCIPLES OF WATER TREATMENT** **9 Hours**

Objectives – Selection of unit operations and processes – Principles of flocculation, sedimentation, filtration, disinfection – Design principles of flash mixer, flocculator, clarifiers, filters – Disinfection devices – Softening – Demineralization – Aeration – Iron removal – Defluoridation – Operation and maintenance aspects – Residue management.

Unit III **DISTRIBUTION** **9 Hours**

Requirements of water distribution -Components -Service reservoirs -Functions and drawings -Network design - Analysis of distribution networks – Hardy cross method – Equivalent pipe method - Pipe Appurtenances -operation and maintenance -Leak detection, Methods. House service connection - Systems of plumbing.

Unit IV **SEWERAGE SYSTEM, COLLECTION AND TRANSMISSION** **9 Hours**

Sources of wastewater – Quantity of sanitary sewage – Storm runoff estimation – Wastewater characteristics and significance – Effluent disposal stand over – Design of sewers – Computer applications – Laying, jointing and testing of sewers – Sewer appurtenances – Pump selection.

Unit V **SEWAGE TREATMENT AND DISPOSAL** **9 Hours**

Objectives – Selection of unit operation and process – Design principles of primary and secondary treatment, screen chamber, grit chamber, primary sedimentation tanks, activated sludge process – Aeration tank and oxidation ditch – Trickling filter –Stabilization ponds – Septic tanks with soak pits – Sludge: treatment and disposal –Biogas recovery – Sewage farming.

Disposal on land – Disposal into water bodies – Oxygen sag curve – Streeter Phelp's model – Wastewater reclamation techniques.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Design the components of the transmission main for the water conveyance
2. Design the water treatment units based on its principles and functions
3. Extend the water distribution to the individual buildings
4. Build a sewerage system by flow estimation and designing suitable size of sewers
5. Design the treatment units for the treatment of waste water based on the quality and quantity.

References:

Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2003.

Punmia, B.C., Jain, A.K., and Jain.A., Environmental Engineering, Vol.II, Lakshmi Publications, Newsletter, 2005

Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1997.

Government of India, "Manual on Water Supply and Treatment", CPHEEO, Ministry of Urban Development, New Delhi, 2003

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1902CE552		ENVIRONMENTAL ENGINEERING LAB	L	T	P	C
			0	0	2	1

Course Objectives:	
	1. To know the basics, importance of water and wastewater treatment and methods measurement.
	2. Tostudythe various effects of water and waste water pollution.
	3.Effect of BOD and COD
	4.To find Calcium, Potassium and Sodium
	5.Heavy metal effects and finding methods
List of experiments	
1. Measurement of pH, Electrical conductivity and turbidity	
2. Determination of Calcium, Potassium and Sodium	
3. Determination of Phosphate and Sulphate	
4. Determination of Optimum Coagulant Dosage by Jar test apparatus	
5. Determination of available Chlorine in Bleaching powder and residual chlorine in water	
6. Determination of Ammonia Nitrogen	
7. Estimation of suspended, volatile and fixed solids	
8. Determination of Dissolved Oxygen	
9. Estimation of B.O.D	
10. Estimation of C.O. D	
Total:	**45 Hours**
Course Outcomes:	
	After completion of the course, Student will be able to
	1.characterize given water and waste water sample
References:	

1.Standard methods for the examination of water and wastewater, APHA, 20th Edition, Washington, 1998

2. Garg, S.K., "Environmental Engineering Vol. I & II", Khanna Publishers, New Delhi

3. Modi, P.N., "Environmental Engineering Vol. I & II", Standard Book House, Delhi-6

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1902CE603		HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the student to the concept of hydrological aspects of water availability andrequirementsand should be able to quantify, control and regulate the water resources.

Unit I	**PRECIPITATION AND ABSTRACTIONS**	**9 Hours**

Hydrological cycle-Meteorological measurements–Requirements, types and forms ofprecipitation-Rain Gauges-Spatial analysis of rainfall data using Thiessen and Isohyetalmethods-Interception-Evaporation. Horton's equation, pan evaporation measurements and evaporationsuppression-Infiltration-Horton's equation-double ring infiltrometer, infiltration indices

Unit II	**RUNOFF**	**9 Hours**

Watershed, catchment and basin-Catchment characteristics-factors affecting runoff-Run offestimation using empirical-Strange"s table and SCS methods–Stage discharge relationshipsflow measurements-Hydrograph–Unit Hydrograph–IUH

Unit III	**FLOOD AND DROUGHT**	**9 Hours**

Natural Disasters-FloodEstimation-Frequency Analysis-Flood Control-Definitions of droughtsMeteorological, hydrological and agricultural droughts-IMD method-NDVI analysis-Drought Prone Area Programme (DPAP)

Unit IV	**RESERVOIRS**	**9 Hours**

Classification of reservoirs, General principles of design, site selection, spillways, elevation–area-capacity-storage estimation, sedimentation-life of reservoirs–rule curve

Unit V	**GROUNDWATER AND MANAGEMENT**	**9Hours**

Origin-Classification and types-properties of aquifers-governing equations–steady andunsteady flow-artificial recharge-RWH in rural and urbanareas

	Total:	**45 Hours**

Further Reading:

1. How to prepare data for GIS and RS
2. Civil engineering application for various fields

Course Outcomes:

After completion of the course, Student will be able to

1. Explainthe key drivers on water resources, hydrological processes andtheir integrated behavior in catchments
2. Make use ofhydrological models to surface water problemsincluding basin characteristics, runoff and Hydrograph
3. Outline the concept of hydrological extremes such as Flood and Droughtand management strategies
4. Describe theimportance of spatial analysis ofrainfall and design waterstorage reservoirs
5. Illustrate theconcepts of groundwater for water resources management

References:

Subramanya .K. "Engineering Hydrology"-Tata McGraw Hill, 2010

David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007

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1901MGX01		**TOTAL QUALITY MANAGEMENT**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**
Course Objectives:		To facilitate the understanding of Quality Management principles and process.				
Unit I	INTRODUCTION					**9 Hours**
Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Costs of quality.						
Unit II	TQM PRINCIPLES					**9 Hours**
Leadership – Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating						
Unit III	TQM TOOLS AND TECHNIQUES I					**9 Hours**
The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.						
Unit IV	TQM TOOLS AND TECHNIQUES II					**9 Hours**
Control Charts – Process Capability – Concepts of Six Sigma – Quality Function Development (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.						
Unit V	QUALITY SYSTEMS					**9Hours**
Need for ISO 9000 – ISO 9001-2008 Quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors.						
		Total:				**45 Hours**
Further Reading:						
	1. Engineering economics and cost analysis					
	2. Construction and planning management					
Course Outcomes:						
	After completion of the course, Student will be able to					
	1. Understand the concepts, dimension quality and philosophies of TQM.					
	2. Understand the principles of TQM and its strategies.					
	3. Apply seven statistical quality and management tools.					
	4. Understand TQM tools for continuous improvement.					
	5. Understand the QMS and EMS.					

1902CE604		GLOBAL WARMING AND CLIMATE CHANGE	L	T	P	C
			3	0	0	3

Course Objectives:

1. To understand the Earth's Climate System and the concept of Global Warming.
2. To analyze the global warming and their effects due to climate change.
3. To comprehend the impact of climate change on society and its mitigation measures.

Unit I	**INTRODUCTION OF GLOBAL WARMING**	**9 Hours**

Introduction - the gas law - ideal gas equation- the mole concept- sample calculations- ppm - sulphur pollutants-oxides of nitrogen - particulate - Green House Gases.

Unit II	**MITIGATION MEASURE, EMISSION TARGETS AND CARBON TREADING**	**9 Hours**

Introduction-reduction of carbon dioxide emissions from power generation- carbon credits- carbon dioxide from vehicle - miscellaneous source of carbon dioxide- uptake of carbon dioxide by vegetation

Unit III	**OVERVIEW OF CLIMATE VARIABILITY AND CLIMATE SCIENCE**	**9 Hours**

Climate dynamics, climate change and climate prediction - the chemical and physical climate system and aspects - El Nino and global warming - global change in recent history.

Unit IV	**BASICS OF GLOBAL CLIMATE**	**9 Hours**

Components and phenomena in the climate system - basics of radioactive forcing - atmospheric circulation-ocean circulation-land surface processes - the carbon cycle.

Unit V	**PHYSICAL PROCESSES IN THE CLIMATE SYSTEM**	**9 Hours**

Conservation of momentum-equation of state- temperature equation - continuity equation - conservation of mass applied to moisture – saturation - wave processes in the atmosphere and ocean.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Outline the principle involved in the greenhouse gas emission.
2. Explain the carbon emission and its mitigation methods.
3. Illustrate about the climate variability parameters.
4. Describe the climate components and the circulation system.
5. Discuss about the physical processes involved in the climate system.

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1903CE033		WATER POLLUTION AND MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

1. To impart knowledge on the importance and necessity of water
2. To educate about the water pollution and its impact
3. To impart knowledge on water quality analyzing techniques
4. To make awareness in monitoring and management of water

Unit I	**WATER RESOURCES**	**9 Hours**

Necessity & properties of water –Water resources of the world and India –National Water Policy– Water cycle– Surface & subsurface sources –Water Quality Parameters – Standards.

Unit II	**WATER POLLUTION**	**9 Hours**

Sources – Classification, nature andToxicology of water pollutants –Ground water pollution–Ocean Pollution by toxic wastes– River pollution-A case study

Unit III	**EFFECTS OF WATER POLLUTION**	**9 Hours**

Effects of waterpollutants on Human health– Ecologicaland Economic impacts of water pollution–Marine oilpollution and its impacts.

Unit IV	**ANALYSIS & INSTRUMENTATION**	**9 Hours**

Analysis of Pollutants: Titrimetry – Gravimetry – Spectrophotometry – Chromatographyand Flame techniques.Instrumentation: Principles and Applications of UV– VIS Spectrophotometer – Flame Photometer – Atomic Absorption Spectrophotometer –Gas Chromatography – GLC – HPLC

Unit V	**MONITORING & MANAGEMENT**	**9 Hours**

Water quality monitoring–Water (Prevention and Pollution Control) act 1974 – Pollution control devices – Polluters pay principle.

	Total:	**45 Hours**

Further Reading:

1. Water supply engineering
2. Waste water engineering

Course Outcomes:

After completion of the course, Student will be able to

1. Illustrate about the sources of water and the quality standards
2. Classify the nature of pollutants and its source
3. Outline the effects of water pollution on biodiversity
4. Select the suitable analysis technique for the water quality parameter estimation
5. Select the accurate monitoring and management methods

References:

1. Laurent Hodges – Environmental Pollution
2. Willard, Merritt and Dean – Instrumental Analysis
3. APHA – Analysis of Water and Waste Water

1901HS002	INTELLECTUAL PROPERTY RIGHTS FOR ENGINEERS	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art or engineering. This course covers the fundamental aspects of intellectual property (IP): copyright and related rights, trademarks, patents, geographical indications, and industrial designs. It also covers contemporary issues impacting the IP field such as: new plant varieties, unfair competition, enforcement of IP rights and emerging issues in IP.

COURSE OBJECTIVES:

1. A foundation in the basic conceptsof IP
2. Better understanding of therelationship between IP and otherpolicy areas such as health, climatechange, traditional knowledge andemerging technologies

Module I	Introduction	9 Hours

Overview of IP, Copyright, Trademarks, Geographical Indicators, Industrial Designs, Patents, Unfair competition, Enforcement of IP Rights, Emerging Issues in IP & IP Management

Module II	Copyrights &Trademarks	6 Hours

The concept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, Formats & Filing Procedures

Module III	Geographical Indicators & Industrial Designs	6 Hours

The concept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, Formats& Filing Procedures

Module IV	Patents	15 Hours

The Macro-Economic Impact of the Patent System, The Patent Application Process, The Different Layers of the International Patent System and Regional Patent Protection Mechanisms, Kinds of Intellectual Property Protection Based on Types of Inventions, Legal Issues of the Patenting Process, Enforcement, New Issues, Important Cases and Discussions, IP and Development - Flexibilities and Public Domain under Patents, Patent Search

Module V	Patent Cooperation Treaty	9 Hours

What is PCT? Use of PCT, Preparing a PCT Application, PCT Services, Patent Agent and Common Representatives, International Search, International Examination

TOTAL: 45 HOURS

Course Outcomes:

1. Explain various types of IPRs specific to Engineering
2. Explain concepts such as Copyrights, Trademarks, GIs and Industrial designs
3. Explain basic concepts of Engineering Patents
4. Explain concept of Patent Search and various methods to do it
5. Develop a sample PCT Application and explain examination procedures

FURTHER READING:

1. Intellectual Property Rights by PandeyNeeraj&DharniKhushdeep, 2014
2. Fundamentals of IPR: for students, Industrialist and patent lawyers, Ramakrishna B & Anil Kumar HS, 2017Drucker

REFERENCES:

1. Law relating to IPR by Dr MK Bandarai, Central Law Publication, 2014
2. Introduction to Intellectual Property Rights, H.S. Chawla, Oxfors& IBH Publishing, 2020
3. Introduction to IPR by JP Mishra, Central Law Publications
4. https://patents.google.comIntroduction to IPR books

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1901HS006	DESIGN THINKING FOR INNOVATION	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art, engineering, or prototyping. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions

COURSE OBJECTIVES:

1. Understand how teaching and learning occurs in the design process
2. Recognize the ethical and social dilemmas and obligations of the practice of design
3. Diagnose common adoption barriers in individuals, groups and organizations.
4. Develop a design theory from independent and qualitative research and observations
5. Participate in and lead innovation in creative and collaborative settings
6. Undertake complex and unstructured problem-solving challenges in unfamiliar domains

Module I	**Introduction to Design Thinking**	**8 Hours**

Human Centered Design, Why Design Thinking, 5-Step Design Thinking Process, Applications, Creative Confidence, The culture of Innovation

Module II	**Design Thinking Approach**	**12 Hours**

IDEO's method of Design Thinking, Divergent Thinking & Innovation Funnel, Customer Journey Maps to uncover Innovation Opportunities, Case Study : Turing Creative Ideas into Viable Companies

Module III	**Exploring Design Thinking ToolKit**	**5 Hours**

Discovery, Interpretation, Ideation, Experimentation, Evolution

Module IV	**Design Challenge Project: Phase-1**	**5 Hours**

Define a Challenge, Project Plan, How Might We statement, Project Timeline, Project Checklist

Module V	**Design Challenge Project: Phase-2**	**15 Hours**

Discovery – Understand the Challenge, Prepare Research, Gather Inspiration, Interpretation – Tell Stories, Search for meaning, Frame Opportunities, Ideation – Generate Ideas, Refine Ideas, Experimentation – Make Prototypes, Get Feedback, Evolution – Track Learnings, Engage Others

TOTAL: 45 HOURS

Course Outcomes:

1. Describe Key Concepts and basics of Design Thinking Principles
2. Elaborate the Design Thinking Approach through IDEO's method & Customer Journey Maps
3. Conduct user interviews and synthesize learnings to uncover insights and identify opportunities for innovation
4. Develop Design Driven Innovative Solutions to RealWorld Problems

FURTHER READING:

1.Design for Social Impact: How to by IDEO.org
2.Design Thinking ToolKit by IDEO.org
3.The Field guide to Human Centered Design by IDEO.org

REFERENCES:

1.Creative Confidence: Unleashing the Creative Potential Within Us AllBook by David M. Kelley and Tom Kelley, 2013

2.Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Book by Tim Brown, 2009

1901MGX07		UNIVERSAL HUMAN VALUES & ETHICS	L	T	P	C
			3	0	0	3

Course Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Unit I	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**	**9 Hours**

Understanding the need, basic guidelines, content and process for Value Education-Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations - Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being withtheir correct priority - Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfill the above human aspirations: understanding and living in harmony at various levels

Unit II	**Understanding Harmony in the Human Being - Harmony in Myself**	**9 Hours**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body' - Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha - Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) - Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail - Programs to ensure Sanyam and Swasthya

Unit III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**	**10 Hours**

Understanding harmony in the Family- the basic unit of human interaction - Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship - Understanding the meaning of *Vishwas*; Difference between intention and competence - Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!

Unit IV	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**	**9 Hours**

Understanding the harmony in the Nature - Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature - Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space - Holistic perception of harmony at all levels of existence

Unit V	**Implications of the above Holistic Understanding of Harmony**	**8 Hours**

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, - b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models - Case studies of typical holistic technologies, management models and production systems - Strategy for transition from the present state to Universal Human Order:a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers - b) At the level of society: as mutually enriching institutions and organizations		
	Total:	**45 Hours**
Further Proceeding:		
	1. Analysis about Code of Conduct for Ethical & Moral values	
Course Outcomes:		
	After completion of the course, Student will be able to	
	1. Understand the significance of value inputs in a classroom and start applying them in their life and profession	
	2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	
	3. Understand the value of harmonious relationship based on trust and respect in their life and profession	
	4. Understand the role of a human being in ensuring harmony in society and nature.	
	5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	
References:		
1. A Nagraj, 1998, JeevanVidyaEkParichay, Divya Path Sansthan, Amarkantak.		
2. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.		
3. A N Tripathy, 2003, Human Values, New Age International Publishers.		
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA		

1902CE019	COASTAL ZONE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:	At the end of the semester, 1.The student shall be able to understand the coastal processes
	2.The student shall be able to understand the coastal dynamics
	3.The student shall be able to understand impacts of structures like docks, harbors and quays leading to simple management perspectives along the coastal zone

Unit I	**COASTAL ZONE**	**9 Hours**
Coastal zone – Coastal zone regulations – Beach profile – Surf zone – Off shore – Coastal waters – Estuaries – Wet lands and Lagoons – Living resources – Nonliving resources.		
Unit II	**WAVE DYNAMICS**	**9 Hours**
Wave classification – Airy's Linear Wave theory – Deep water waves – Shallow water waves – Wave pressure – Wave energy – Wave Decay – Reflection, Refraction and Diffraction of waves – Breaking of waves – Wave force on structures – Vertical – Sloping and stepped barriers – Force on piles.		
Unit III	**WAVE FORECASTING AND TIDES**	**9 Hours**
Need for forecasting – SMB and PNJ methods of wave forecasting – Classification of tides – Darwin's equilibrium theory of tides – Effects on structures – seiches, Surges and Tsunamis.		
Unit IV	**COASTAL PROCESSES**	**9 Hours**
Erosion and depositional shore features – Methods of protection – Littoral currents – Coastal aquifers – Sea water intrusion – Impact of sewage disposal in seas.		
Unit V	**HARBOURS**	**9 Hours**
Structures near coast – Selection of site – Types and selection of break waters – Need and mode of dredging – Selection of dredgers – Effect of Mangalore Forest.		
	Total:	**45 Hours**

Further Reading:	
	1.Richard Sylvester, "Coastal Engineering, Volume I and II", Elseiner Scientific Publishing Co., 1999
	2.Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw Hill Book Co., 1999
Course Outcomes:	
	After completion of the course, Student will be able to
	1. Describe the Coastal zone regulations,
	2. Describe the coastal processes
	3. Explain the wave dynamics and forecast waves
	4. Understand the erosion and depositional shore protection
	5. Plan the coastal structures including harbours and tides

References:

1.Ed. A.T. Ippen, "Coastline Hydrodynamics", McGraw-Hill Inc., New York, 1993

2.Dwivedi, S.N., Natarajan, R and Ramachandran, S.,"Coastal Zone Management in Tamilnadu", Madras, 199

3.Richard Sylvester, "Coastal Engineering, Volume I and II", Elseiner Scientific Publishing Co., 1999

4.Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw Hill Book Co., 1999

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ME ENVIRONMENTAL ENGINEERING

2102EV104		ENVIRONMENTAL CHEMISTRY	L	T	P	C
			3	0	0	3

Course Objectives:

1. To educate the students about water chemistry
2. To impart knowledge in the area of air and soil chemistry
3. To impart knowledge on the transformation of chemicals in the environment

Unit I	Introduction	9 Hours

Stoichiometry and mass balance-Chemical equilibrium, acid base, solubility product (Ksp), heavy metal precipitation, amphoteric hydroxides, CO2 solubility in water and species distribution – Chemical kinetics, First order- 12 Principles of green chemistry.

Unit II	Aquatic Chemistry	11 Hours

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation – Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction, pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation.

Unit III	Atmospheric Chemistry	7 Hours

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, CO_2 capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination.

Unit IV	Soil Chemistry	9 Hours

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

Unit V	Environmental Chemicals	9 Hours

Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins,PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.

Total:	45 Hours

Further Reading

To analyze and create a solution for environmental issues.

Course Outcomes:

After completion of the course, Student will be able to

1. Distinguish the chemistry involved
2. Understand the chemistry involved in water
3. Identify and solve the air pollution related issues
4. Understand the soil related chemistry and issues
5. Identify contaminating chemicals and can work out chemicals need calculations for treatment purpose

2102EV102		ENVIRONMENTAL MICROBIOLOGY	L	T	P	C
			3	0	0	3

Course Objectives:

1. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
2. The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.
3. The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease-causing organisms are also covered.
4. An exposure to toxicology due to industrial products and byproducts are also covered.
5. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.

Unit I **Classification And Characteristics** **5 Hours**

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

Unit II **Microbes And Nutrient Cycles** **10 Hours**

Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaebacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Micro Organism in nutrient cycle.

Unit III **Metabolism of Microorganisms** **10 Hours**

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb"s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

Unit IV **Pathogens in Wastewater** **10 Hours**

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Indicator organisms of water – Coliforms - total coliforms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, □-oxidation, β-oxidation, nitrification and de-nitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Unit V **Toxicology** **10 Hours**

Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bio concentration – Bioaccumulation, bio magnification, bioassay, bio monitoring, bioleaching.

Total: 45 Hours

Further Reading

Identification and culturing of microorganisms from different sources

Course Outcomes:

After completion of the course, Student will be able to

1. The candidate at the end of the course will have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.
2. The candidate would be able to understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
3. The candidate would have understood the role microbial metabolism in a wastewater treatment plant.
4. The candidate would know the role of microorganisms in contaminated water and the diseases caused.

	synthetic products in the environment.

References:

1. S.C.Bhatia, Hand Book of Environmental Microbiology, Part 1 and 2, Atlantic Publisher
2. Gabriel Bitton, Wastewater Microbiology, 2nd Edition ,
3. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, Environmental Microbiology, Academic Press.
4. SVS. Rana, Essentials of Ecology and Environmental Science, 3rd Edition, Prentice Hall of India Private Limited
5. Stanley E. Manahan, Environmental Science and Technology, Lewis Publishers.
6. Hurst, C.J. (2002) Manual of Environmental Microbiology. 2nd Ed. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 - X.
7. Frank C. Lu and Sam Kacew, LU‟s Basic Toxicology, Taylor & Francis, London (4th Ed), 2002

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2103EV001		TRANSPORT OF WATER AND WASTEWATER	L	T	P	C
			3	0	0	3

Course Objectives:

1. To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain
2. To educate the students in computer application on design.

Unit I **General Hydraulics and Flow Measurement** **8 Hours**

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

Unit II **Water Transmission and Distribution** **10 Hours**

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

Unit III **Wastewater Collection and Conveyance** **10 Hours**

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

Unit IV **Storm Water Drainage** **7 Hours**

Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods.

Unit V **Case Studies and Software Applications** **10 Hours**

Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

Total: 45 Hours

Further Reading

Designing of pipelines and sewers for various project areas

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the fluid flow properties
2. Design water supply main, distribution network and sewer for various field conditions
3. Design the drainage network for wastewater
4. Design the storm water drainage systems
5. Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

2102EV103		**PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Objectives:

1. To educate the students on the principles and process designs of various treatment systems for water and wastewater
2. To educate the students on design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I **Introduction** **5 Hours**

Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physio-chemical treatment – Selection criteria-types of reactors- reactor selection-batch- continuous type-kinetics.

Unit II **Treatment Principles** **10 Hours**

Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra-filtration and hyper filtration electro dialysis, distillation – stripping and crystallization – Recent Advances. Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends

Unit III **Design of Municipal Water Treatment Plants** **10 Hours**

Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit IV **Design of Industrial Water Treatment Plants** **10Hours**

Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit V **Design of Wastewater Treatment Plants** **10 Hours**

Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks- sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers- floatation units-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.

Total: 45 Hours

Further Reading

Implementation of advanced treatment technologies for various wastewater treatment

Course Outcomes:

After completion of the course, Student will be able to

1. Identify the pollutants type in the wastewater
2. Understand the various treatment principles
3. Design the sewage treatment plants
4. Design suitable treatment units for various industries
5. Develop conceptual schematics required for the treatment of wastewater

2102EV105		ENVIRONMENTAL CHEMISTRY LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

1. To train in the analysis of physical parameters of water and waste water
2. To train in the analysis of chemical parameters of water and waste water

List of Experiments:

1. Good Laboratory Practices, Quality control, calibration of Glassware
2. Sampling and Analysis of water (pH, alkalinity, hardness chloride, Sulphate, turbidity EC, TDS, nitrate, fluoride)
3. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).
4. Sampling and analysis of air pollutants Ambient & Stack (RSPM, SO2 and NOx)
5. Sampling and characterization of soil (CEC & SAR, pH and K).

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. assess quality of environment
2. conduct analysis on characteristics of water and waste water

References:

1. APHA, Standard Methods for the Examination of Water and Wastewater, 21st Ed.
2. Washington, 2005.
3. Laboratory Manual for the Examination of water, wastewater soil Rump, H.H. and Krist, H.
4. Second Edition, VCH, Germany, 1992.
5. Methods of air sampling & analysis, James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

2102EV103		PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I	Introduction	10 Hours

Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth - Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process- reactors-batch-continuous type.

Unit II	Aerobic Treatment of Wastewater	10 Hours

Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfection – disposal options – reclamation and reuse – Flow charts, layout, PID, hydraulic profile, recent trends.

Unit III	Anaerobic Treatment of Wastewater	10 Hours

Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal – Nutrient removal systems – Flow chart, Layout and Hydraulic profile – Recent trends.

Unit IV	Sludge Treatment and Disposal	5 Hours

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

Unit V	Construction Operations and Maintenance Aspects	10 Hours

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and controlling of plant operations – capacity building - Retrofitting Case studies – sewage treatment plants – sludge management facilities.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Develop conceptual schematics required for biological treatment of wastewater
2. Translate pertinent criteria into system requirements.

References:

1. Arceivala, S.J., Wastewater Treatment for Pollution Control, TMH, New Delhi, Second Edition, 2000.
2. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
3. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
4. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations, CRC Press, New York (2009).

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2103EV004		AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends

Unit I	Introduction	7 Hours

Structure and composition of Atmosphere – Sources and classification of air pollutants - Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects on the planet – Global Climate Change, Ozone Holes – Ambient Air Quality and Emission Standards – Air Pollution Indices – Emission Inventories – Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants.

Unit II	Air Pollution Modelling	5 Hours

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques - Air Pollution Climatology.

Unit III	Control Of Particulate Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators (cyclone) , Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

Unit IV	Control of Gaseous Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

Unit V	Indoor Air Quality Management	11 Hours

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control – Membrane process - UV photolysis – Internal Combustion Engines - Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Apply sampling techniques
2. Apply modelling techniques
3. Suggest suitable air pollution prevention equipment's and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards

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2102EV202		**INDUSTRIAL WASTE MANAGEMENT**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Objectives:

To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.

Unit I **Introduction** **8 Hours**

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

Unit II **Industrial Pollution Prevention & Waste Minimisation** **8 Hours**

Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

Unit III **Industrial Wastewater Treatment** **10 Hours**

Flow and Load Equalization – Solids Separation – Removal of Fats, Oil & Grease- Neutralization – Removal of Inorganic Constituents – Precipitation, Heavy metal removal , Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis& Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.

Unit IV **Wastewater Reuse and Residual Management** **9 Hours**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

Unit V **Case Studies** **10 Hours**

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Define the Principles of pollution prevention and mechanism of oxidation processes.
2. Suggest the suitable technologies for the treatment of wastewater.
3. Discuss about the wastewater characteristics
4. Design the treatment systems

2103EV007		SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment.

Unit I — **Sources, Classification and Regulatory Framework** — **9 Hours**

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.

Unit II — **Waste Characterization and Source Reduction** — **8 Hours**

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

Unit III — **Storage, Collection and Transport Of Wastes** — **9 Hours**

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

Unit IV — **Waste Processing Technologies** — **10 Hours**

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

Unit V — **Waste Disposal** — **9 Hours**

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
2. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste
3. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges

2103EV010		ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
			3	0	0	3

Course Objectives:

1. To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
2. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

Unit I	Introduction	8 Hours

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA.

Unit II	Impact Identification and Prediction	10 Hours

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment.

Unit III	Social Impact Assessment and EIA Documentation	8 Hours

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	Environmental Management Plan	7 Hours

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	Environmental Risk Assessment and Management	12 Hours

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipathway exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
2. Know about the legal requirements of Environmental and Risk Assessment for projects.

2102EV203		**UNIT OPERATIONS AND PROCESSES LABORATORY**	**L**	**T**	**P**	**C**
			0	**0**	**2**	**1**

Course Objectives:	
	1. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.
	2. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.

List of Experiments:		
1. Coagulation and Flocculation		
2. Batch studies on settling		
3. Studies on Filtration- Characteristics of Filter media		
4. Water softening		
5. Adsorption studies/Kinetics		
6. Reverse Osmosis- Silt Density Index		
7. Kinetics of suspended growth process (activated sludge process)- Sludge volume Index		
8. Anaerobic Reactor systems / kinetics (Demonstration)		
9. Advanced Oxidation Processes – (Ozonation, Photocatalysis)		
10. Disinfection for Drinking water		
	Total :	**45 Hours**

Course Outcomes:	
	After completion of the course, Student will be able to
	1. Conduct treatability studies for water and waste water treatment.
	2. Design laboratory models for various unit operations and processes.

References:

1. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
3. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
4. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.

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2103EV020		ENVIRONMENTAL POLICIES AND LEGISLATION	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.

Unit I **Introduction** **9 Hours**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration– Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework(SPCB/CPCB/MoEF)

Unit II **Water (P&CP) Act, 1974** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit III **Air (P&CP) Act, 1981** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation

Unit IV **Environment (Protection) Act 1986** **13 Hours**

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

Unit V **Other Topics** **7 Hours**

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Know the National environmental legislations and the policies
2. plan programmes to comply with the legal requirements related to organizations

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BE CIVIL ENGINEERING

1902CE401	BUILDING MATERIALS AND MANAGEMENT	L	T	P	C
		3	0	0	3

UNIT I	BUILDING MATERIALS	9 Hours

Lime, Brick, Timber and its Products, Floor and Wall Tiles, Pozzolanas, Ferrous metals, Thermal Insulation Material. Finishing Materials: Glass, Timber, Aluminum, Plastics, Paints, Varnishes, Distemper, Waterproofing and Damp Proofing Materials, Ferrocement and its application, Fabre textiles – Geo membranes and Geotextiles for earth reinforcement.

UNIT II	BUILDING COMPONENTS	9 Hours

Partition wall and Cavity wall, Composite Masonry, Doors, Windows, Ventilators, Stairs, Lift, Ramps, Escalators, Anti Termite Treatment, Brick masonry- Bond- Jointing-Stone masonry
Temporary building structures - Site Clearance - Marking –Earthwork, Slip and moving forms, scaffolding, Plumbing and Sanitation, Fire Protection, Introduction to Building Maintenance, Acoustics and Sound Insulation.

UNIT III	SUB STRUCTURE AND SUPERSTRUCTURE TECHNIQUES	9 Hours

Techniques of box jacking- pipe jacking- under water construction of diaphragm walls and basement Tunneling techniques, caisson -sinking cofferdam, Dewatering and stand by plant equipment for underground open excavation, Launching girders, bridge decks, off shore platforms, braced domes and space decks.

UNIT IV	CONSTRUCTION EQUIPMENTS	9 Hours

Selection of equipment for earth work - types of earthwork equipment, Equipment for material handling and erection of structures, Equipment for dredging, trenching, tunneling, Equipment for compaction, batching and mixing and concreting, Equipment for foundation and pile driving.

UNIT V	MANAGEMENT	9 Hours

Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management.

	Total:	45 Hours

COURSE OUTCOMES:

6. Summarize the most common and advanced materials used for construction.
7. Illustrate the construction process of various building components.
8. Explain the various construction methods and techniques involved in sub structure and super structure.
9. Choose the appropriate modern construction tools and equipment in various construction activities.
10. Choose the appropriate method of management for materials.

REFERENCES:

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2012.
2. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3. Gambhir.M.L., "Concrete Technology", 3rd Edition, Tata McGraw Hill Education, 2004
4. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.
5. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
6. Gambhir. M.L., &NehaJamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.

1902CE505		ENVIRONMENTAL ENGINEEERING	L	T	P	C
			3	0	0	3

Course Objectives:

7. To examine the water supply system and conveyance system.
8. To create an ability to evaluate the water treatment and advanced water treatment system.
9. To train the students to analyze water distribution system and supply to buildings.
10. To understand the importance of planning and design of sewerage system.
11. To create an ability to design the waste water treatment system.
12. To impart the signification of disposal of Sewage.

Unit I **WATER SUPPLY SYSTEMS – SOURCE AND CONVEYANCE** **9 Hours**

Objectives – Population forecasting – Design period – Water demand –Sources of water – Source selection – Water quality parameters and significance –Standards – Intake structures – Conveyance – Hydraulics – Laying, jointing and testing of pipes – Pump selection –Appurtenances.

Unit II **DESIGN PRINCIPLES OF WATER TREATMENT** **9 Hours**

Objectives – Selection of unit operations and processes – Principles of flocculation, sedimentation, filtration, disinfection – Design principles of flash mixer, flocculator, clarifiers, filters – Disinfection devices – Softening – Demineralization – Aeration – Iron removal – Defluoridation – Operation and maintenance aspects – Residue management.

Unit III **DISTRIBUTION** **9 Hours**

Requirements of water distribution -Components -Service reservoirs -Functions and drawings -Network design - Analysis of distribution networks – Hardy cross method – Equivalent pipe method - Pipe Appurtenances -operation and maintenance -Leak detection, Methods. House service connection - Systems of plumbing.

Unit IV **SEWERAGE SYSTEM, COLLECTION AND TRANSMISSION** **9 Hours**

Sources of wastewater – Quantity of sanitary sewage – Storm runoff estimation – Wastewater characteristics and significance – Effluent disposal stand over – Design of sewers – Computer applications – Laying, jointing and testing of sewers – Sewer appurtenances – Pump selection.

Unit V **SEWAGE TREATMENT AND DISPOSAL** **9 Hours**

Objectives – Selection of unit operation and process – Design principles of primary and secondary treatment, screen chamber, grit chamber, primary sedimentation tanks, activated sludge process – Aeration tank and oxidation ditch – Trickling filter –Stabilization ponds – Septic tanks with soak pits – Sludge: treatment and disposal –Biogas recovery – Sewage farming.

Disposal on land – Disposal into water bodies – Oxygen sag curve – Streeter Phelp's model – Wastewater reclamation techniques.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

6. Design the components of the transmission main for the water conveyance
7. Design the water treatment units based on its principles and functions
8. Extend the water distribution to the individual buildings
9. Build a sewerage system by flow estimation and designing suitable size of sewers
10. Design the treatment units for the treatment of waste water based on the quality and quantity.

References:

Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2003.

Punmia, B.C., Jain, A.K., and Jain.A., Environmental Engineering, Vol.II, Lakshmi Publications, Newsletter, 2005

Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1997.

Government of India, "Manual on Water Supply and Treatment", CPHEEO, Ministry of Urban Development, New Delhi, 2003

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1902CE552		ENVIRONMENTAL ENGINEERING LAB	L	T	P	C
			0	0	2	1

Course Objectives:	
	1. To know the basics, importance of water and wastewater treatment and methods measurement.
	2. Tostudythe various effects of water and waste water pollution.
	3.Effect of BOD and COD
	4.To find Calcium, Potassium and Sodium
	5.Heavy metal effects and finding methods
List of experiments	
11. Measurement of pH, Electrical conductivity and turbidity	
12. Determination of Calcium, Potassium and Sodium	
13. Determination of Phosphate and Sulphate	
14. Determination of Optimum Coagulant Dosage by Jar test apparatus	
15. Determination of available Chlorine in Bleaching powder and residual chlorine in water	
16. Determination of Ammonia Nitrogen	
17. Estimation of suspended, volatile and fixed solids	
18. Determination of Dissolved Oxygen	
19. Estimation of B.O.D	
20. Estimation of C.O. D	
Total:	**45 Hours**
Course Outcomes:	
	After completion of the course, Student will be able to
	1.characterize given water and waste water sample
References:	

1.Standard methods for the examination of water and wastewater, APHA, 20th Edition, Washington, 1998

2. Garg, S.K., "Environmental Engineering Vol. I & II", Khanna Publishers, New Delhi

3. Modi, P.N., "Environmental Engineering Vol. I & II", Standard Book House, Delhi-6

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1902CE603		HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the student to the concept of hydrological aspects of water availability andrequirementsand should be able to quantify, control and regulate the water resources.

Unit I	**PRECIPITATION AND ABSTRACTIONS**	**9 Hours**

Hydrological cycle-Meteorological measurements–Requirements, types and forms ofprecipitation-Rain Gauges-Spatial analysis of rainfall data using Thiessen and Isohyetalmethods-Interception-Evaporation. Horton's equation, pan evaporation measurements and evaporationsuppression-Infiltration-Horton's equation-double ring infiltrometer, infiltration indices

Unit II	**RUNOFF**	**9 Hours**

Watershed, catchment and basin-Catchment characteristics-factors affecting runoff-Run offestimation using empirical-Strange"s table and SCS methods–Stage discharge relationshipsflow measurements-Hydrograph–Unit Hydrograph–IUH

Unit III	**FLOOD AND DROUGHT**	**9 Hours**

Natural Disasters-FloodEstimation-Frequency Analysis-Flood Control-Definitions of droughtsMeteorological, hydrological and agricultural droughts-IMD method-NDVI analysis-Drought Prone Area Programme (DPAP)

Unit IV	**RESERVOIRS**	**9 Hours**

Classification of reservoirs, General principles of design, site selection, spillways, elevation–area-capacity-storage estimation, sedimentation-life of reservoirs–rule curve

Unit V	**GROUNDWATER AND MANAGEMENT**	**9Hours**

Origin-Classification and types-properties of aquifers-governing equations–steady andunsteady flow-artificial recharge-RWH in rural and urbanareas

	Total:	**45 Hours**

Further Reading:

3. How to prepare data for GIS and RS
4. Civil engineering application for various fields

Course Outcomes:

After completion of the course, Student will be able to

6. Explainthe key drivers on water resources, hydrological processes andtheir integrated behavior in catchments
7. Make use ofhydrological models to surface water problemsincluding basin characteristics, runoff and Hydrograph
8. Outline the concept of hydrological extremes such as Flood and Droughtand management strategies
9. Describe theimportance of spatial analysis ofrainfall and design waterstorage reservoirs
10. Illustrate theconcepts of groundwater for water resources management

References:

Subramanya .K. "Engineering Hydrology"-Tata McGraw Hill, 2010

David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007

1901MGX01		TOTAL QUALITY MANAGEMENT	L	T	P	C
			3	0	0	3
Course Objectives:		To facilitate the understanding of Quality Management principles and process.				
Unit I	INTRODUCTION					**9 Hours**
Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Costs of quality.						
Unit II	TQM PRINCIPLES					**9 Hours**
Leadership – Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating						
Unit III	TQM TOOLS AND TECHNIQUES I					**9 Hours**
The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.						
Unit IV	TQM TOOLS AND TECHNIQUES II					**9 Hours**
Control Charts – Process Capability – Concepts of Six Sigma – Quality Function Development (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.						
Unit V	QUALITY SYSTEMS					**9Hours**
Need for ISO 9000 – ISO 9001-2008 Quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors.						
		Total:				**45 Hours**
Further Reading:						
	3. Engineering economics and cost analysis					
	4. Construction and planning management					
Course Outcomes:						
	After completion of the course, Student will be able to					
	6. Understand the concepts, dimension quality and philosophies of TQM.					
	7. Understand the principles of TQM and its strategies.					
	8. Apply seven statistical quality and management tools.					
	9. Understand TQM tools for continuous improvement.					
	10. Understand the QMS and EMS.					

1902CE604		GLOBAL WARMING AND CLIMATE CHANGE	L	T	P	C
			3	0	0	3

Course Objectives:

4. To understand the Earth's Climate System and the concept of Global Warming.
5. To analyze the global warming and their effects due to climate change.
6. To comprehend the impact of climate change on society and its mitigation measures.

Unit I	**INTRODUCTION OF GLOBAL WARMING**	**9 Hours**

Introduction - the gas law - ideal gas equation- the mole concept- sample calculations- ppm - sulphur pollutants-oxides of nitrogen - particulate - Green House Gases.

Unit II	**MITIGATION MEASURE, EMISSION TARGETS AND CARBON TREADING**	**9 Hours**

Introduction-reduction of carbon dioxide emissions from power generation- carbon credits- carbon dioxide from vehicle - miscellaneous source of carbon dioxide- uptake of carbon dioxide by vegetation

Unit III	**OVERVIEW OF CLIMATE VARIABILITY AND CLIMATE SCIENCE**	**9 Hours**

Climate dynamics, climate change and climate prediction - the chemical and physical climate system and aspects - El Nino and global warming - global change in recent history.

Unit IV	**BASICS OF GLOBAL CLIMATE**	**9 Hours**

Components and phenomena in the climate system - basics of radioactive forcing - atmospheric circulation-ocean circulation-land surface processes - the carbon cycle.

Unit V	**PHYSICAL PROCESSES IN THE CLIMATE SYSTEM**	**9 Hours**

Conservation of momentum-equation of state- temperature equation - continuity equation - conservation of mass applied to moisture – saturation - wave processes in the atmosphere and ocean.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Outline the principle involved in the greenhouse gas emission.
2. Explain the carbon emission and its mitigation methods.
3. Illustrate about the climate variability parameters.
4. Describe the climate components and the circulation system.
5. Discuss about the physical processes involved in the climate system.

1903CE033		WATER POLLUTION AND MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:		
	5.	To impart knowledge on the importance and necessity of water
	6.	To educate about the water pollution and its impact
	7.	To impart knowledge on water quality analyzing techniques
	8.	To make awareness in monitoring and management of water

Unit I	**WATER RESOURCES**	**9 Hours**
Necessity & properties of water –Water resources of the world and India –National Water Policy– Water cycle– Surface & subsurface sources –Water Quality Parameters – Standards.		
Unit II	**WATER POLLUTION**	**9 Hours**
Sources – Classification, nature andToxicology of water pollutants –Ground water pollution–Ocean Pollution by toxic wastes– River pollution-A case study		
Unit III	**EFFECTS OF WATER POLLUTION**	**9 Hours**
Effects of waterpollutants on Human health– Ecologicaland Economic impacts of water pollution–Marine oilpollution and its impacts.		
Unit IV	**ANALYSIS & INSTRUMENTATION**	**9 Hours**
Analysis of Pollutants: Titrimetry – Gravimetry – Spectrophotometry – Chromatographyand Flame techniques.Instrumentation: Principles and Applications of UV– VIS Spectrophotometer – Flame Photometer – Atomic Absorption Spectrophotometer –Gas Chromatography – GLC – HPLC		
Unit V	**MONITORING & MANAGEMENT**	**9 Hours**
Water quality monitoring–Water (Prevention and Pollution Control) act 1974 – Pollution control devices – Polluters pay principle.		
	Total:	**45 Hours**

Further Reading:		
	3.	Water supply engineering
	4.	Waste water engineering

Course Outcomes:		
	After completion of the course, Student will be able to	
	6.	Illustrate about the sources of water and the quality standards
	7.	Classify the nature of pollutants and its source
	8.	Outline the effects of water pollution on biodiversity
	9.	Select the suitable analysis technique for the water quality parameter estimation
	10.	Select the accurate monitoring and management methods

References:

4. Laurent Hodges – Environmental Pollution
5. Willard, Merritt and Dean – Instrumental Analysis
6. APHA – Analysis of Water and Waste Water

1901HS002	INTELLECTUAL PROPERTY RIGHTS FOR ENGINEERS	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art or engineering. This course covers the fundamental aspects of intellectual property (IP): copyright and related rights, trademarks, patents, geographical indications, and industrial designs. It also covers contemporary issues impacting the IP field such as: new plant varieties, unfair competition, enforcement of IP rights and emerging issues in IP.

COURSE OBJECTIVES:

3. A foundation in the basic conceptsof IP
4. Better understanding of therelationship between IP and otherpolicy areas such as health, climatechange, traditional knowledge andemerging technologies

Module I	Introduction	9 Hours

Overview of IP, Copyright, Trademarks, Geographical Indicators, Industrial Designs, Patents, Unfair competition, Enforcement of IP Rights, Emerging Issues in IP & IP Management

Module II	Copyrights &Trademarks	6 Hours

The concept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, Formats & Filing Procedures

Module III	Geographical Indicators & Industrial Designs	6 Hours

The concept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, Formats& Filing Procedures

Module IV	Patents	15 Hours

The Macro-Economic Impact of the Patent System, The Patent Application Process, The Different Layers of the International Patent System and Regional Patent Protection Mechanisms, Kinds of Intellectual Property Protection Based on Types of Inventions, Legal Issues of the Patenting Process, Enforcement, New Issues, Important Cases and Discussions, IP and Development - Flexibilities and Public Domain under Patents, Patent Search

Module V	Patent Cooperation Treaty	9 Hours

What is PCT? Use of PCT, Preparing a PCT Application, PCT Services, Patent Agent and Common Representatives, International Search, International Examination

TOTAL: 45 HOURS

Course Outcomes:

6. Explain various types of IPRs specific to Engineering
7. Explain concepts such as Copyrights, Trademarks, GIs and Industrial designs
8. Explain basic concepts of Engineering Patents
9. Explain concept of Patent Search and various methods to do it
10. Develop a sample PCT Application and explain examination procedures

FURTHER READING:

3. Intellectual Property Rights by PandeyNeeraj&DharniKhushdeep, 2014
4. Fundamentals of IPR: for students, Industrialist and patent lawyers, Ramakrishna B & Anil Kumar HS, 2017Drucker

REFERENCES:

1. Law relating to IPR by Dr MK Bandarai, Central Law Publication, 2014
2. Introduction to Intellectual Property Rights, H.S. Chawla, Oxfors& IBH Publishing, 2020
3. Introduction to IPR by JP Mishra, Central Law Publications
4. https://patents.google.comIntroduction to IPR books

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1901HS006	DESIGN THINKING FOR INNOVATION	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art, engineering, or prototyping. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions

COURSE OBJECTIVES:

7. Understand how teaching and learning occurs in the design process
8. Recognize the ethical and social dilemmas and obligations of the practice of design
9. Diagnose common adoption barriers in individuals, groups and organizations.
10. Develop a design theory from independent and qualitative research and observations
11. Participate in and lead innovation in creative and collaborative settings
12. Undertake complex and unstructured problem-solving challenges in unfamiliar domains

Module I	**Introduction to Design Thinking**	**8 Hours**

Human Centered Design, Why Design Thinking, 5-Step Design Thinking Process, Applications, Creative Confidence, The culture of Innovation

Module II	**Design Thinking Approach**	**12 Hours**

IDEO's method of Design Thinking, Divergent Thinking & Innovation Funnel, Customer Journey Maps to uncover Innovation Opportunities, Case Study : Turing Creative Ideas into Viable Companies

Module III	**Exploring Design Thinking ToolKit**	**5 Hours**

Discovery, Interpretation, Ideation, Experimentation, Evolution

Module IV	**Design Challenge Project: Phase-1**	**5 Hours**

Define a Challenge, Project Plan, How Might We statement, Project Timeline, Project Checklist

Module V	**Design Challenge Project: Phase-2**	**15 Hours**

Discovery – Understand the Challenge, Prepare Research, Gather Inspiration, Interpretation – Tell Stories, Search for meaning, Frame Opportunities, Ideation – Generate Ideas, Refine Ideas, Experimentation – Make Prototypes, Get Feedback, Evolution – Track Learnings, Engage Others

TOTAL: 45 HOURS

Course Outcomes:

1. Describe Key Concepts and basics of Design Thinking Principles
2. Elaborate the Design Thinking Approach through IDEO's method & Customer Journey Maps
3. Conduct user interviews and synthesize learnings to uncover insights and identify opportunities for innovation
4. Develop Design Driven Innovative Solutions to RealWorld Problems

FURTHER READING:

1.Design for Social Impact: How to by IDEO.org
2.Design Thinking ToolKit by IDEO.org
3.The Field guide to Human Centered Design by IDEO.org

REFERENCES:

1.Creative Confidence: Unleashing the Creative Potential Within Us AllBook by David M. Kelley and Tom Kelley, 2013

2.Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Book by Tim Brown, 2009

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1901MGX07		UNIVERSAL HUMAN VALUES & ETHICS	L	T	P	C
			3	0	0	3

Course Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Unit I	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**	**9 Hours**

Understanding the need, basic guidelines, content and process for Value Education-Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations - Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being withtheir correct priority - Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfill the above human aspirations: understanding and living in harmony at various levels

Unit II	**Understanding Harmony in the Human Being - Harmony in Myself**	**9 Hours**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body' - Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha - Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) - Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail - Programs to ensure Sanyam and Swasthya

Unit III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**	**10 Hours**

Understanding harmony in the Family- the basic unit of human interaction - Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship - Understanding the meaning of *Vishwas*; Difference between intention and competence - Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!

Unit IV	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**	**9 Hours**

Understanding the harmony in the Nature - Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature - Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space - Holistic perception of harmony at all levels of existence

Unit V	**Implications of the above Holistic Understanding of Harmony**	**8 Hours**

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, - b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models - Case studies of typical holistic technologies, management models and production systems - Strategy for transition from the present state to Universal Human Order:a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers - b) At the level of society: as mutually enriching institutions and organizations		
	Total:	**45 Hours**
Further Proceeding:		
	2. Analysis about Code of Conduct for Ethical & Moral values	
Course Outcomes:		
	After completion of the course, Student will be able to	
	1. Understand the significance of value inputs in a classroom and start applying them in their life and profession	
	2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	
	3. Understand the value of harmonious relationship based on trust and respect in their life and profession	
	4. Understand the role of a human being in ensuring harmony in society and nature.	
	5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	
References:		
1. A Nagraj, 1998, JeevanVidyaEkParichay, Divya Path Sansthan, Amarkantak.		
2. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.		
3. A N Tripathy, 2003, Human Values, New Age International Publishers.		
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA		

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1902CE019	COASTAL ZONE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:	At the end of the semester, 1.The student shall be able to understand the coastal processes
	2.The student shall be able to understand the coastal dynamics
	3.The student shall be able to understand impacts of structures like docks, harbors and quays leading to simple management perspectives along the coastal zone

Unit I	**COASTAL ZONE**	**9 Hours**
Coastal zone – Coastal zone regulations – Beach profile – Surf zone – Off shore – Coastal waters – Estuaries – Wet lands and Lagoons – Living resources – Nonliving resources.		
Unit II	**WAVE DYNAMICS**	**9 Hours**
Wave classification – Airy's Linear Wave theory – Deep water waves – Shallow water waves – Wave pressure – Wave energy – Wave Decay – Reflection, Refraction and Diffraction of waves – Breaking of waves – Wave force on structures – Vertical – Sloping and stepped barriers – Force on piles.		
Unit III	**WAVE FORECASTING AND TIDES**	**9 Hours**
Need for forecasting – SMB and PNJ methods of wave forecasting – Classification of tides – Darwin's equilibrium theory of tides – Effects on structures – seiches, Surges and Tsunamis.		
Unit IV	**COASTAL PROCESSES**	**9 Hours**
Erosion and depositional shore features – Methods of protection – Littoral currents – Coastal aquifers – Sea water intrusion – Impact of sewage disposal in seas.		
Unit V	**HARBOURS**	**9 Hours**
Structures near coast – Selection of site – Types and selection of break waters – Need and mode of dredging – Selection of dredgers – Effect of Mangalore Forest.		
	Total:	**45 Hours**

Further Reading:	
	1.Richard Sylvester, "Coastal Engineering, Volume I and II", Elseiner Scientific Publishing Co., 1999
	2.Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw Hill Book Co., 1999
Course Outcomes:	
	After completion of the course, Student will be able to
	6. Describe the Coastal zone regulations,
	7. Describe the coastal processes
	8. Explain the wave dynamics and forecast waves
	9. Understand the erosion and depositional shore protection
	10. Plan the coastal structures including harbours and tides

References:

1.Ed. A.T. Ippen, "Coastline Hydrodynamics", McGraw-Hill Inc., New York, 1993

2.Dwivedi, S.N., Natarajan, R and Ramachandran, S.,"Coastal Zone Management in Tamilnadu", Madras, 199

3.Richard Sylvester, "Coastal Engineering, Volume I and II", Elseiner Scientific Publishing Co., 1999

4.Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw Hill Book Co., 1999

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NAGAPATTINAM – 611 002. TAMILNADU, INDIA

Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai

(Accredited by NAAC with 'A' Grade and NBA)

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ME ENVIRONMENTAL ENGINEERING

17EV102		ENVIRONMENTAL CHEMISTRY	L	T	P	C
			3	0	0	3

Course Objectives:

4. To educate the students about water chemistry
5. To impart knowledge in the area of air and soil chemistry
6. To impart knowledge on the transformation of chemicals in the environment

Unit I	Introduction	9 Hours

Stoichiometry and mass balance-Chemical equilibrium, acid base, solubility product (Ksp), heavy metal precipitation, amphoteric hydroxides, CO2 solubility in water and species distribution – Chemical kinetics, First order- 12 Principles of green chemistry.

Unit II	Aquatic Chemistry	11 Hours

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation – Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction, pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation.

Unit III	Atmospheric Chemistry	7 Hours

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, CO_2 capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination.

Unit IV	Soil Chemistry	9 Hours

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

Unit V	Environmental Chemicals	9 Hours

Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins,PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.

Total:	45 Hours

Further Reading

To analyze and create a solution for environmental issues.

Course Outcomes:

After completion of the course, Student will be able to

6. Distinguish the chemistry involved
7. Understand the chemistry involved in water
8. Identify and solve the air pollution related issues
9. Understand the soil related chemistry and issues
10. Identify contaminating chemicals and can work out chemicals need calculations for treatment purpose

17EV103		ENVIRONMENTAL MICROBIOLOGY	L	T	P	C
			3	0	0	3

Course Objectives:

6. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
7. The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.
8. The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease-causing organisms are also covered.
9. An exposure to toxicology due to industrial products and byproducts are also covered.
10. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.

Unit I	Classification And Characteristics	5 Hours

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

Unit II	Microbes And Nutrient Cycles	10 Hours

Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaebacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Micro Organism in nutrient cycle.

Unit III	Metabolism of Microorganisms	10 Hours

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb"s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

Unit IV	Pathogens in Wastewater	10 Hours

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Indicator organisms of water – Coliforms - total coliforms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, □-oxidation, β-oxidation, nitrification and de-nitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Unit V	Toxicology	10 Hours

Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bio concentration – Bioaccumulation, bio magnification, bioassay, bio monitoring, bioleaching.

	Total:	45 Hours

Further Reading

Identification and culturing of microorganisms from different sources

Course Outcomes:

After completion of the course, Student will be able to

6. The candidate at the end of the course will have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.
7. The candidate would be able to understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
8. The candidate would have understood the role microbial metabolism in a wastewater treatment plant.
9. The candidate would know the role of microorganisms in contaminated water and the

	10. The candidate has the ability to conduct and test the toxicity due to various natural and synthetic products in the environment.

References:

8. S.C.Bhatia, Hand Book of Environmental Microbiology, Part 1 and 2, Atlantic Publisher
9. Gabriel Bitton, Wastewater Microbiology, 2nd Edition ,
10. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, Environmental Microbiology, Academic Press.
11. SVS. Rana, Essentials of Ecology and Environmental Science, 3rd Edition, Prentice Hall of India Private Limited
12. Stanley E. Manahan, Environmental Science and Technology, Lewis Publishers.
13. Hurst, C.J. (2002) Manual of Environmental Microbiology. 2nd Ed. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 - X.
14. Frank C. Lu and Sam Kacew, LU‟s Basic Toxicology, Taylor & Francis, London (4th Ed), 2002

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17EV104		TRANSPORT OF WATER AND WASTEWATER	L	T	P	C
			3	0	0	3

Course Objectives:

3. To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain
4. To educate the students in computer application on design.

Unit I	General Hydraulics and Flow Measurement	8 Hours

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

Unit II	Water Transmission and Distribution	10 Hours

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

Unit III	Wastewater Collection and Conveyance	10 Hours

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

Unit IV	Storm Water Drainage	7 Hours

Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods.

Unit V	Case Studies and Software Applications	10 Hours

Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

	Total:	45 Hours

Further Reading

Designing of pipelines and sewers for various project areas

Course Outcomes:

After completion of the course, Student will be able to

6. Understand the fluid flow properties
7. Design water supply main, distribution network and sewer for various field conditions
8. Design the drainage network for wastewater
9. Design the storm water drainage systems
10. Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

17EV105		PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

3. To educate the students on the principles and process designs of various treatment systems for water and wastewater
4. To educate the students on design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I	Introduction	5 Hours

Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physio-chemical treatment – Selection criteria-types of reactors- reactor selection-batch- continuous type-kinetics.

Unit II	Treatment Principles	10 Hours

Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra-filtration and hyper filtration electro dialysis, distillation – stripping and crystallization – Recent Advances. Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends

Unit III	Design of Municipal Water Treatment Plants	10 Hours

Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit IV	Design of Industrial Water Treatment Plants	10Hours

Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit V	Design of Wastewater Treatment Plants	10 Hours

Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks- sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers- floatation units-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.

Total:	45 Hours

Further Reading

Implementation of advanced treatment technologies for various wastewater treatment

Course Outcomes:

After completion of the course, Student will be able to

6. Identify the pollutants type in the wastewater
7. Understand the various treatment principles
8. Design the sewage treatment plants
9. Design suitable treatment units for various industries
10. Develop conceptual schematics required for the treatment of wastewater

17EV106		ENVIRONMENTAL CHEMISTRY LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

3. To train in the analysis of physical parameters of water and waste water
4. To train in the analysis of chemical parameters of water and waste water

List of Experiments:

6. Good Laboratory Practices, Quality control, calibration of Glassware 03
7. Sampling and Analysis of water (pH, alkalinity, hardness chloride, Sulphate, turbidity EC, TDS, nitrate, fluoride) 12
8. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals). 12
9. Sampling and analysis of air pollutants Ambient & Stack (RSPM, SO2 and NOx) 09
10. Sampling and characterization of soil (CEC & SAR, pH and K). 09

	Total :	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

3. assess quality of environment
4. conduct analysis on characteristics of water and waste water

References:

6. APHA, Standard Methods for the Examination of Water and Wastewater, 21st Ed.
7. Washington, 2005.
8. Laboratory Manual for the Examination of water, wastewater soil Rump, H.H. and Krist, H.
9. Second Edition, VCH, Germany, 1992.
10. Methods of air sampling & analysis, James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

17EV107		ENVIRONMENTAL MICROBIOLOGY LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

1. To train in the analysis of physical parameters of water and waste water
2. To train in the analysis of chemical parameters of water and waste water

List of Experiments:

1. Preparation of culture media
2. Isolation, culturing and Identification of Microorganisms
3. Microorganisms from polluted habitats (soil, water and air)
4. Measurement of growth of microorganisms, Assay of enzymes involved in biotransformation
5. Biodegradation of organic matter in waste water Analysis of air borne microorganisms
6. Staining of bacteria
7. Effect of pH, temperature on microbial growth
8. Pollutant removal using microbes from industrial effluent.
9. Effect of pesticides on soil microorganisms
10. Bacteriological analysis of wastewater (Coliforms, E.coli, Streptococcus) – MPN
11. Bacteriological analysis of wastewater (Coliforms, Streptococcus) - MF techniques
12. Effect of Heavy metals on microbial growth

13. Detection of Anaerobic bacteria (Clostridium sp.)		
14. Bioreactors		
	Total :	**45 Hours**

Course Outcomes:	
	After completion of the course, Student will be able to
	1. Field oriented testing of water, wastewater and solid waste for microbial contamination.
	2. Perform toxicity test.

References:

1. Standard methods for the examination of water and wastewater, American Public Health Association (21st edition) 2005.
2. Charles Gerba, Environmental Microbiology: A laboratory manual, Elsevier Publications, 2012.
3. Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, and Linda D. Stetzenbach, Manual of Environmental Microbiology, 3rd Edition, ASM Press, 2007.

17EV201		PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I	Introduction	10 Hours

Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth - Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process- reactors-batch-continuous type.

Unit II	Aerobic Treatment of Wastewater	10 Hours

Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfection – disposal options – reclamation and reuse – Flow charts, layout, PID, hydraulic profile, recent trends.

Unit III	Anaerobic Treatment of Wastewater	10 Hours

Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal – Nutrient removal systems – Flow chart, Layout and Hydraulic profile – Recent trends.

Unit IV	Sludge Treatment and Disposal	5 Hours

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

Unit V	Construction Operations and Maintenance Aspects	10 Hours

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and controlling of plant operations – capacity building - Retrofitting Case studies – sewage treatment plants – sludge management facilities.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

3. Develop conceptual schematics required for biological treatment of wastewater
4. Translate pertinent criteria into system requirements.

References:

5. Arceivala, S.J., Wastewater Treatment for Pollution Control, TMH, New Delhi, Second Edition, 2000.
6. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
7. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
8. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations, CRC Press, New York (2009).

17EV202		AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
			3	0	0	3

Course Objectives:	
	To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends

Unit I	Introduction	7 Hours

Structure and composition of Atmosphere – Sources and classification of air pollutants - Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects on the planet – Global Climate Change, Ozone Holes – Ambient Air Quality and Emission Standards – Air Pollution Indices – Emission Inventories – Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants.

Unit II	Air Pollution Modelling	5 Hours

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques - Air Pollution Climatology.

Unit III	Control Of Particulate Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators (cyclone) , Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

Unit IV	Control of Gaseous Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

Unit V	Indoor Air Quality Management	11 Hours

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control – Membrane process - UV photolysis – Internal Combustion Engines - Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

	Total:	45 Hours

Course Outcomes:	
	After completion of the course, Student will be able to
	4. Apply sampling techniques
	5. Apply modelling techniques
	6. Suggest suitable air pollution prevention equipment's and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards

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17EV203		INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.

Unit I **Introduction** **8 Hours**

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

Unit II **Industrial Pollution Prevention & Waste Minimisation** **8 Hours**

Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

Unit III **Industrial Wastewater Treatment** **10 Hours**

Flow and Load Equalization – Solids Separation – Removal of Fats, Oil & Grease- Neutralization – Removal of Inorganic Constituents – Precipitation, Heavy metal removal , Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis& Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.

Unit IV **Wastewater Reuse and Residual Management** **9 Hours**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

Unit V **Case Studies** **10 Hours**

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

5. Define the Principles of pollution prevention and mechanism of oxidation processes.
6. Suggest the suitable technologies for the treatment of wastewater.
7. Discuss about the wastewater characteristics
8. Design the treatment systems

17EV204		SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment.

Unit I **Sources, Classification and Regulatory Framework** **9 Hours**

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.

Unit II **Waste Characterization and Source Reduction** **8 Hours**

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

Unit III **Storage, Collection and Transport Of Wastes** **9 Hours**

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

Unit IV **Waste Processing Technologies** **10 Hours**

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

Unit V **Waste Disposal** **9 Hours**

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

4. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
5. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste
6. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges

17EV205		ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
			3	0	0	3

Course Objectives:

3. To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
4. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

Unit I	Introduction	8 Hours

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA.

Unit II	Impact Identification and Prediction	10 Hours

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment.

Unit III	Social Impact Assessment and EIA Documentation	8 Hours

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	Environmental Management Plan	7 Hours

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	Environmental Risk Assessment and Management	12 Hours

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipathway exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

3. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
4. Know about the legal requirements of Environmental and Risk Assessment for projects.

17EV206		UNIT OPERATIONS AND PROCESSES LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

3. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.
4. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.

List of Experiments:

11. Coagulation and Flocculation
12. Batch studies on settling
13. Studies on Filtration- Characteristics of Filter media
14. Water softening
15. Adsorption studies/Kinetics
16. Reverse Osmosis- Silt Density Index
17. Kinetics of suspended growth process (activated sludge process)- Sludge volume Index
18. Anaerobic Reactor systems / kinetics (Demonstration)
19. Advanced Oxidation Processes – (Ozonation, Photocatalysis)
20. Disinfection for Drinking water

	Total :	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

3. Conduct treatability studies for water and waste water treatment.
4. Design laboratory models for various unit operations and processes.

References:

5. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
6. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
7. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
8. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.

17EV001		AIR POLLUTION METEOROLOGY AND MODELING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I **Atmospheric Pollution** **9 Hours**

Atmospheric Pollution, type of pollutants, gaseous and particulate pollutants, size of atmospheric particles, emission inventory, various sources of emissions, bio-mass burning, pollution formation in combustion, Visibility and Acid Deposition Industrial pollution.

Unit II **Meteorology** **9 Hours**

Air pollution meteorology: sources of air pollution, methods for air pollution measurement and control, meteorological factors that contribute to air quality degradation, basic chemistry of the atmosphere and how it contributes to secondary pollutant formation. Effect of air pollution on Human health, material and vegetation, Deposition of particulate pollutants in the respiratory system.

Unit III **Transport Models** **9 Hours**

Atmospheric chemical transport models, box models, three-dimensional atmospheric chemical transport models, components of air quality forecasting and modelling, evaluation and validation, air quality standards and index, long range transport of pollutants. Back trajectory construction and applications

Unit IV **Dispersion Models** **9 Hours**

Transport and dispersion of air pollutants - wind velocity, wind speed and turbulence; estimating concentrations from point sources - the Gaussian Equation - atmospheric stability - Air pollution modelling and prediction - Plume rise, modelling techniques.

Unit V **Software Modelling** **9 Hours**

Exposure to computer models for air quality.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Know the causes of climate change
2. Know the effects of climate change on various environments and various models.

References:

1. Rao.M.N. &RaoH.V.N., "Air Pollution", Tata McGraw Hill,2006.
2. Richard W.Boubel, Donald L. Fox, D.Bruce Turner& Arthur C. Stern, "Fundamentals of Air Pollution, Hardcover", 2007.
3. Kenneth Wark, Cecil F. Warn,"Air pollution its origin and control", 2007.
4. StevenC.Chapra, "Surface Water quality modeling", The McGraw-Hill- Companies Inc., New York, 1997.

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17EV002		CLIMATE CHANGE AND MODELING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I	Climate Change and Climate Variability	9 Hours

Introduction – Atmosphere - weather and Climate - climate parameters (Temperature ,Rainfall, Humidity, Wind etc) – Equations governing the atmosphere - Numerical Weather Prediction Models - Introduction to GCMs - Application in Climate Change Projections.

Unit II	IPCC SRES Scenarios	9 Hours

Intergovernmental Panel on Climate Change (IPCC) - An Overview - Key Assumptions - Scenario Family - Storyline (A1, B1, A2, B2).

Unit III	Global Climate MODEL (GCM) and Regional Climate Model (RCM)	9 Hours

Some typical GCMs (HadCM3Q-UK Met Office) - Issues with GCMs - Introduction to RCMs and LAMs - some typical RCMs like PRECIS, Sim CLIM, MAGICC/SCENGENE - Advantages and Disadvantages of GCMs and RCMs.

Unit IV	Downscaling Global Climate Model - An Overview	9 Hours

Need for downscaling - Selection of GCMs for regional climate change studies - Ensemble theory – Selection of - Ensembles, Model Domain (Spatial domain and temporal domain), Resolution and climate variables - Lateral boundary conditions - Methods of downscaling (Statistical and Dynamical) - examples from each and their limitations.

Unit V	Analysis /Post Processing	9 Hours

a. Model validation - post processing – Introduction to Analysis tools - Ferret, R, Grads, IDL, SPSS, ArcGIS

b. Climate change Impact - Vulnerability assessment – adaptation strategies.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1.Know the causes of climate change

2.Know the effects of climate change on various environments and various models.

References:

1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK.
2. McGuffie, K. and Henderson-Sellers, A. "A Climate Modelling Primer, Third Edition, John Wiley & Sons, Ltd, Chichester, UK. ,2005
3. Neelin David J, "Climate Change and Climate Modelling", Cambridge University Press
4. Thomas Stocker, "Introduction to Climate Modelling", Advances in Geophysical and Environmental Mechanics and Mathematics. Springer Publication.

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17EV005		ENVIRONMENTAL POLICIES AND LEGISLATION	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.

Unit I **Introduction** **9 Hours**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration– Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework(SPCB/CPCB/MoEF)

Unit II **Water (P&CP) Act, 1974** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit III **Air (P&CP) Act, 1981** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation

Unit IV **Environment (Protection) Act 1986** **13 Hours**

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

Unit V **Other Topics** **7 Hours**

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

3. Know the National environmental legislations and the policies
4. plan programmes to comply with the legal requirements related to organizations

17EV008		MEMBRANE TECHNOLOGIES FOR WATER AND WASTE WATER TREATMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the concept and principles of membrane separation and its applications in water and wastewater treatment.

Unit I **Membrane Filtration Processes** **10 Hours**

Solid Liquid separation systems- Theory of Membrane separation – mass Transport Characteristics- Cross Flow filtration - Membrane Filtration- Flux and Pressure drop -Types and choice of membranes, porous, non-porous, symmetric and asymmetric – Plate and Frame, spiral wound and hollow fibre membranes – Liquid Membranes

Unit II **Membrane Systems** **10 Hours**

Microfiltration principles and applications – Ultra filtration principles and applications - Nano Filtration principles and applications – Reverse Osmosis: Theory and design of modules, assembly, plant process control and applications – Electro dialysis : Ion exchange membranes, process design- Pervaporation – Liquid membrane – Liquid Pertraction – Supported Liquid Membrane and Emulsion Liquid membrane - Membrane manufactures – Membrane Module/Element designs – Membrane System components – Design of Membrane systems - pump types and Pump selection– Plant operations – Economics of Membrane systems

Unit III **Membrane Bioreactors** **9 Hours**

Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations, Commercial Technologies, Case Studies.

Unit IV **Pretreatment Systems** **8 Hours**

Membrane Fouling – Control of Fouling and Concentration Polarisation-Pretreatment methods and strategies – monitoring of Pretreatment – Langlier Index, Silt Density Index, Chemical cleaning , Biofoulant control.

Unit V **Case Studies** **8 Hours**

Case studies on the design of membrane-based water and wastewater treatment systems – zero Liquid effluent discharge Plants – Desalination of brackish water.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be

1. familiar with main membrane processes, principles, separation mechanisms, and applications
2. understand the selection criteria for different membrane processes
3. know the principle of the most common membrane applications
4. Carry out design of project for a particular membrane technology application.

17EV009		REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

1. To educate the students on aspects of Remote Sensing
2. Develop the different remote sensing technique
3. To educate the students on aspects of GIS and data management
4. Develop the GIS Applications for monitoring and management of environment

Unit I	**Remote Sensing Elements**	**8 Hours**

Historical Perspective, Principles of remote sensing, components of Remote Sensing, Energy source and electromagnetic radiation, Electromagnetic spectrum, Energy interaction, Spectral response pattern of earth surface features, Energy recording technology.

Unit II	**Remote Sensing Technology**	**9 Hours**

Classification of Remote Sensing Systems, Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR

Unit III	**Social Impact Assessment and EIA Documentation**	**9 Hours**

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	**Environmental Management Plan**	**10 Hours**

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	**Environmental Risk Assessment and Management**	**9 Hours**

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
2. Know about the legal requirements of Environmental and Risk Assessment for projects.

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BE CIVIL ENGINEERING

1902CE401	BUILDING MATERIALS AND MANAGEMENT	L	T	P	C
		3	0	0	3

UNIT I	BUILDING MATERIALS	9 Hours

Lime, Brick, Timber and its Products, Floor and Wall Tiles, Pozzolanas, Ferrous metals, Thermal Insulation Material. Finishing Materials: Glass, Timber, Aluminum, Plastics, Paints, Varnishes, Distemper, Waterproofing and Damp Proofing Materials, Ferrocement and its application, Fabre textiles – Geo membranes and Geotextiles for earth reinforcement.

UNIT II	BUILDING COMPONENTS	9 Hours

Partition wall and Cavity wall, Composite Masonry, Doors, Windows, Ventilators, Stairs, Lift, Ramps, Escalators, Anti Termite Treatment, Brick masonry- Bond- Jointing-Stone masonry
Temporary building structures - Site Clearance - Marking –Earthwork, Slip and moving forms, scaffolding, Plumbing and Sanitation, Fire Protection, Introduction to Building Maintenance, Acoustics and Sound Insulation.

UNIT III	SUB STRUCTURE AND SUPERSTRUCTURE TECHNIQUES	9 Hours

Techniques of box jacking- pipe jacking- under water construction of diaphragm walls and basement Tunneling techniques, caisson -sinking cofferdam, Dewatering and stand by plant equipment for underground open excavation, Launching girders, bridge decks, off shore platforms, braced domes and space decks.

UNIT IV	CONSTRUCTION EQUIPMENTS	9 Hours

Selection of equipment for earth work - types of earthwork equipment, Equipment for material handling and erection of structures, Equipment for dredging, trenching, tunneling, Equipment for compaction, batching and mixing and concreting, Equipment for foundation and pile driving.

UNIT V	MANAGEMENT	9 Hours

Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management.

	Total:	45 Hours

COURSE OUTCOMES:

11. Summarize the most common and advanced materials used for construction.
12. Illustrate the construction process of various building components.
13. Explain the various construction methods and techniques involved in sub structure and super structure.
14. Choose the appropriate modern construction tools and equipment in various construction activities.
15. Choose the appropriate method of management for materials.

REFERENCES:

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2012.
2. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3. Gambhir.M.L., "Concrete Technology", 3rd Edition, Tata McGraw Hill Education, 2004
4. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.
5. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
6. Gambhir. M.L., &NehaJamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.

1902CE505		ENVIRONMENTAL ENGINEEERING	L	T	P	C
			3	0	0	3

Course Objectives:

13. To examine the water supply system and conveyance system.
14. To create an ability to evaluate the water treatment and advanced water treatment system.
15. To train the students to analyze water distribution system and supply to buildings.
16. To understand the importance of planning and design of sewerage system.
17. To create an ability to design the waste water treatment system.
18. To impart the signification of disposal of Sewage.

Unit I **WATER SUPPLY SYSTEMS – SOURCE AND CONVEYANCE** **9 Hours**

Objectives – Population forecasting – Design period – Water demand –Sources of water – Source selection – Water quality parameters and significance –Standards – Intake structures – Conveyance – Hydraulics – Laying, jointing and testing of pipes – Pump selection –Appurtenances.

Unit II **DESIGN PRINCIPLES OF WATER TREATMENT** **9 Hours**

Objectives – Selection of unit operations and processes – Principles of flocculation, sedimentation, filtration, disinfection – Design principles of flash mixer, flocculator, clarifiers, filters – Disinfection devices – Softening – Demineralization – Aeration – Iron removal – Defluoridation – Operation and maintenance aspects – Residue management.

Unit III **DISTRIBUTION** **9 Hours**

Requirements of water distribution -Components -Service reservoirs -Functions and drawings -Network design - Analysis of distribution networks – Hardy cross method – Equivalent pipe method - Pipe Appurtenances -operation and maintenance -Leak detection, Methods. House service connection - Systems of plumbing.

Unit IV **SEWERAGE SYSTEM, COLLECTION AND TRANSMISSION** **9 Hours**

Sources of wastewater – Quantity of sanitary sewage – Storm runoff estimation – Wastewater characteristics and significance – Effluent disposal stand over – Design of sewers – Computer applications – Laying, jointing and testing of sewers – Sewer appurtenances – Pump selection.

Unit V **SEWAGE TREATMENT AND DISPOSAL** **9 Hours**

Objectives – Selection of unit operation and process – Design principles of primary and secondary treatment, screen chamber, grit chamber, primary sedimentation tanks, activated sludge process – Aeration tank and oxidation ditch – Trickling filter –Stabilization ponds – Septic tanks with soak pits – Sludge: treatment and disposal –Biogas recovery – Sewage farming.

Disposal on land – Disposal into water bodies – Oxygen sag curve – Streeter Phelp's model – Wastewater reclamation techniques.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

11. Design the components of the transmission main for the water conveyance
12. Design the water treatment units based on its principles and functions
13. Extend the water distribution to the individual buildings
14. Build a sewerage system by flow estimation and designing suitable size of sewers
15. Design the treatment units for the treatment of waste water based on the quality and quantity.

References:

Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2003.

Punmia, B.C., Jain, A.K., and Jain.A., Environmental Engineering, Vol.II, Lakshmi Publications, Newsletter, 2005

Manual on Sewerage and Sewage Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1997.

Government of India, "Manual on Water Supply and Treatment", CPHEEO, Ministry of Urban Development, New Delhi, 2003

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1902CE552		ENVIRONMENTAL ENGINEERING LAB	L	T	P	C
			0	0	2	1

Course Objectives:	
	1. To know the basics, importance of water and wastewater treatment and methods measurement.
	2. Tostudythe various effects of water and waste water pollution.
	3.Effect of BOD and COD
	4.To find Calcium, Potassium and Sodium
	5.Heavy metal effects and finding methods
List of experiments	
21. Measurement of pH, Electrical conductivity and turbidity	
22. Determination of Calcium, Potassium and Sodium	
23. Determination of Phosphate and Sulphate	
24. Determination of Optimum Coagulant Dosage by Jar test apparatus	
25. Determination of available Chlorine in Bleaching powder and residual chlorine in water	
26. Determination of Ammonia Nitrogen	
27. Estimation of suspended, volatile and fixed solids	
28. Determination of Dissolved Oxygen	
29. Estimation of B.O.D	
30. Estimation of C.O. D	
Total:	**45 Hours**
Course Outcomes:	
	After completion of the course, Student will be able to
	1.characterize given water and waste water sample
References:	

1.Standard methods for the examination of water and wastewater, APHA, 20th Edition, Washington, 1998

2. Garg, S.K., "Environmental Engineering Vol. I & II", Khanna Publishers, New Delhi

3. Modi, P.N., "Environmental Engineering Vol. I & II", Standard Book House, Delhi-6

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1902CE603		HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the student to the concept of hydrological aspects of water availability andrequirementsand should be able to quantify, control and regulate the water resources.

Unit I	**PRECIPITATION AND ABSTRACTIONS**	**9 Hours**

Hydrological cycle-Meteorological measurements–Requirements, types and forms ofprecipitation-Rain Gauges-Spatial analysis of rainfall data using Thiessen and Isohyetalmethods-Interception-Evaporation. Horton's equation, pan evaporation measurements and evaporationsuppression-Infiltration-Horton's equation-double ring infiltrometer, infiltration indices

Unit II	**RUNOFF**	**9 Hours**

Watershed, catchment and basin-Catchment characteristics-factors affecting runoff-Run offestimation using empirical-Strange"s table and SCS methods–Stage discharge relationshipsflow measurements-Hydrograph–Unit Hydrograph–IUH

Unit III	**FLOOD AND DROUGHT**	**9 Hours**

Natural Disasters-FloodEstimation-Frequency Analysis-Flood Control-Definitions of droughtsMeteorological, hydrological and agricultural droughts-IMD method-NDVI analysis-Drought Prone Area Programme (DPAP)

Unit IV	**RESERVOIRS**	**9 Hours**

Classification of reservoirs, General principles of design, site selection, spillways, elevation–area-capacity-storage estimation, sedimentation-life of reservoirs–rule curve

Unit V	**GROUNDWATER AND MANAGEMENT**	**9Hours**

Origin-Classification and types-properties of aquifers-governing equations–steady andunsteady flow-artificial recharge-RWH in rural and urbanareas

	Total:	**45 Hours**

Further Reading:

5. How to prepare data for GIS and RS
6. Civil engineering application for various fields

Course Outcomes:

After completion of the course, Student will be able to

11. Explainthe key drivers on water resources, hydrological processes andtheir integrated behavior in catchments
12. Make use ofhydrological models to surface water problemsincluding basin characteristics, runoff and Hydrograph
13. Outline the concept of hydrological extremes such as Flood and Droughtand management strategies
14. Describe theimportance of spatial analysis ofrainfall and design waterstorage reservoirs
15. Illustrate theconcepts of groundwater for water resources management

References:

Subramanya .K. "Engineering Hydrology"-Tata McGraw Hill, 2010

David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007

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1901MGX01		TOTAL QUALITY MANAGEMENT	L	T	P	C
			3	0	0	3
Course Objectives:		To facilitate the understanding of Quality Management principles and process.				
Unit I	INTRODUCTION					**9 Hours**
Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention – Costs of quality.						
Unit II	TQM PRINCIPLES					**9 Hours**
Leadership – Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating						
Unit III	TQM TOOLS AND TECHNIQUES I					**9 Hours**
The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.						
Unit IV	TQM TOOLS AND TECHNIQUES II					**9 Hours**
Control Charts – Process Capability – Concepts of Six Sigma – Quality Function Development (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.						
Unit V	QUALITY SYSTEMS					**9Hours**
Need for ISO 9000 – ISO 9001-2008 Quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors.						
		Total:				**45 Hours**
Further Reading:						
	5. Engineering economics and cost analysis					
	6. Construction and planning management					
Course Outcomes:						
	After completion of the course, Student will be able to					
	11. Understand the concepts, dimension quality and philosophies of TQM.					
	12. Understand the principles of TQM and its strategies.					
	13. Apply seven statistical quality and management tools.					
	14. Understand TQM tools for continuous improvement.					
	15. Understand the QMS and EMS.					

1902CE604		GLOBAL WARMING AND CLIMATE CHANGE	L	T	P	C
			3	0	0	3

Course Objectives:

7. To understand the Earth's Climate System and the concept of Global Warming.
8. To analyze the global warming and their effects due to climate change.
9. To comprehend the impact of climate change on society and its mitigation measures.

Unit I	**INTRODUCTION OF GLOBAL WARMING**	**9 Hours**

Introduction - the gas law - ideal gas equation- the mole concept- sample calculations- ppm - sulphur pollutants-oxides of nitrogen - particulate - Green House Gases.

Unit II	**MITIGATION MEASURE, EMISSION TARGETS AND CARBON TREADING**	**9 Hours**

Introduction-reduction of carbon dioxide emissions from power generation- carbon credits- carbon dioxide from vehicle - miscellaneous source of carbon dioxide- uptake of carbon dioxide by vegetation

Unit III	**OVERVIEW OF CLIMATE VARIABILITY AND CLIMATE SCIENCE**	**9 Hours**

Climate dynamics, climate change and climate prediction - the chemical and physical climate system and aspects - El Nino and global warming - global change in recent history.

Unit IV	**BASICS OF GLOBAL CLIMATE**	**9 Hours**

Components and phenomena in the climate system - basics of radioactive forcing - atmospheric circulation-ocean circulation-land surface processes - the carbon cycle.

Unit V	**PHYSICAL PROCESSES IN THE CLIMATE SYSTEM**	**9 Hours**

Conservation of momentum-equation of state- temperature equation - continuity equation - conservation of mass applied to moisture – saturation - wave processes in the atmosphere and ocean.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Outline the principle involved in the greenhouse gas emission.
2. Explain the carbon emission and its mitigation methods.
3. Illustrate about the climate variability parameters.
4. Describe the climate components and the circulation system.
5. Discuss about the physical processes involved in the climate system.

1903CE033		WATER POLLUTION AND MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:	
	9. To impart knowledge on the importance and necessity of water
	10. To educate about the water pollution and its impact
	11. To impart knowledge on water quality analyzing techniques
	12. To make awareness in monitoring and management of water

Unit I	**WATER RESOURCES**	**9 Hours**
Necessity & properties of water –Water resources of the world and India –National Water Policy– Water cycle– Surface & subsurface sources –Water Quality Parameters – Standards.		
Unit II	**WATER POLLUTION**	**9 Hours**
Sources – Classification, nature andToxicology of water pollutants –Ground water pollution–Ocean Pollution by toxic wastes– River pollution-A case study		
Unit III	**EFFECTS OF WATER POLLUTION**	**9 Hours**
Effects of waterpollutants on Human health– Ecologicaland Economic impacts of water pollution–Marine oilpollution and its impacts.		
Unit IV	**ANALYSIS & INSTRUMENTATION**	**9 Hours**
Analysis of Pollutants: Titrimetry – Gravimetry – Spectrophotometry – Chromatographyand Flame techniques.Instrumentation: Principles and Applications of UV– VIS Spectrophotometer – Flame Photometer – Atomic Absorption Spectrophotometer –Gas Chromatography – GLC – HPLC		
Unit V	**MONITORING & MANAGEMENT**	**9 Hours**
Water quality monitoring–Water (Prevention and Pollution Control) act 1974 – Pollution control devices – Polluters pay principle.		
	Total:	**45 Hours**

Further Reading:	
	5. Water supply engineering
	6. Waste water engineering

Course Outcomes:	
	After completion of the course, Student will be able to
	11. Illustrate about the sources of water and the quality standards
	12. Classify the nature of pollutants and its source
	13. Outline the effects of water pollution on biodiversity
	14. Select the suitable analysis technique for the water quality parameter estimation
	15. Select the accurate monitoring and management methods

References:

7. Laurent Hodges – Environmental Pollution
8. Willard, Merritt and Dean – Instrumental Analysis
9. APHA – Analysis of Water and Waste Water

1901HS002	INTELLECTUAL PROPERTY RIGHTS FOR ENGINEERS	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art or engineering. This course covers the fundamental aspects of intellectual property (IP): copyright and related rights, trademarks, patents, geographical indications, and industrial designs. It also covers contemporary issues impacting the IP field such as: new plant varieties, unfair competition, enforcement of IP rights and emerging issues in IP.

COURSE OBJECTIVES:

5. A foundation in the basic conceptsof IP
6. Better understanding of therelationship between IP and otherpolicy areas such as health, climatechange, traditional knowledge andemerging technologies

Module I	Introduction	9 Hours

Overview of IP, Copyright, Trademarks, Geographical Indicators, Industrial Designs, Patents, Unfair competition, Enforcement of IP Rights, Emerging Issues in IP & IP Management

Module II	Copyrights &Trademarks	6 Hours

The concept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, Formats & Filing Procedures

Module III	Geographical Indicators & Industrial Designs	6 Hours

The concept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, Formats& Filing Procedures

Module IV	Patents	15 Hours

The Macro-Economic Impact of the Patent System, The Patent Application Process, The Different Layers of the International Patent System and Regional Patent Protection Mechanisms, Kinds of Intellectual Property Protection Based on Types of Inventions, Legal Issues of the Patenting Process, Enforcement, New Issues, Important Cases and Discussions, IP and Development - Flexibilities and Public Domain under Patents, Patent Search

Module V	Patent Cooperation Treaty	9 Hours

What is PCT? Use of PCT, Preparing a PCT Application, PCT Services, Patent Agent and Common Representatives, International Search, International Examination

TOTAL: 45 HOURS

Course Outcomes:

11. Explain various types of IPRs specific to Engineering
12. Explain concepts such as Copyrights, Trademarks, GIs and Industrial designs
13. Explain basic concepts of Engineering Patents
14. Explain concept of Patent Search and various methods to do it
15. Develop a sample PCT Application and explain examination procedures

FURTHER READING:

5. Intellectual Property Rights by PandeyNeeraj&DharniKhushdeep, 2014
6. Fundamentals of IPR: for students, Industrialist and patent lawyers, Ramakrishna B & Anil Kumar HS, 2017Drucker

REFERENCES:

1. Law relating to IPR by Dr MK Bandarai, Central Law Publication, 2014
2.Introduction to Intellectual Property Rights, H.S. Chawla, Oxfors& IBH Publishing, 2020
3. Introduction to IPR by JP Mishra, Central Law Publications
4. https://patents.google.comIntroduction to IPR books

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1901HS006	DESIGN THINKING FOR INNOVATION	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art, engineering, or prototyping. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions

COURSE OBJECTIVES:

13. Understand how teaching and learning occurs in the design process
14. Recognize the ethical and social dilemmas and obligations of the practice of design
15. Diagnose common adoption barriers in individuals, groups and organizations.
16. Develop a design theory from independent and qualitative research and observations
17. Participate in and lead innovation in creative and collaborative settings
18. Undertake complex and unstructured problem-solving challenges in unfamiliar domains

Module I	**Introduction to Design Thinking**	**8 Hours**

Human Centered Design, Why Design Thinking, 5-Step Design Thinking Process, Applications, Creative Confidence, The culture of Innovation

Module II	**Design Thinking Approach**	**12 Hours**

IDEO's method of Design Thinking, Divergent Thinking & Innovation Funnel, Customer Journey Maps to uncover Innovation Opportunities, Case Study : Turing Creative Ideas into Viable Companies

Module III	**Exploring Design Thinking ToolKit**	**5 Hours**

Discovery, Interpretation, Ideation, Experimentation, Evolution

Module IV	**Design Challenge Project: Phase-1**	**5 Hours**

Define a Challenge, Project Plan, How Might We statement, Project Timeline, Project Checklist

Module V	**Design Challenge Project: Phase-2**	**15 Hours**

Discovery – Understand the Challenge, Prepare Research, Gather Inspiration, Interpretation – Tell Stories, Search for meaning, Frame Opportunities, Ideation – Generate Ideas, Refine Ideas, Experimentation – Make Prototypes, Get Feedback, Evolution – Track Learnings, Engage Others

TOTAL: 45 HOURS

Course Outcomes:

1. Describe Key Concepts and basics of Design Thinking Principles
2. Elaborate the Design Thinking Approach through IDEO's method & Customer Journey Maps
3. Conduct user interviews and synthesize learnings to uncover insights and identify opportunities for innovation
4. Develop Design Driven Innovative Solutions to RealWorld Problems

FURTHER READING:

1.Design for Social Impact: How to by IDEO.org
2.Design Thinking ToolKit by IDEO.org
3.The Field guide to Human Centered Design by IDEO.org

REFERENCES:

1.Creative Confidence: Unleashing the Creative Potential Within Us AllBook by David M. Kelley and Tom Kelley, 2013

2.Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Book by Tim Brown, 2009

E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

NAGAPATTINAM – 611 002. TAMILNADU, INDIA

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1901MGX07		UNIVERSAL HUMAN VALUES & ETHICS	L	T	P	C
			3	0	0	3

Course Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Unit I	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**	**9 Hours**

Understanding the need, basic guidelines, content and process for Value Education-Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration - Continuous Happiness and Prosperity- A look at basic Human Aspirations - Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being withtheir correct priority - Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario - Method to fulfill the above human aspirations: understanding and living in harmony at various levels

Unit II	**Understanding Harmony in the Human Being - Harmony in Myself**	**9 Hours**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body' - Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha - Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) - Understanding the characteristics and activities of 'I' and harmony in 'I' - Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail - Programs to ensure Sanyam and Swasthya

Unit III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**	**10 Hours**

Understanding harmony in the Family- the basic unit of human interaction - Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship - Understanding the meaning of *Vishwas*; Difference between intention and competence - Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals - Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!

Unit IV	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**	**9 Hours**

Understanding the harmony in the Nature - Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature - Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space - Holistic perception of harmony at all levels of existence

Unit V	**Implications of the above Holistic Understanding of Harmony**	**8 Hours**

Natural acceptance of human values - Definitiveness of Ethical Human Conduct - Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order - Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, - b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models - Case studies of typical holistic technologies, management models and production systems - Strategy for transition from the present state to Universal Human Order:a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers - b) At the level of society: as mutually enriching institutions and organizations		
	Total:	**45 Hours**
Further Proceeding:		
	3. Analysis about Code of Conduct for Ethical & Moral values	
Course Outcomes:		
	After completion of the course, Student will be able to	
	1. Understand the significance of value inputs in a classroom and start applying them in their life and profession	
	2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.	
	3. Understand the value of harmonious relationship based on trust and respect in their life and profession	
	4. Understand the role of a human being in ensuring harmony in society and nature.	
	5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	
References:		
1. A Nagraj, 1998, JeevanVidyaEkParichay, Divya Path Sansthan, Amarkantak.		
2. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.		
3. A N Tripathy, 2003, Human Values, New Age International Publishers.		
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA		

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1902CE019	COASTAL ZONE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:	At the end of the semester, 1.The student shall be able to understand the coastal processes
	2.The student shall be able to understand the coastal dynamics
	3.The student shall be able to understand impacts of structures like docks, harbors and quays leading to simple management perspectives along the coastal zone

Unit I	**COASTAL ZONE**	**9 Hours**
Coastal zone – Coastal zone regulations – Beach profile – Surf zone – Off shore – Coastal waters – Estuaries – Wet lands and Lagoons – Living resources – Nonliving resources.		
Unit II	**WAVE DYNAMICS**	**9 Hours**
Wave classification – Airy's Linear Wave theory – Deep water waves – Shallow water waves – Wave pressure – Wave energy – Wave Decay – Reflection, Refraction and Diffraction of waves – Breaking of waves – Wave force on structures – Vertical – Sloping and stepped barriers – Force on piles.		
Unit III	**WAVE FORECASTING AND TIDES**	**9 Hours**
Need for forecasting – SMB and PNJ methods of wave forecasting – Classification of tides – Darwin's equilibrium theory of tides – Effects on structures – seiches, Surges and Tsunamis.		
Unit IV	**COASTAL PROCESSES**	**9 Hours**
Erosion and depositional shore features – Methods of protection – Littoral currents – Coastal aquifers – Sea water intrusion – Impact of sewage disposal in seas.		
Unit V	**HARBOURS**	**9 Hours**
Structures near coast – Selection of site – Types and selection of break waters – Need and mode of dredging – Selection of dredgers – Effect of Mangalore Forest.		
	Total:	**45 Hours**

Further Reading:	
	1.Richard Sylvester, "Coastal Engineering, Volume I and II", Elseiner Scientific Publishing Co., 1999
	2.Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw Hill Book Co., 1999
Course Outcomes:	
	After completion of the course, Student will be able to
	11. Describe the Coastal zone regulations,
	12. Describe the coastal processes
	13. Explain the wave dynamics and forecast waves
	14. Understand the erosion and depositional shore protection
	15. Plan the coastal structures including harbours and tides

References:

1.Ed. A.T. Ippen, "Coastline Hydrodynamics", McGraw-Hill Inc., New York, 1993

2.Dwivedi, S.N., Natarajan, R and Ramachandran, S.,"Coastal Zone Management in Tamilnadu", Madras, 199

3.Richard Sylvester, "Coastal Engineering, Volume I and II", Elseiner Scientific Publishing Co., 1999

4.Quinn, A.D., "Design & Construction of Ports and Marine Structures", McGraw Hill Book Co., 1999

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ME ENVIRONMENTAL ENGINEERING

17EV102		ENVIRONMENTAL CHEMISTRY	L	T	P	C
			3	0	0	3

Course Objectives:

7. To educate the students about water chemistry
8. To impart knowledge in the area of air and soil chemistry
9. To impart knowledge on the transformation of chemicals in the environment

Unit I	Introduction	9 Hours

Stoichiometry and mass balance-Chemical equilibrium, acid base, solubility product (Ksp), heavy metal precipitation, amphoteric hydroxides, CO2 solubility in water and species distribution – Chemical kinetics, First order- 12 Principles of green chemistry.

Unit II	Aquatic Chemistry	11 Hours

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation – Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction, pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation.

Unit III	Atmospheric Chemistry	7 Hours

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, CO_2 capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination.

Unit IV	Soil Chemistry	9 Hours

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

Unit V	Environmental Chemicals	9 Hours

Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins,PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.

Total:	45 Hours

Further Reading

To analyze and create a solution for environmental issues.

Course Outcomes:

After completion of the course, Student will be able to

11. Distinguish the chemistry involved
12. Understand the chemistry involved in water
13. Identify and solve the air pollution related issues
14. Understand the soil related chemistry and issues
15. Identify contaminating chemicals and can work out chemicals need calculations for treatment purpose

17EV103		ENVIRONMENTAL MICROBIOLOGY	L	T	P	C
			3	0	0	3

Course Objectives:

11. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
12. The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.
13. The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease-causing organisms are also covered.
14. An exposure to toxicology due to industrial products and byproducts are also covered.
15. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.

Unit I	Classification And Characteristics	5 Hours

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

Unit II	Microbes And Nutrient Cycles	10 Hours

Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaebacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Micro Organism in nutrient cycle.

Unit III	Metabolism of Microorganisms	10 Hours

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb"s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

Unit IV	Pathogens in Wastewater	10 Hours

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Indicator organisms of water – Coliforms - total coliforms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, □-oxidation, β-oxidation, nitrification and de-nitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Unit V	Toxicology	10 Hours

Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bio concentration – Bioaccumulation, bio magnification, bioassay, bio monitoring, bioleaching.

	Total:	45 Hours

Further Reading

Identification and culturing of microorganisms from different sources

Course Outcomes:

After completion of the course, Student will be able to

11. The candidate at the end of the course will have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.
12. The candidate would be able to understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
13. The candidate would have understood the role microbial metabolism in a wastewater treatment plant.
14. The candidate would know the role of microorganisms in contaminated water and the

	15. The candidate has the ability to conduct and test the toxicity due to various natural and synthetic products in the environment.

References:

15. S.C.Bhatia, Hand Book of Environmental Microbiology, Part 1 and 2, Atlantic Publisher
16. Gabriel Bitton, Wastewater Microbiology, 2nd Edition ,
17. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, Environmental Microbiology, Academic Press.
18. SVS. Rana, Essentials of Ecology and Environmental Science, 3rd Edition, Prentice Hall of India Private Limited
19. Stanley E. Manahan, Environmental Science and Technology, Lewis Publishers.
20. Hurst, C.J. (2002) Manual of Environmental Microbiology. 2nd Ed. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 - X.
21. Frank C. Lu and Sam Kacew, LU‟s Basic Toxicology, Taylor & Francis, London (4th Ed), 2002

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17EV104		TRANSPORT OF WATER AND WASTEWATER	L	T	P	C
			3	0	0	3

Course Objectives:

5. To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain
6. To educate the students in computer application on design.

Unit I	General Hydraulics and Flow Measurement	8 Hours

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

Unit II	Water Transmission and Distribution	10 Hours

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

Unit III	Wastewater Collection and Conveyance	10 Hours

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

Unit IV	Storm Water Drainage	7 Hours

Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods.

Unit V	Case Studies and Software Applications	10 Hours

Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

	Total:	45 Hours

Further Reading

Designing of pipelines and sewers for various project areas

Course Outcomes:

After completion of the course, Student will be able to

11. Understand the fluid flow properties
12. Design water supply main, distribution network and sewer for various field conditions
13. Design the drainage network for wastewater
14. Design the storm water drainage systems
15. Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

17EV105		PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

5. To educate the students on the principles and process designs of various treatment systems for water and wastewater
6. To educate the students on design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I	Introduction	5 Hours

Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physio-chemical treatment – Selection criteria-types of reactors- reactor selection-batch- continuous type-kinetics.

Unit II	Treatment Principles	10 Hours

Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra-filtration and hyper filtration electro dialysis, distillation – stripping and crystallization – Recent Advances. Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends

Unit III	Design of Municipal Water Treatment Plants	10 Hours

Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit IV	Design of Industrial Water Treatment Plants	10Hours

Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit V	Design of Wastewater Treatment Plants	10 Hours

Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks- sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers- floatation units-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.

Total:	45 Hours

Further Reading

Implementation of advanced treatment technologies for various wastewater treatment

Course Outcomes:

After completion of the course, Student will be able to

11. Identify the pollutants type in the wastewater
12. Understand the various treatment principles
13. Design the sewage treatment plants
14. Design suitable treatment units for various industries
15. Develop conceptual schematics required for the treatment of wastewater

17EV106		ENVIRONMENTAL CHEMISTRY LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

5. To train in the analysis of physical parameters of water and waste water
6. To train in the analysis of chemical parameters of water and waste water

List of Experiments:

11. Good Laboratory Practices, Quality control, calibration of Glassware 03
12. Sampling and Analysis of water (pH, alkalinity, hardness chloride, Sulphate, turbidity EC, TDS, nitrate, fluoride) 12
13. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals). 12
14. Sampling and analysis of air pollutants Ambient & Stack (RSPM, SO2 and NOx) 09
15. Sampling and characterization of soil (CEC & SAR, pH and K). 09

	Total :	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

5. assess quality of environment
6. conduct analysis on characteristics of water and waste water

References:

11. APHA, Standard Methods for the Examination of Water and Wastewater, 21st Ed.
12. Washington, 2005.
13. Laboratory Manual for the Examination of water, wastewater soil Rump, H.H. and Krist, H.
14. Second Edition, VCH, Germany, 1992.
15. Methods of air sampling & analysis, James P.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

17EV107		ENVIRONMENTAL MICROBIOLOGY LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

3. To train in the analysis of physical parameters of water and waste water
4. To train in the analysis of chemical parameters of water and waste water

List of Experiments:

15. Preparation of culture media
16. Isolation, culturing and Identification of Microorganisms
17. Microorganisms from polluted habitats (soil, water and air)
18. Measurement of growth of microorganisms, Assay of enzymes involved in biotransformation
19. Biodegradation of organic matter in waste water Analysis of air borne microorganisms
20. Staining of bacteria
21. Effect of pH, temperature on microbial growth
22. Pollutant removal using microbes from industrial effluent.
23. Effect of pesticides on soil microorganisms
24. Bacteriological analysis of wastewater (Coliforms, E.coli, Streptococcus) – MPN
25. Bacteriological analysis of wastewater (Coliforms, Streptococcus) - MF techniques
26. Effect of Heavy metals on microbial growth

27. Detection of Anaerobic bacteria (Clostridium sp.)		
28. Bioreactors		
	Total :	**45 Hours**

Course Outcomes:	
	After completion of the course, Student will be able to
	3. Field oriented testing of water, wastewater and solid waste for microbial contamination.
	4. Perform toxicity test.

References:

4. Standard methods for the examination of water and wastewater, American Public Health Association (21st edition) 2005.
5. Charles Gerba, Environmental Microbiology: A laboratory manual, Elsevier Publications, 2012.
6. Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, and Linda D. Stetzenbach, Manual of Environmental Microbiology, 3rd Edition, ASM Press, 2007.

17EV201		PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I **Introduction** **10 Hours**

Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth - Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process- reactors-batch-continuous type.

Unit II **Aerobic Treatment of Wastewater** **10 Hours**

Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfection – disposal options – reclamation and reuse – Flow charts, layout, PID, hydraulic profile, recent trends.

Unit III **Anaerobic Treatment of Wastewater** **10 Hours**

Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal – Nutrient removal systems – Flow chart, Layout and Hydraulic profile – Recent trends.

Unit IV **Sludge Treatment and Disposal** **5 Hours**

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

Unit V **Construction Operations and Maintenance Aspects** **10 Hours**

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and controlling of plant operations – capacity building - Retrofitting Case studies – sewage treatment plants – sludge management facilities.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

5. Develop conceptual schematics required for biological treatment of wastewater
6. Translate pertinent criteria into system requirements.

References:

9. Arceivala, S.J., Wastewater Treatment for Pollution Control, TMH, New Delhi, Second Edition, 2000.
10. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
11. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
12. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations, CRC Press, New York (2009).

17EV202		AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends

Unit I **Introduction** **7 Hours**

Structure and composition of Atmosphere – Sources and classification of air pollutants - Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects on the planet – Global Climate Change, Ozone Holes – Ambient Air Quality and Emission Standards – Air Pollution Indices – Emission Inventories – Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants.

Unit II **Air Pollution Modelling** **5 Hours**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques - Air Pollution Climatology.

Unit III **Control Of Particulate Contaminants** **11 Hours**

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators (cyclone) , Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

Unit IV **Control of Gaseous Contaminants** **11 Hours**

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

Unit V **Indoor Air Quality Management** **11 Hours**

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control – Membrane process - UV photolysis – Internal Combustion Engines - Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

7. Apply sampling techniques
8. Apply modelling techniques
9. Suggest suitable air pollution prevention equipment's and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards

17EV203		INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.

Unit I **Introduction** **8 Hours**

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

Unit II **Industrial Pollution Prevention & Waste Minimisation** **8 Hours**

Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

Unit III **Industrial Wastewater Treatment** **10 Hours**

Flow and Load Equalization – Solids Separation – Removal of Fats, Oil & Grease- Neutralization – Removal of Inorganic Constituents – Precipitation, Heavy metal removal , Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis& Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.

Unit IV **Wastewater Reuse and Residual Management** **9 Hours**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

Unit V **Case Studies** **10 Hours**

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

9. Define the Principles of pollution prevention and mechanism of oxidation processes.
10. Suggest the suitable technologies for the treatment of wastewater.
11. Discuss about the wastewater characteristics
12. Design the treatment systems

17EV204		SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment.

Unit I **Sources, Classification and Regulatory Framework** **9 Hours**

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.

Unit II **Waste Characterization and Source Reduction** **8 Hours**

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

Unit III **Storage, Collection and Transport Of Wastes** **9 Hours**

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

Unit IV **Waste Processing Technologies** **10 Hours**

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

Unit V **Waste Disposal** **9 Hours**

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

7. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
8. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste
9. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges

17EV205		ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
			3	0	0	3

Course Objectives:

5. To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
6. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

Unit I	Introduction	8 Hours

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA.

Unit II	Impact Identification and Prediction	10 Hours

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment.

Unit III	Social Impact Assessment and EIA Documentation	8 Hours

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	Environmental Management Plan	7 Hours

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	Environmental Risk Assessment and Management	12 Hours

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipathway exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

5. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
6. Know about the legal requirements of Environmental and Risk Assessment for projects.

17EV206		UNIT OPERATIONS AND PROCESSES LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

5. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.
6. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.

List of Experiments:

21. Coagulation and Flocculation
22. Batch studies on settling
23. Studies on Filtration- Characteristics of Filter media
24. Water softening
25. Adsorption studies/Kinetics
26. Reverse Osmosis- Silt Density Index
27. Kinetics of suspended growth process (activated sludge process)- Sludge volume Index
28. Anaerobic Reactor systems / kinetics (Demonstration)
29. Advanced Oxidation Processes – (Ozonation, Photocatalysis)
30. Disinfection for Drinking water

Total :	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

5. Conduct treatability studies for water and waste water treatment.
6. Design laboratory models for various unit operations and processes.

References:

9. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
10. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
11. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
12. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.

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17EV001		AIR POLLUTION METEOROLOGY AND MODELING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I **Atmospheric Pollution** **9 Hours**

Atmospheric Pollution, type of pollutants, gaseous and particulate pollutants, size of atmospheric particles, emission inventory, various sources of emissions, bio-mass burning, pollution formation in combustion, Visibility and Acid Deposition Industrial pollution.

Unit II **Meteorology** **9 Hours**

Air pollution meteorology: sources of air pollution, methods for air pollution measurement and control, meteorological factors that contribute to air quality degradation, basic chemistry of the atmosphere and how it contributes to secondary pollutant formation. Effect of air pollution on Human health, material and vegetation, Deposition of particulate pollutants in the respiratory system.

Unit III **Transport Models** **9 Hours**

Atmospheric chemical transport models, box models, three-dimensional atmospheric chemical transport models, components of air quality forecasting and modelling, evaluation and validation, air quality standards and index, long range transport of pollutants. Back trajectory construction and applications

Unit IV **Dispersion Models** **9 Hours**

Transport and dispersion of air pollutants - wind velocity, wind speed and turbulence; estimating concentrations from point sources - the Gaussian Equation - atmospheric stability - Air pollution modelling and prediction - Plume rise, modelling techniques.

Unit V **Software Modelling** **9 Hours**

Exposure to computer models for air quality.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

3. Know the causes of climate change
4. Know the effects of climate change on various environments and various models.

References:

5. Rao.M.N. &RaoH.V.N., "Air Pollution", Tata McGraw Hill,2006.
6. Richard W.Boubel, Donald L. Fox, D.Bruce Turner& Arthur C. Stern, "Fundamentals of Air Pollution, Hardcover", 2007.
7. Kenneth Wark, Cecil F. Warn,"Air pollution its origin and control", 2007.
8. StevenC.Chapra, "Surface Water quality modeling", The McGraw-Hill- Companies Inc., New York, 1997.

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17EV002		CLIMATE CHANGE AND MODELING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I	Climate Change and Climate Variability	9 Hours

Introduction – Atmosphere - weather and Climate - climate parameters (Temperature ,Rainfall, Humidity, Wind etc) – Equations governing the atmosphere - Numerical Weather Prediction Models - Introduction to GCMs - Application in Climate Change Projections.

Unit II	IPCC SRES Scenarios	9 Hours

Intergovernmental Panel on Climate Change (IPCC) - An Overview - Key Assumptions - Scenario Family - Storyline (A1, B1, A2, B2).

Unit III	Global Climate MODEL (GCM) and Regional Climate Model (RCM)	9 Hours

Some typical GCMs (HadCM3Q-UK Met Office) - Issues with GCMs - Introduction to RCMs and LAMs - some typical RCMs like PRECIS, Sim CLIM, MAGICC/SCENGENE - Advantages and Disadvantages of GCMs and RCMs.

Unit IV	Downscaling Global Climate Model - An Overview	9 Hours

Need for downscaling - Selection of GCMs for regional climate change studies - Ensemble theory – Selection of - Ensembles, Model Domain (Spatial domain and temporal domain), Resolution and climate variables - Lateral boundary conditions - Methods of downscaling (Statistical and Dynamical) - examples from each and their limitations.

Unit V	Analysis /Post Processing	9 Hours

a. Model validation - post processing – Introduction to Analysis tools - Ferret, R, Grads, IDL, SPSS, ArcGIS

b. Climate change Impact - Vulnerability assessment – adaptation strategies.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1.Know the causes of climate change

2.Know the effects of climate change on various environments and various models.

References:

5. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK.
6. McGuffie, K. and Henderson-Sellers, A. "A Climate Modelling Primer, Third Edition, John Wiley & Sons, Ltd, Chichester, UK. ,2005
7. Neelin David J, "Climate Change and Climate Modelling", Cambridge University Press
8. Thomas Stocker, "Introduction to Climate Modelling", Advances in Geophysical and Environmental Mechanics and Mathematics. Springer Publication.

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17EV005		ENVIRONMENTAL POLICIES AND LEGISLATION	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.

Unit I **Introduction** **9 Hours**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration– Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework(SPCB/CPCB/MoEF)

Unit II **Water (P&CP) Act, 1974** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit III **Air (P&CP) Act, 1981** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation

Unit IV **Environment (Protection) Act 1986** **13 Hours**

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

Unit V **Other Topics** **7 Hours**

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

5. Know the National environmental legislations and the policies
6. plan programmes to comply with the legal requirements related to organizations

17EV008		MEMBRANE TECHNOLOGIES FOR WATER AND WASTE WATER TREATMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the concept and principles of membrane separation and its applications in water and wastewater treatment.

Unit I **Membrane Filtration Processes** **10 Hours**

Solid Liquid separation systems- Theory of Membrane separation – mass Transport Characteristics- Cross Flow filtration - Membrane Filtration- Flux and Pressure drop -Types and choice of membranes, porous, non-porous, symmetric and asymmetric – Plate and Frame, spiral wound and hollow fibre membranes – Liquid Membranes

Unit II **Membrane Systems** **10 Hours**

Microfiltration principles and applications – Ultra filtration principles and applications - Nano Filtration principles and applications – Reverse Osmosis: Theory and design of modules, assembly, plant process control and applications – Electro dialysis : Ion exchange membranes, process design- Pervaporation – Liquid membrane – Liquid Pertraction – Supported Liquid Membrane and Emulsion Liquid membrane - Membrane manufactures – Membrane Module/Element designs – Membrane System components – Design of Membrane systems - pump types and Pump selection– Plant operations – Economics of Membrane systems

Unit III **Membrane Bioreactors** **9 Hours**

Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations, Commercial Technologies, Case Studies.

Unit IV **Pretreatment Systems** **8 Hours**

Membrane Fouling – Control of Fouling and Concentration Polarisation-Pretreatment methods and strategies – monitoring of Pretreatment – Langlier Index, Silt Density Index, Chemical cleaning , Biofoulant control.

Unit V **Case Studies** **8 Hours**

Case studies on the design of membrane-based water and wastewater treatment systems – zero Liquid effluent discharge Plants – Desalination of brackish water.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be

5. familiar with main membrane processes, principles, separation mechanisms, and applications
6. understand the selection criteria for different membrane processes
7. know the principle of the most common membrane applications
8. Carry out design of project for a particular membrane technology application.

17EV009		REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

5. To educate the students on aspects of Remote Sensing
6. Develop the different remote sensing technique
7. To educate the students on aspects of GIS and data management
8. Develop the GIS Applications for monitoring and management of environment

Unit I	**Remote Sensing Elements**	**8 Hours**

Historical Perspective, Principles of remote sensing, components of Remote Sensing, Energy source and electromagnetic radiation, Electromagnetic spectrum, Energy interaction, Spectral response pattern of earth surface features, Energy recording technology.

Unit II	**Remote Sensing Technology**	**9 Hours**

Classification of Remote Sensing Systems, Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR

Unit III	**Social Impact Assessment and EIA Documentation**	**9 Hours**

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	**Environmental Management Plan**	**10 Hours**

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	**Environmental Risk Assessment and Management**	**9 Hours**

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

3. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
4. Know about the legal requirements of Environmental and Risk Assessment for projects.

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BE

1701MGX001		PROFESSIONAL ETHICS	L	T	P	C
			3	0	0	3

Course Objectives:

1.The primary goal is to stimulate critical and responsible reflection on moral issues surrounding engineering practice and to provide the conceptual tools necessary for pursuing those issues.

2.Also to make the students aware of the different ethical issues, codes of conduct for engineers in the society and moralities in an organization.

Unit I	INTRODUCTION & HUMAN VALUES	9 Hours

Morals, Values and Ethics- Work Ethic - Team work – Types of Ethics - Respect for Others- Living Peacefully- Honesty- Courage - Valuing Time - Co-operation - Commitment- Self-Confidence - Customs and religion-Caring and Sharing.

Unit II	ENGINEERING ETHICS	9 Hours

Engineering ethics – Variety of moral issues – Types of Inquiry – Professional accountability – Self Interest – Moral dilemmas – Kohlberg's Theory – Gilligan's Theory – Theories about Right Action – Ethical codes of IEEE and Institution of Engineers.

Unit III	SAFETY & RESPONSIBILITY OF ENGINEERS	10 Hours

Engineering as experimentation – Safety and Risks – Risk – benefit analysis – Computer Technology Privacy – Social Policy – Engineering standards – Communicating Risk and Public Policy – Occupational Crime – Professional Rights and Employee Rights – Whistle Blowing – Collective Bargaining – Conflicts of Interest.

Unit IV	ENGINEER'S ROLE	9 Hours

Engineers as Managers, Advisors, Consultants, Experts and Witness – Engineers role in industry and society – Theories about right action – Moral leadership - Collegiality and loyalty – IPR – Discrimination - Bhopal gas tragedy case study.

Unit V	GLOBAL ISSUES	8 Hours

Multinational corporations-Environmental Ethics- Weapons Development- Code of Conduct – Eco – friendly production system – Sustainable technology & development – ozone depletion – Eco system – Pollution control.

	Total:	45 Hours

Further Proceeding:

4. Analysis about Safety and Risk Management in an Organisation
5. Analysis about Code of Conduct for Ethical & Moral values

Course Outcomes:

After completion of the course, Student will be able to

6. Obtain awareness on Human Values & Social Values of the every individual.
7. Knowledge about ethical theories and relevant code of conduct for engineers.
8. Enumerate the safety and responsibility of engineers in the society.
9. Realize their responsibilities, professional rights and moralities for the enhancement of an organization.
10. Explain about the environmental impacts at present day scenario.

1702CE305		BUILDING MATERIALS AND RESOURCE PLANNING	L	T	P	C
			3	0	0	3

Course Objectives:

1. To give students an understanding of typical and potential application of Building materials.
2. To ensure that students know about the manufacturing process of Building materials and mix designing procedure of concrete
3. Give students an appreciation of the effective use of common and modern materials in construction

Unit I — **Stones – bricks – concrete blocks** — **9 Hours**

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Cement, Concrete blocks – Lightweight concrete blocks.

Unit II — **Lime – cement – aggregates – mortar** — **9 Hours**

Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – Industrial byproducts – Fly ash – Aggregates – Natural stone aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading – Sand Bulking.

Unit III — **Concrete** — **9 Hours**

Concrete – Ingredients – Manufacturing Process – Batching plants – RMC – Properties of fresh concrete – Slump – Flow and compaction Factor – Properties of hardened concrete – Compressive, Tensile and shear strength – Modulus of rupture – Tests – Mix specification – Mix proportioning – BIS method – High Strength Concrete and HPC – Self compacting Concrete – Other types of Concrete – Durability of Concrete.

Unit IV — **Timber and modern material** — **9 Hours**

Timber – Market forms – Industrial timber– Plywood – Veneer – Therma Cole – Panels of laminates – Steel Aluminum composite panel – Uses – Paints – Varnishes – Distempers – Bitumens.Glass – Ceramics – Sealants for joints – Fiber glass reinforced plastic – Clay products – Refractories – Composite materials — Fiber textiles – Geomembranes and Geotextiles for earth reinforcement.

Unit V — **Materials management** — **9 Hours**

Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management

Total: 45 Hours

Further Reading:

1. On completion of this course the students will be able to Compare the properties of most common and advanced building materials and understand the typical and potential applications of these materials

Course Outcomes:

After completion of the course, Student will be able to

1. Summarize the most common and advanced materials used for construction.
2. Explain the manufacturing process of various building materials
3. Explain the properties of fresh and hardened concrete and performance of other types of concrete.
4. Illustrate the usage of timber, plywood and aluminum, composite material, paints, distemper and modern materials.

	5.summarize the procedure in material management					
1702CE604		**WATER SUPPLY ENGINEERING**	**L**	**T**	**P**	**C**
			3	**0**	**0**	**3**

Course Objectives:

1. To examine the water supply system and conveyance system.
2. To create an ability to evaluate the water treatment and advanced water treatment system.
3. To train the students to analyze water distribution system and supply to buildings.

Unit I	**PLANNING FOR WATER SUPPLY SYSTEM**	**08 Hours**

Public water supply system -Planning -Design period - Population forecasting -Water demand -Sources of water and their characteristics -Surface and Groundwater- Impounding Reservoir Well hydraulics - Development and selection of source - Water quality - Characterization and standards.

Unit II	**CONVEYANCE SYSTEM**	**07 Hours**

Water supply -intake structures -Functions and drawings -Pipes and conduits for water- Pipe materials - Hydraulics of flow in pipes -Transmission main design – Materials of pipes- Laying, jointing and testing of pipes - Drawings appurtenances - Types and capacity of pumps -Selection of pumps and pipe materials.

Unit III	**WATER TREATMENT**	**12 Hours**

Objectives - Unit operations and processes - Principles, functions design and drawing of Screens, Flash mixers, flocculators, sedimentation tanks and sand filters - Disinfection- Residue Management.

Unit IV	**ADVANCED WATER TREATMENT**	**09 Hours**

Aerator - Iron and manganese removal, Defluoridation and demineralization -Water softening - Desalination - Membrane Systems-Construction and Operation & Maintenance aspects of Water Treatment Plants- Recent advances-Membrane processes.

Unit V	**WATER DISTRIBUTION AND SUPPLY TO BUILDINGS**	**09 Hours**

Requirements of water distribution -Components -Service reservoirs -Functions and drawings -Network design - Analysis of distribution networks –Pipe Appurtenances -operation and maintenance -Leak detection, Methods. Principles of design of water supply in buildings -House service connection -Fixtures and fittings -Systems of plumbing and drawings of types of plumbing.

Total:	**45 Hours**

Further Reading:

7. Apply an appropriate unit system for the water treatment.
8. Estimate the quantity of wastewater and storm run-off generated from the town/ city and design a suitable collection system for the generated wastewater.

Course Outcomes:

After completion of the course, Student will be able to

1. Discuss about the principles and development of water supply system.
2. Design the pipelines for water supply system governed with head loss.
3. Design drawing of various unit operations in water supply system.
4. Identify the methods for removing contaminants in water treatment system using advanced techniques.
5. Interpret the network for water supply to buildings and House service connection.

References:

1. Garg, S.K., "Environmental Engineering", Vol.1 Khanna Publishers, New Delhi, 2005.
2. Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2005.
3. Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2005

1702CE652		ENVIRONMENTAL AND IRRIGATION DESIGN AND DRAWING	L	T	P	C
			3	0	0	3

Course Objectives:

1.to know about the design of environmental structures

2.to know the pictorial representation of irrigation structures

Unit I	WATER SUPPLY AND TREATMENT	08 Hours

Design &Drawing of flash mixer, flocculator, clarifier – Slow sand filter – Rapid sand filter – Infiltration gallery – Intake towers – Service reservoirs – Pumping station – House service connection for water supply and drainage.

Unit II	SEWAGE TREATMENT & DISPOSAL	07 Hours

Design and Drawing of screen chamber - Grit channel - Primary clarifier - Activated sludge process – Aeration tank & oxidation ditch – Trickling filters – Secondary clarifiers – Sludge digester – Sludge drying beds – Waste stabilisation ponds - Septic tanks and disposal arrangements – Manholes.

Unit III	IMPOUNDING STRUCTURES	12 Hours

Gravity dam, Tank Surplus Weir, Tank Sluice with tower road – Drawing showing plan, elevation, half section including foundation details.

Unit IV	CANAL TRANSMISSION STRUCTURES	09 Hours

Aqueducts – Syphon Aqueducts – Super passage – Canal siphon – Canal Drops- Drawing showing plan, elevation and foundation details.

Unit V	CANAL REGULATION STRUCTURES	09 Hours

Canal head works- Canal Regular – Canal escape- Proportional Distributors – Drawing showing detailed plan, elevation and foundation.

	Total:	45 Hours

Further Reading:

1.to analyse and draw advanced irrigation and environmental structures

Course Outcomes:

After completion of the course, Student will be able to

1.design environmental treatment system

2. design the irrigationimpounding structures

3. design the canal transmission structures

4. design the canal regulation structures

References:

1.Garg, S.K., "Environmental Engineering", Vol.1 Khanna Publishers, New Delhi, 2005.

2.Sathyanarayana Murthy "Irrigation Design and Drawing" Published by MrsL.Banumathi, Tuni east Godavari District. A.P. 1998

3.Sharma R.K. Irrigation Engineering and Hydraulic Structures Oxford and IBH Publishing co., New Delhi 2002.

4.Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2005.

5.Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2005

1702CE702		WASTE WATER ENGINEERING	L	T	P	C
			3	0	0	3

Course Objectives:

1. To understand the importance of planning and design of sewerage system.
2. To create an ability to evaluate the waste water treatment system.
3. To impart the signification of disposal of Sewage.

Unit I	PLANNING FOR SEWERAGE SYSTEMS	09 Hours

Sources of wastewater generation – Effects – Estimation of sanitary sewage flow – Estimation of storm runoff – Factors affecting Characteristics and composition of sewage and their significance – Effluent standards – Legislation requirements.

Unit II	DESIGN OF SEWER	09 Hours

Sewerage – Hydraulics of flow in sewers – Design period - Design of sanitary and storm sewers – Small bore systems – Materials of sewers– Laying, joining & testing of sewers – Forces acting on sewers– Cleaning and maintenances of sewers- Sewer appurtenances – Pumps – selection of pumps and pipe Drainage -. Plumbing System for Buildings – One pipe and two pipe system.

Unit III	PRIMARY TREATMENT OF SEWAGE	09 Hours

Objective – Unit Operation and Processes – Selection of treatment processes – Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – Operation and Maintenance aspects – Onsite sanitation - Septic tank, Grey water harvesting.

Unit IV	SECONDARY TREATMENT OF SEWAGE	09 Hours

Objective – Selection of Treatment Methods – Principles, Functions, Design and Drawing of Units - Activated Sludge Process and Trickling filter, other treatment methods – Oxidation ditches, UASB – Waste Stabilization Ponds – Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction and Operation & Maintenance of Sewage Treatment Plants.

Unit V	DISPOSAL OF SEWAGE AND SLUDGE	09 Hours

Standards for Disposal - Methods – dilution – Self-purification of surface water bodies – Oxygen sag curve – Land disposal – Sewage farming – Deep well injection – Soil dispersion system -Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge Conditioning and Dewatering – disposal – Advances in Sludge Treatment and disposal.

	Total:	45 Hours

Further Reading:

1. Design the necessary treatment units for energy conservation.
2. Design the suitable disposal unit for the sludge without endangering the environment.

Course Outcomes:

After completion of the course, Student will be able to

1. Examine the waste water quality characteristics and standards.
2. Design sewerage systems and discuss about the treatment process step by step done in primary level.
3. Design the various unit operations for waste water treatment.
4. Design the sludge treatment and disposal methods.
5. Perform quality analysis of sewage the characteristics and composition of sewage, self - Purification of streams.

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1703CE006		SOLID WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

- To study the Sources and types of municipal solid wastes
- To impart the knowledge of On-site Processing, collection and transfer of solid waste.
- To acquire the knowledge of Off –site Processing and waste disposal management.

Unit I	**SOURCES AND TYPES OF MUNICIPAL SOLID WASTES**	**8 Hours**

Sources and types of solid wastes - Quantity – factors affecting generation of solid wastes- characteristics – methods of sampling and characterization- Effects of improper disposal of solid wastes – public health effects- Principle of solid waste management – social & economic aspects - Public awareness- Role of NGOs- Legislation.

Unit II	**ON-SITE STORAGE & PROCESSING**	**8 Hours**

On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options.

Unit III	**COLLECTION AND TRANSFER**	**8 Hours**

Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, operation & maintenance; options under Indian conditions.

Unit IV	**OFF-SITE PROCESSING**	**12 Hours**

Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions.

Unit V	**DISPOSAL**	**9 Hours**

Dumping of solid waste; sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment

Total:	**45 Hours**

Further Reading:

- They can categorize the types of wastes
- They can choose the disposal units

Course Outcomes:

After completion of the course, Student will be able to

- Explain the Sources and types of municipal solid wastes
- Interpret the suitable method of Segregation of solid waste under Indian condition.
- Identify the methods of collectionand transfer of solid wastes
- Demonstrate the suitable Off –site Processing techniques
- Choose the various options for disposal of wastes and their selection criteria

References:

Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000

R.E.Landreth and P.A.Rebers, Municipal Solid Wastes – problems and Solutions, Lewis Publishers, 1997.

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1703CE009		GROUNDWATER ENGINEERING	L	T	P	C
			3	0	0	3

Course Objectives:		
	1.To introduce the student to the principles of Groundwater governing Equations andCharacteristicsofdifferentaquifers	
	2.Characteristicsofdifferentaquifers	
	3.To understand the techniques of development and management of groundwater	
	4.To be introduced to the different theories of traffic flow	
	5.To be aware of the importance of traffic safety	
Unit I	**HYDROGEOLOGICAL PARAMETERS**	**9 Hours**
Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation–Ground water table fluctuation and its interpretations – Groundwater development and Potential in India – GEC norms.		
Unit II	**WELLHYDRAULICS**	**9Hours**
ObjectivesofGroundwaterhydraulics–Darcy'sLaw-Groundwaterequation–steadystate flow.DupuitForchheimerassumption-Unsteadystateflow-Theismethod-JacobMethod-Slug tests – Imagewell theory –Partial penetrationsof wells		
Unit III	**GROUNDWATER MANAGEMENT**	**9Hours**
Need for Management Model – Database for groundwater management –groundwater balance study – Introduction to Mathematical model – Conjunctive use – Collector well and Infiltration gallery		
Unit IV	**GROUNDWATER QUALITY**	**9 Hours**
Ground water chemistry - Origin, movement and quality - Water quality standards – Health and aesthetic aspects of water quality - Saline intrusion – Environmental concern and Regulatory requirements		
Unit V	**GROUNDWATER CONSERVATION**	**9 Hours**
Artificial recharge techniques – Remediation of Saline intrusion– Ground water management studies – Protection zone delineation, Contamination source inventory, remediation schemes - Ground water Pollution and legislation.		
	Total:	**45 Hours**
Further Reading:		
	1. Ground water to improving quality parameter	
	2. Water resource and hydrology for features need.	
Course Outcomes:		
	1. Students will be able to understand aquifer properties and its dynamics after the completionof thecourse.Itgivesanexposuretowardswelldesignandpracticalproblems ofgroundwateraquifers	
	2. Studentswillbeabletounderstandtheimportanceofartificialrechargeandgroundwater qualityconcepts	
	3. Modelregionalgroundwaterflowanddesignwaterwells	
	4.Estimatewaterqualityparameters	
	5.To safety ground water improvements of quality parameter	

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ME ENVIRONMENTAL ENGINEERING

17EV102		ENVIRONMENTAL CHEMISTRY	L	T	P	C
			3	0	0	3

Course Objectives:

10. To educate the students about water chemistry
11. To impart knowledge in the area of air and soil chemistry
12. To impart knowledge on the transformation of chemicals in the environment

Unit I	**Introduction**	**9 Hours**

Stoichiometry and mass balance-Chemical equilibrium, acid base, solubility product (Ksp), heavy metal precipitation, amphoteric hydroxides, CO2 solubility in water and species distribution – Chemical kinetics, First order- 12 Principles of green chemistry.

Unit II	**Aquatic Chemistry**	**11 Hours**

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation – Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction,pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation.

Unit III	**Atmospheric Chemistry**	**7 Hours**

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, CO_2 capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination.

Unit IV	**Soil Chemistry**	**9 Hours**

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

Unit V	**Environmental Chemicals**	**9 Hours**

Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins,PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.

Total:	**45 Hours**

Further Reading

To analyze and create a solution for environmental issues.

Course Outcomes:

After completion of the course, Student will be able to

16. Distinguish the chemistry involved
17. Understand the chemistry involved in water
18. Identify and solve the air pollution related issues
19. Understand the soil related chemistry and issues
20. Identify contaminating chemicals and can work out chemicals need calculations for treatment purpose

17EV103		ENVIRONMENTAL MICROBIOLOGY	L	T	P	C
			3	0	0	3

Course Objectives:

16. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
17. The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.
18. The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease-causing organisms are also covered.
19. An exposure to toxicology due to industrial products and byproducts are also covered.
20. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.

Unit I	Classification And Characteristics	5 Hours

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

Unit II	Microbes And Nutrient Cycles	10 Hours

Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaebacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Micro Organism in nutrient cycle.

Unit III	Metabolism of Microorganisms	10 Hours

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb"s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

Unit IV	Pathogens in Wastewater	10 Hours

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Indicator organisms of water – Coliforms - total coliforms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, □-oxidation, β-oxidation, nitrification and de-nitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Unit V	Toxicology	10 Hours

Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bio concentration – Bioaccumulation, bio magnification, bioassay, bio monitoring, bioleaching.

	Total:	45 Hours

Further Reading

Identification and culturing of microorganisms from different sources

Course Outcomes:

After completion of the course, Student will be able to

16. The candidate at the end of the course will have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.
17. The candidate would be able to understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
18. The candidate would have understood the role microbial metabolism in a wastewater treatment plant.
19. The candidate would know the role of microorganisms in contaminated water and the

	20. The candidate has the ability to conduct and test the toxicity due to various natural and synthetic products in the environment.

References:

22. S.C.Bhatia, Hand Book of Environmental Microbiology, Part 1 and 2, Atlantic Publisher
23. Gabriel Bitton, Wastewater Microbiology, 2nd Edition ,
24. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, Environmental Microbiology, Academic Press.
25. SVS. Rana, Essentials of Ecology and Environmental Science, 3rd Edition, Prentice Hall of India Private Limited
26. Stanley E. Manahan, Environmental Science and Technology, Lewis Publishers.
27. Hurst, C.J. (2002) Manual of Environmental Microbiology. 2nd Ed. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 - X.
28. Frank C. Lu and Sam Kacew, LU"s Basic Toxicology, Taylor & Francis, London (4th Ed), 2002

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17EV104		TRANSPORT OF WATER AND WASTEWATER	L	T	P	C
			3	0	0	3

Course Objectives:

7. To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain
8. To educate the students in computer application on design.

Unit I	General Hydraulics and Flow Measurement	8 Hours

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

Unit II	Water Transmission and Distribution	10 Hours

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

Unit III	Wastewater Collection and Conveyance	10 Hours

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

Unit IV	Storm Water Drainage	7 Hours

Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods.

Unit V	Case Studies and Software Applications	10 Hours

Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

	Total:	45 Hours

Further Reading

Designing of pipelines and sewers for various project areas

Course Outcomes:

After completion of the course, Student will be able to

16. Understand the fluid flow properties
17. Design water supply main, distribution network and sewer for various field conditions
18. Design the drainage network for wastewater
19. Design the storm water drainage systems
20. Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

17EV105		PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

7. To educate the students on the principles and process designs of various treatment systems for water and wastewater
8. To educate the students on design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I	Introduction	5 Hours

Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physio-chemical treatment – Selection criteria-types of reactors- reactor selection-batch- continuous type-kinetics.

Unit II	Treatment Principles	10 Hours

Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra-filtration and hyper filtration electro dialysis, distillation – stripping and crystallization – Recent Advances. Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends

Unit III	Design of Municipal Water Treatment Plants	10 Hours

Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit IV	Design of Industrial Water Treatment Plants	10Hours

Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit V	Design of Wastewater Treatment Plants	10 Hours

Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks- sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers- floatation units-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.

Total:	45 Hours

Further Reading

Implementation of advanced treatment technologies for various wastewater treatment

Course Outcomes:

After completion of the course, Student will be able to

16. Identify the pollutants type in the wastewater
17. Understand the various treatment principles
18. Design the sewage treatment plants
19. Design suitable treatment units for various industries
20. Develop conceptual schematics required for the treatment of wastewater

17EV106		ENVIRONMENTAL CHEMISTRY LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

7. To train in the analysis of physical parameters of water and waste water
8. To train in the analysis of chemical parameters of water and waste water

List of Experiments:

16. Good Laboratory Practices, Quality control, calibration of Glassware 03
17. Sampling and Analysis of water (pH, alkalinity, hardness chloride, Sulphate, turbidity EC, TDS, nitrate, fluoride) 12
18. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals). 12
19. Sampling and analysis of air pollutants Ambient & Stack (RSPM, SO2 and NOx) 09
20. Sampling and characterization of soil (CEC & SAR, pH and K). 09

	Total :	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

7. assess quality of environment
8. conduct analysis on characteristics of water and waste water

References:

16. APHA, Standard Methods for the Examination of Water and Wastewater, 21st Ed.
17. Washington, 2005.
18. Laboratory Manual for the Examination of water, wastewater soil Rump, H.H. and Krist, H.
19. Second Edition, VCH, Germany, 1992.
20. Methods of air sampling &analysis, JamesP.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

17EV107		ENVIRONMENTAL MICROBIOLOGY LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

5. To train in the analysis of physical parameters of water and waste water
6. To train in the analysis of chemical parameters of water and waste water

List of Experiments:

29. Preparation of culture media
30. Isolation, culturing and Identification of Microorganisms
31. Microorganisms from polluted habitats (soil, water and air)
32. Measurement of growth of microorganisms, Assay of enzymes involved in biotransformation
33. Biodegradation of organic matter in waste water Analysis of air borne microorganisms
34. Staining of bacteria
35. Effect of pH, temperature on microbial growth
36. Pollutant removal using microbes from industrial effluent.
37. Effect of pesticides on soil microorganisms
38. Bacteriological analysis of wastewater (Coliforms, E.coli, Streptococcus) – MPN
39. Bacteriological analysis of wastewater (Coliforms, Streptococcus) - MF techniques
40. Effect of Heavy metals on microbial growth

41. Detection of Anaerobic bacteria (Clostridium sp.)		
42. Bioreactors		
	Total :	**45 Hours**

Course Outcomes:	
	After completion of the course, Student will be able to
	5. Field oriented testing of water, wastewater and solid waste for microbial contamination.
	6. Perform toxicity test.

References:

7. Standard methods for the examination of water and wastewater, American Public Health Association (21st edition) 2005.
8. Charles Gerba, Environmental Microbiology: A laboratory manual, Elsevier Publications, 2012.
9. Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, and Linda D. Stetzenbach, Manual of Environmental Microbiology, 3rd Edition, ASM Press, 2007.

17EV201		PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I **Introduction** **10 Hours**

Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth - Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process- reactors-batch-continuous type.

Unit II **Aerobic Treatment of Wastewater** **10 Hours**

Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfection – disposal options – reclamation and reuse – Flow charts, layout, PID, hydraulic profile, recent trends.

Unit III **Anaerobic Treatment of Wastewater** **10 Hours**

Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal – Nutrient removal systems – Flow chart, Layout and Hydraulic profile – Recent trends.

Unit IV **Sludge Treatment and Disposal** **5 Hours**

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

Unit V **Construction Operations and Maintenance Aspects** **10 Hours**

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and controlling of plant operations – capacity building - Retrofitting Case studies – sewage treatment plants – sludge management facilities.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

7. Develop conceptual schematics required for biological treatment of wastewater
8. Translate pertinent criteria into system requirements.

References:

13. Arceivala, S.J., Wastewater Treatment for Pollution Control, TMH, New Delhi, Second Edition, 2000.
14. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
15. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
16. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations, CRC Press, New York (2009).

17EV202		AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends

Unit I **Introduction** **7 Hours**

Structure and composition of Atmosphere – Sources and classification of air pollutants - Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects on the planet – Global Climate Change, Ozone Holes – Ambient Air Quality and Emission Standards – Air Pollution Indices – Emission Inventories – Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants.

Unit II **Air Pollution Modelling** **5 Hours**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques - Air Pollution Climatology.

Unit III **Control Of Particulate Contaminants** **11 Hours**

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators (cyclone) , Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

Unit IV **Control of Gaseous Contaminants** **11 Hours**

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

Unit V **Indoor Air Quality Management** **11 Hours**

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control – Membrane process - UV photolysis – Internal Combustion Engines - Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

10. Apply sampling techniques
11. Apply modelling techniques
12. Suggest suitable air pollution prevention equipment's and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards

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17EV203		INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.

Unit I **Introduction** **8 Hours**

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

Unit II **Industrial Pollution Prevention & Waste Minimisation** **8 Hours**

Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

Unit III **Industrial Wastewater Treatment** **10 Hours**

Flow and Load Equalization – Solids Separation – Removal of Fats, Oil & Grease- Neutralization – Removal of Inorganic Constituents – Precipitation, Heavy metal removal , Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis& Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.

Unit IV **Wastewater Reuse and Residual Management** **9 Hours**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

Unit V **Case Studies** **10 Hours**

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

13. Define the Principles of pollution prevention and mechanism of oxidation processes.
14. Suggest the suitable technologies for the treatment of wastewater.
15. Discuss about the wastewater characteristics
16. Design the treatment systems

17EV204		SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment.

Unit I **Sources, Classification and Regulatory Framework** **9 Hours**

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.

Unit II **Waste Characterization and Source Reduction** **8 Hours**

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

Unit III **Storage, Collection and Transport Of Wastes** **9 Hours**

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

Unit IV **Waste Processing Technologies** **10 Hours**

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

Unit V **Waste Disposal** **9 Hours**

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

10. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
11. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste
12. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges

17EV205		ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
			3	0	0	3

Course Objectives:

7. To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
8. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

Unit I	Introduction	8 Hours

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA.

Unit II	Impact Identification and Prediction	10 Hours

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment.

Unit III	Social Impact Assessment and EIA Documentation	8 Hours

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	Environmental Management Plan	7 Hours

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	Environmental Risk Assessment and Management	12 Hours

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipathway exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

7. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
8. Know about the legal requirements of Environmental and Risk Assessment for projects.

17EV206		UNIT OPERATIONS AND PROCESSES LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

7. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.
8. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.

List of Experiments:

31. Coagulation and Flocculation	7
32. Batch studies on settling	10
33. Studies on Filtration- Characteristics of Filter media	7
34. Water softening	7
35. Adsorption studies/Kinetics	7
36. Reverse Osmosis- Silt Density Index	7
37. Kinetics of suspended growth process (activated sludge process)- Sludge volume Index	14
38. Anaerobic Reactor systems / kinetics (Demonstration)	10
39. Advanced Oxidation Processes – (Ozonation, Photocatalysis)	14
40. Disinfection for Drinking water	7
Total :	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

7. Conduct treatability studies for water and waste water treatment.
8. Design laboratory models for various unit operations and processes.

References:

13. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
14. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
15. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
16. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.

17EV001		AIR POLLUTION METEOROLOGY AND MODELING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I **Atmospheric Pollution** **9 Hours**

Atmospheric Pollution, type of pollutants, gaseous and particulate pollutants, size of atmospheric particles, emission inventory, various sources of emissions, bio-mass burning, pollution formation in combustion, Visibility and Acid Deposition Industrial pollution.

Unit II **Meteorology** **9 Hours**

Air pollution meteorology: sources of air pollution, methods for air pollution measurement and control, meteorological factors that contribute to air quality degradation, basic chemistry of the atmosphere and how it contributes to secondary pollutant formation. Effect of air pollution on Human health, material and vegetation, Deposition of particulate pollutants in the respiratory system.

Unit III **Transport Models** **9 Hours**

Atmospheric chemical transport models, box models, three-dimensional atmospheric chemical transport models, components of air quality forecasting and modelling, evaluation and validation, air quality standards and index, long range transport of pollutants. Back trajectory construction and applications

Unit IV **Dispersion Models** **9 Hours**

Transport and dispersion of air pollutants - wind velocity, wind speed and turbulence; estimating concentrations from point sources - the Gaussian Equation - atmospheric stability - Air pollution modelling and prediction - Plume rise, modelling techniques.

Unit V **Software Modelling** **9 Hours**

Exposure to computer models for air quality.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

5. Know the causes of climate change
6. Know the effects of climate change on various environments and various models.

References:

9. Rao.M.N. &RaoH.V.N., "Air Pollution", Tata McGraw Hill,2006.
10. Richard W.Boubel, Donald L. Fox, D.Bruce Turner& Arthur C. Stern, "Fundamentals of Air Pollution, Hardcover", 2007.
11. Kenneth Wark, Cecil F. Warn,"Air pollution its origin and control", 2007.
12. StevenC.Chapra, "Surface Water quality modeling", The McGraw-Hill- Companies Inc., New York, 1997.

17EV002		CLIMATE CHANGE AND MODELING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I	Climate Change and Climate Variability	9 Hours

Introduction – Atmosphere - weather and Climate - climate parameters (Temperature ,Rainfall, Humidity, Wind etc) – Equations governing the atmosphere - Numerical Weather Prediction Models - Introduction to GCMs - Application in Climate Change Projections.

Unit II	IPCC SRES Scenarios	9 Hours

Intergovernmental Panel on Climate Change (IPCC) - An Overview - Key Assumptions - Scenario Family - Storyline (A1, B1, A2, B2).

Unit III	Global Climate MODEL (GCM) and Regional Climate Model (RCM)	9 Hours

Some typical GCMs (HadCM3Q-UK Met Office) - Issues with GCMs - Introduction to RCMs and LAMs - some typical RCMs like PRECIS, Sim CLIM, MAGICC/SCENGENE - Advantages and Disadvantages of GCMs and RCMs.

Unit IV	Downscaling Global Climate Model - An Overview	9 Hours

Need for downscaling - Selection of GCMs for regional climate change studies - Ensemble theory – Selection of - Ensembles, Model Domain (Spatial domain and temporal domain), Resolution and climate variables - Lateral boundary conditions - Methods of downscaling (Statistical and Dynamical) - examples from each and their limitations.

Unit V	Analysis /Post Processing	9 Hours

a. Model validation - post processing – Introduction to Analysis tools - Ferret, R, Grads, IDL, SPSS, ArcGIS

b. Climate change Impact - Vulnerability assessment – adaptation strategies.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1.Know the causes of climate change

2.Know the effects of climate change on various environments and various models.

References:

9. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK.
10. McGuffie, K. and Henderson-Sellers, A. "A Climate Modelling Primer, Third Edition, John Wiley & Sons, Ltd, Chichester, UK. ,2005
11. Neelin David J, "Climate Change and Climate Modelling", Cambridge University Press
12. Thomas Stocker, "Introduction to Climate Modelling", Advances in Geophysical and Environmental Mechanics and Mathematics. Springer Publication.

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17EV005		ENVIRONMENTAL POLICIES AND LEGISLATION	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.

Unit I **Introduction** **9 Hours**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration– Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework(SPCB/CPCB/MoEF)

Unit II **Water (P&CP) Act, 1974** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit III **Air (P&CP) Act, 1981** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation

Unit IV **Environment (Protection) Act 1986** **13 Hours**

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

Unit V **Other Topics** **7 Hours**

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

7. Know the National environmental legislations and the policies
8. plan programmes to comply with the legal requirements related to organizations

17EV008		MEMBRANE TECHNOLOGIES FOR WATER AND WASTE WATER TREATMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the concept and principles of membrane separation and its applications in water and wastewater treatment.

Unit I **Membrane Filtration Processes** **10 Hours**

Solid Liquid separation systems- Theory of Membrane separation – mass Transport Characteristics- Cross Flow filtration - Membrane Filtration- Flux and Pressure drop -Types and choice of membranes, porous, non-porous, symmetric and asymmetric – Plate and Frame, spiral wound and hollow fibre membranes – Liquid Membranes

Unit II **Membrane Systems** **10 Hours**

Microfiltration principles and applications – Ultra filtration principles and applications - Nano Filtration principles and applications – Reverse Osmosis: Theory and design of modules, assembly, plant process control and applications – Electro dialysis : Ion exchange membranes, process design- Pervaporation – Liquid membrane – Liquid Pertraction – Supported Liquid Membrane and Emulsion Liquid membrane - Membrane manufactures – Membrane Module/Element designs – Membrane System components – Design of Membrane systems - pump types and Pump selection– Plant operations – Economics of Membrane systems

Unit III **Membrane Bioreactors** **9 Hours**

Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations, Commercial Technologies, Case Studies.

Unit IV **Pretreatment Systems** **8 Hours**

Membrane Fouling – Control of Fouling and Concentration Polarisation-Pretreatment methods and strategies – monitoring of Pretreatment – Langlier Index, Silt Density Index, Chemical cleaning , Biofoulant control.

Unit V **Case Studies** **8 Hours**

Case studies on the design of membrane-based water and wastewater treatment systems – zero Liquid effluent discharge Plants – Desalination of brackish water.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be

9. familiar with main membrane processes, principles, separation mechanisms, and applications
10. understand the selection criteria for different membrane processes
11. know the principle of the most common membrane applications
12. Carry out design of project for a particular membrane technology application.

17EV009		REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

9. To educate the students on aspects of Remote Sensing
10. Develop the different remote sensing technique
11. To educate the students on aspects of GIS and data management
12. Develop the GIS Applications for monitoring and management of environment

Unit I	**Remote Sensing Elements**	**8 Hours**

Historical Perspective, Principles of remote sensing, components of Remote Sensing, Energy source and electromagnetic radiation, Electromagnetic spectrum, Energy interaction, Spectral response pattern of earth surface features, Energy recording technology.

Unit II	**Remote Sensing Technology**	**9 Hours**

Classification of Remote Sensing Systems, Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR

Unit III	**Social Impact Assessment and EIA Documentation**	**9 Hours**

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	**Environmental Management Plan**	**10 Hours**

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	**Environmental Risk Assessment and Management**	**9 Hours**

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

5. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
6. Know about the legal requirements of Environmental and Risk Assessment for projects.

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1701MGX001		PROFESSIONAL ETHICS	L	T	P	C
			3	0	0	3

Course Objectives:

1.The primary goal is to stimulate critical and responsible reflection on moral issues surrounding engineering practice and to provide the conceptual tools necessary for pursuing those issues.

2.Also to make the students aware of the different ethical issues, codes of conduct for engineers in the society and moralities in an organization.

Unit I	INTRODUCTION & HUMAN VALUES	9 Hours

Morals, Values and Ethics- Work Ethic - Team work – Types of Ethics - Respect for Others- Living Peacefully- Honesty- Courage - Valuing Time - Co-operation - Commitment- Self-Confidence - Customs and religion-Caring and Sharing.

Unit II	ENGINEERING ETHICS	9 Hours

Engineering ethics – Variety of moral issues – Types of Inquiry – Professional accountability – Self Interest – Moral dilemmas – Kohlberg's Theory – Gilligan's Theory – Theories about Right Action – Ethical codes of IEEE and Institution of Engineers.

Unit III	SAFETY & RESPONSIBILITY OF ENGINEERS	10 Hours

Engineering as experimentation – Safety and Risks – Risk – benefit analysis – Computer Technology Privacy – Social Policy – Engineering standards – Communicating Risk and Public Policy – Occupational Crime – Professional Rights and Employee Rights – Whistle Blowing – Collective Bargaining – Conflicts of Interest.

Unit IV	ENGINEER'S ROLE	9 Hours

Engineers as Managers, Advisors, Consultants, Experts and Witness – Engineers role in industry and society – Theories about right action – Moral leadership - Collegiality and loyalty – IPR – Discrimination - Bhopal gas tragedy case study.

Unit V	GLOBAL ISSUES	8 Hours

Multinational corporations-Environmental Ethics- Weapons Development- Code of Conduct – Eco – friendly production system – Sustainable technology & development – ozone depletion – Eco system – Pollution control.

	Total:	45 Hours

Further Proceeding:

11. Analysis about Safety and Risk Management in an Organisation
12. Analysis about Code of Conduct for Ethical & Moral values

Course Outcomes:

After completion of the course, Student will be able to

13. Obtain awareness on Human Values & Social Values of the every individual.
14. Knowledge about ethical theories and relevant code of conduct for engineers.
15. Enumerate the safety and responsibility of engineers in the society.
16. Realize their responsibilities, professional rights and moralities for the enhancement of an organization.
17. Explain about the environmental impacts at present day scenario.

1702CE305		BUILDING MATERIALS AND RESOURCE PLANNING	L	T	P	C
			3	0	0	3

Course Objectives:

1. To give students an understanding of typical and potential application of Building materials.
2. To ensure that students know about the manufacturing process of Building materials and mix designing procedure of concrete
3. Give students an appreciation of the effective use of common and modern materials in construction

Unit I **Stones – bricks – concrete blocks** **9 Hours**

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Cement, Concrete blocks – Lightweight concrete blocks.

Unit II **Lime – cement – aggregates – mortar** **9 Hours**

Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – Industrial byproducts – Fly ash – Aggregates – Natural stone aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading – Sand Bulking.

Unit III **Concrete** **9 Hours**

Concrete – Ingredients – Manufacturing Process – Batching plants – RMC – Properties of fresh concrete – Slump – Flow and compaction Factor – Properties of hardened concrete – Compressive, Tensile and shear strength – Modulus of rupture – Tests – Mix specification – Mix proportioning – BIS method – High Strength Concrete and HPC – Self compacting Concrete – Other types of Concrete – Durability of Concrete.

Unit IV **Timber and modern material** **9 Hours**

Timber – Market forms – Industrial timber– Plywood – Veneer – Therma Cole – Panels of laminates – Steel Aluminum composite panel – Uses – Paints – Varnishes – Distempers – Bitumens.Glass – Ceramics – Sealants for joints – Fiber glass reinforced plastic – Clay products – Refractories – Composite materials — Fiber textiles – Geomembranes and Geotextiles for earth reinforcement.

Unit V **Materials management** **9 Hours**

Materials Management - Material Procurement and Delivery - Inventory Control - Tradeoffs of Costs in Materials Management

Total: 45 Hours

Further Reading:

2. On completion of this course the students will be able to Compare the properties of most common and advanced building materials and understand the typical and potential applications of these materials

Course Outcomes:

After completion of the course, Student will be able to

1. Summarize the most common and advanced materials used for construction.
2. Explain the manufacturing process of various building materials
3. Explain the properties of fresh and hardened concrete and performance of other types of concrete.
4. Illustrate the usage of timber, plywood and aluminum, composite material, paints, distemper and modern materials.

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1702CE604		WATER SUPPLY ENGINEERING	L	T	P	C
			3	0	0	3

Course Objectives:

4. To examine the water supply system and conveyance system.
5. To create an ability to evaluate the water treatment and advanced water treatment system.
6. To train the students to analyze water distribution system and supply to buildings.

Unit I	PLANNING FOR WATER SUPPLY SYSTEM	08 Hours

Public water supply system -Planning -Design period - Population forecasting -Water demand -Sources of water and their characteristics -Surface and Groundwater- Impounding Reservoir Well hydraulics - Development and selection of source - Water quality - Characterization and standards.

Unit II	CONVEYANCE SYSTEM	07 Hours

Water supply -intake structures -Functions and drawings -Pipes and conduits for water- Pipe materials - Hydraulics of flow in pipes -Transmission main design – Materials of pipes- Laying, jointing and testing of pipes - Drawings appurtenances - Types and capacity of pumps -Selection of pumps and pipe materials.

Unit III	WATER TREATMENT	12 Hours

Objectives - Unit operations and processes - Principles, functions design and drawing of Screens, Flash mixers, flocculators, sedimentation tanks and sand filters - Disinfection- Residue Management.

Unit IV	ADVANCED WATER TREATMENT	09 Hours

Aerator - Iron and manganese removal, Defluoridation and demineralization -Water softening - Desalination - Membrane Systems-Construction and Operation & Maintenance aspects of Water Treatment Plants- Recent advances-Membrane processes.

Unit V	WATER DISTRIBUTION AND SUPPLY TO BUILDINGS	09 Hours

Requirements of water distribution -Components -Service reservoirs -Functions and drawings -Network design - Analysis of distribution networks –Pipe Appurtenances -operation and maintenance -Leak detection, Methods. Principles of design of water supply in buildings -House service connection -Fixtures and fittings -Systems of plumbing and drawings of types of plumbing.

	Total:	45 Hours

Further Reading:

9. Apply an appropriate unit system for the water treatment.
10. Estimate the quantity of wastewater and storm run-off generated from the town/ city and design a suitable collection system for the generated wastewater.

Course Outcomes:

After completion of the course, Student will be able to

6. Discuss about the principles and development of water supply system.
7. Design the pipelines for water supply system governed with head loss.
8. Design drawing of various unit operations in water supply system.
9. Identify the methods for removing contaminants in water treatment system using advanced techniques.
10. Interpret the network for water supply to buildings and House service connection.

References:

4. Garg, S.K., "Environmental Engineering", Vol.1 Khanna Publishers, New Delhi, 2005.
5. Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2005.
6. Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2005

1702CE652		ENVIRONMENTAL AND IRRIGATION DESIGN AND DRAWING	L	T	P	C
			3	0	0	3

Course Objectives:

1.to know about the design of environmental structures

2.to know the pictorial representation of irrigation structures

Unit I	**WATER SUPPLY AND TREATMENT**	**08 Hours**

Design &Drawing of flash mixer, flocculator, clarifier – Slow sand filter – Rapid sand filter – Infiltration gallery – Intake towers – Service reservoirs – Pumping station – House service connection for water supply and drainage.

Unit II	**SEWAGE TREATMENT & DISPOSAL**	**07 Hours**

Design and Drawing of screen chamber - Grit channel - Primary clarifier - Activated sludge process – Aeration tank & oxidation ditch – Trickling filters – Secondary clarifiers – Sludge digester – Sludge drying beds – Waste stabilisation ponds - Septic tanks and disposal arrangements – Manholes.

Unit III	**IMPOUNDING STRUCTURES**	**12 Hours**

Gravity dam, Tank Surplus Weir, Tank Sluice with tower road – Drawing showing plan, elevation, half section including foundation details.

Unit IV	**CANAL TRANSMISSION STRUCTURES**	**09 Hours**

Aqueducts – Syphon Aqueducts – Super passage – Canal siphon – Canal Drops- Drawing showing plan, elevation and foundation details.

Unit V	**CANAL REGULATION STRUCTURES**	**09 Hours**

Canal head works- Canal Regular – Canal escape- Proportional Distributors – Drawing showing detailed plan, elevation and foundation.

Total:	**45 Hours**

Further Reading:

1.to analyse and draw advanced irrigation and environmental structures

Course Outcomes:

After completion of the course, Student will be able to

1.design environmental treatment system

2. design the irrigationimpounding structures

3. design the canal transmission structures

4. design the canal regulation structures

References:

1.Garg, S.K., "Environmental Engineering", Vol.1 Khanna Publishers, New Delhi, 2005.

2.Sathyanarayana Murthy "Irrigation Design and Drawing" Published by MrsL.Banumathi, Tuni east Godavari District. A.P. 1998

3.Sharma R.K. Irrigation Engineering and Hydraulic Structures Oxford and IBH Publishing co., New Delhi 2002.

4.Modi, P.N. "Water Supply Engineering", Vol. I Standard Book House, New Delhi, 2005.

5.Punmia, B.C., Ashok K Jain and Arun K Jain, "Water Supply Engineering", Laxmi Publications Pvt. Ltd., New Delhi, 2005

1702CE702		WASTE WATER ENGINEERING	L	T	P	C
			3	0	0	3

Course Objectives:

1. To understand the importance of planning and design of sewerage system.
2. To create an ability to evaluate the waste water treatment system.
3. To impart the signification of disposal of Sewage.

Unit I	PLANNING FOR SEWERAGE SYSTEMS	09 Hours

Sources of wastewater generation – Effects – Estimation of sanitary sewage flow – Estimation of storm runoff – Factors affecting Characteristics and composition of sewage and their significance – Effluent standards – Legislation requirements.

Unit II	DESIGN OF SEWER	09 Hours

Sewerage – Hydraulics of flow in sewers – Design period - Design of sanitary and storm sewers – Small bore systems – Materials of sewers– Laying, joining & testing of sewers – Forces acting on sewers– Cleaning and maintenances of sewers- Sewer appurtenances – Pumps – selection of pumps and pipe Drainage -. Plumbing System for Buildings – One pipe and two pipe system.

Unit III	PRIMARY TREATMENT OF SEWAGE	09 Hours

Objective – Unit Operation and Processes – Selection of treatment processes – Principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – Operation and Maintenance aspects – Onsite sanitation - Septic tank, Grey water harvesting.

Unit IV	SECONDARY TREATMENT OF SEWAGE	09 Hours

Objective – Selection of Treatment Methods – Principles, Functions, Design and Drawing of Units - Activated Sludge Process and Trickling filter, other treatment methods – Oxidation ditches, UASB – Waste Stabilization Ponds – Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction and Operation & Maintenance of Sewage Treatment Plants.

Unit V	DISPOSAL OF SEWAGE AND SLUDGE	09 Hours

Standards for Disposal - Methods – dilution – Self-purification of surface water bodies – Oxygen sag curve – Land disposal – Sewage farming – Deep well injection – Soil dispersion system -Sludge characterization – Thickening – Sludge digestion – Biogas recovery – Sludge Conditioning and Dewatering – disposal – Advances in Sludge Treatment and disposal.

	Total:	45 Hours

Further Reading:

3. Design the necessary treatment units for energy conservation.
4. Design the suitable disposal unit for the sludge without endangering the environment.

Course Outcomes:

After completion of the course, Student will be able to

6. Examine the waste water quality characteristics and standards.
7. Design sewerage systems and discuss about the treatment process step by step done in primary level.
8. Design the various unit operations for waste water treatment.
9. Design the sludge treatment and disposal methods.
10. Perform quality analysis of sewage the characteristics and composition of sewage, self - Purification of streams.

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1703CE006		SOLID WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

- To study the Sources and types of municipal solid wastes
- To impart the knowledge of On-site Processing, collection and transfer of solid waste.
- To acquire the knowledge of Off –site Processing and waste disposal management.

Unit I	**SOURCES AND TYPES OF MUNICIPAL SOLID WASTES**	**8 Hours**

Sources and types of solid wastes - Quantity – factors affecting generation of solid wastes- characteristics – methods of sampling and characterization- Effects of improper disposal of solid wastes – public health effects- Principle of solid waste management – social & economic aspects - Public awareness- Role of NGOs- Legislation.

Unit II	**ON-SITE STORAGE & PROCESSING**	**8 Hours**

On-site storage methods – materials used for containers – on-site segregation of solid wastes – public health & economic aspects of storage – options under Indian conditions – Critical Evaluation of Options.

Unit III	**COLLECTION AND TRANSFER**	**8 Hours**

Methods of Collection – types of vehicles – Manpower requirement – collection routes; transfer stations – selection of location, operation & maintenance; options under Indian conditions.

Unit IV	**OFF-SITE PROCESSING**	**12 Hours**

Processing techniques and Equipment; Resource recovery from solid wastes – composting, incineration, Pyrolysis - options under Indian conditions.

Unit V	**DISPOSAL**	**9 Hours**

Dumping of solid waste; sanitary landfills – site selection, design and operation of sanitary landfills – Leachate collection & treatment

Total:	**45 Hours**

Further Reading:

- They can categorize the types of wastes
- They can choose the disposal units

Course Outcomes:

After completion of the course, Student will be able to

- Explain the Sources and types of municipal solid wastes
- Interpret the suitable method of Segregation of solid waste under Indian condition.
- Identify the methods of collectionand transfer of solid wastes
- Demonstrate the suitable Off –site Processing techniques
- Choose the various options for disposal of wastes and their selection criteria

References:

Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000

R.E.Landreth and P.A.Rebers, Municipal Solid Wastes – problems and Solutions, Lewis Publishers, 1997.

1703CE009		GROUNDWATER ENGINEERING	L	T	P	C
			3	0	0	3

Course Objectives:

1.To introduce the student to the principles of Groundwater governing Equations andCharacteristicsofdifferentaquifers

2.Characteristicsofdifferentaquifers

3.To understand the techniques of development and management of groundwater

4.To be introduced to the different theories of traffic flow

5.To be aware of the importance of traffic safety

Unit I	HYDROGEOLOGICAL PARAMETERS	9 Hours

Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation – Ground water table fluctuation and its interpretations – Groundwater development and Potential in India – GEC norms.

Unit II	WELLHYDRAULICS	9Hours

ObjectivesofGroundwaterhydraulics–Darcy'sLaw-Groundwaterequation–steadystate flow.DupuitForchheimerassumption-Unsteadystateflow-Theismethod-JacobMethod-Slug tests – Imagewell theory –Partial penetrationsof wells

Unit III	GROUNDWATER MANAGEMENT	9Hours

Need for Management Model – Database for groundwater management –groundwater balance study – Introduction to Mathematical model – Conjunctive use – Collector well and Infiltration gallery

Unit IV	GROUNDWATER QUALITY	9 Hours

Ground water chemistry - Origin, movement and quality - Water quality standards – Health and aesthetic aspects of water quality - Saline intrusion – Environmental concern and Regulatory requirements

Unit V	GROUNDWATER CONSERVATION	9 Hours

Artificial recharge techniques – Remediation of Saline intrusion– Ground water management studies – Protection zone delineation, Contamination source inventory, remediation schemes
- Ground water Pollution and legislation.

	Total:	45 Hours

Further Reading:

3. Ground water to improving quality parameter
4. Water resource and hydrology for features need.

Course Outcomes:

1. Students will be able to understand aquifer properties and its dynamics after the completionof thecourse.Itgivesanexposuretowardswelldesignandpracticalproblems ofgroundwateraquifers

2. Studentswillbeabletounderstandtheimportanceofartificialrechargeandgroundwater qualityconcepts

3. Modelregionalgroundwaterflowanddesignwaterwells

4.Estimatewaterqualityparameters

5.To safety ground water improvements of quality parameter

E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

NAGAPATTINAM – 611 002. TAMILNADU, INDIA

Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai

(Accredited by NAAC with 'A' Grade and NBA)

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ME ENVIRONMENTAL ENGINEERING

17EV102		ENVIRONMENTAL CHEMISTRY	L	T	P	C
			3	0	0	3

Course Objectives:

13. To educate the students about water chemistry
14. To impart knowledge in the area of air and soil chemistry
15. To impart knowledge on the transformation of chemicals in the environment

Unit I	**Introduction**	**9 Hours**

Stoichiometry and mass balance-Chemical equilibrium, acid base, solubility product (Ksp), heavy metal precipitation, amphoteric hydroxides, CO2 solubility in water and species distribution – Chemical kinetics, First order- 12 Principles of green chemistry.

Unit II	**Aquatic Chemistry**	**11 Hours**

Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation – Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction,pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation.

Unit III	**Atmospheric Chemistry**	**7 Hours**

Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, CO_2 capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination.

Unit IV	**Soil Chemistry**	**9 Hours**

Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

Unit V	**Environmental Chemicals**	**9 Hours**

Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins,PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.

Total:	**45 Hours**

Further Reading

To analyze and create a solution for environmental issues.

Course Outcomes:

After completion of the course, Student will be able to

21. Distinguish the chemistry involved
22. Understand the chemistry involved in water
23. Identify and solve the air pollution related issues
24. Understand the soil related chemistry and issues
25. Identify contaminating chemicals and can work out chemicals need calculations for treatment purpose

17EV103		ENVIRONMENTAL MICROBIOLOGY	L	T	P	C
			3	0	0	3

Course Objectives:

21. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
22. The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.
23. The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease-causing organisms are also covered.
24. An exposure to toxicology due to industrial products and byproducts are also covered.
25. The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.

Unit I **Classification And Characteristics** **5 Hours**

Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

Unit II **Microbes And Nutrient Cycles** **10 Hours**

Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaebacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Micro Organism in nutrient cycle.

Unit III **Metabolism of Microorganisms** **10 Hours**

Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb"s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

Unit IV **Pathogens in Wastewater** **10 Hours**

Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan, and Helminths, Indicator organisms of water – Coliforms - total coliforms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, □-oxidation, β-oxidation, nitrification and de-nitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.

Unit V **Toxicology** **10 Hours**

Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bio concentration – Bioaccumulation, bio magnification, bioassay, bio monitoring, bioleaching.

Total: 45 Hours

Further Reading

Identification and culturing of microorganisms from different sources

Course Outcomes:

After completion of the course, Student will be able to

21. The candidate at the end of the course will have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.
22. The candidate would be able to understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
23. The candidate would have understood the role microbial metabolism in a wastewater treatment plant.
24. The candidate would know the role of microorganisms in contaminated water and the

	25. The candidate has the ability to conduct and test the toxicity due to various natural and synthetic products in the environment.

References:	
29. S.C.Bhatia, Hand Book of Environmental Microbiology, Part 1 and 2, Atlantic Publisher	
30. Gabriel Bitton, Wastewater Microbiology, 2nd Edition ,	
31. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, Environmental Microbiology, Academic Press.	
32. SVS. Rana, Essentials of Ecology and Environmental Science, 3rd Edition, Prentice Hall of India Private Limited	
33. Stanley E. Manahan, Environmental Science and Technology, Lewis Publishers.	
34. Hurst, C.J. (2002) Manual of Environmental Microbiology. 2nd Ed. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 - X.	
35. Frank C. Lu and Sam Kacew, LU"s Basic Toxicology, Taylor & Francis, London (4th Ed), 2002	

17EV104		TRANSPORT OF WATER AND WASTEWATER	L	T	P	C
			3	0	0	3

Course Objectives:

9. To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain
10. To educate the students in computer application on design.

Unit I	General Hydraulics and Flow Measurement	8 Hours

Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

Unit II	Water Transmission and Distribution	10 Hours

Need for Transport of water and wastewater-Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps- characteristics-economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

Unit III	Wastewater Collection and Conveyance	10 Hours

Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

Unit IV	Storm Water Drainage	7 Hours

Necessity- - combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods.

Unit V	Case Studies and Software Applications	10 Hours

Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

	Total:	45 Hours

Further Reading

Designing of pipelines and sewers for various project areas

Course Outcomes:

After completion of the course, Student will be able to

21. Understand the fluid flow properties
22. Design water supply main, distribution network and sewer for various field conditions
23. Design the drainage network for wastewater
24. Design the storm water drainage systems
25. Troubleshooting in water and sewage transmission be able to use various computer software for the design of water and sewage network

17EV105		PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

9. To educate the students on the principles and process designs of various treatment systems for water and wastewater
10. To educate the students on design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I	Introduction	5 Hours

Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physio-chemical treatment – Selection criteria-types of reactors- reactor selection-batch- continuous type-kinetics.

Unit II	Treatment Principles	10 Hours

Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra-filtration and hyper filtration electro dialysis, distillation – stripping and crystallization – Recent Advances. Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends

Unit III	Design of Municipal Water Treatment Plants	10 Hours

Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts – Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit IV	Design of Industrial Water Treatment Plants	10Hours

Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.

Unit V	Design of Wastewater Treatment Plants	10 Hours

Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks- sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers- floatation units-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.

Total:	45 Hours

Further Reading

Implementation of advanced treatment technologies for various wastewater treatment

Course Outcomes:

After completion of the course, Student will be able to

21. Identify the pollutants type in the wastewater
22. Understand the various treatment principles
23. Design the sewage treatment plants
24. Design suitable treatment units for various industries
25. Develop conceptual schematics required for the treatment of wastewater

17EV106		ENVIRONMENTAL CHEMISTRY LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

9. To train in the analysis of physical parameters of water and waste water
10. To train in the analysis of chemical parameters of water and waste water

List of Experiments:

21. Good Laboratory Practices, Quality control, calibration of Glassware 03
22. Sampling and Analysis of water (pH, alkalinity, hardness chloride, Sulphate, turbidity EC, TDS, nitrate, fluoride) 12
23. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals). 12
24. Sampling and analysis of air pollutants Ambient & Stack (RSPM, SO2 and NOx) 09
25. Sampling and characterization of soil (CEC & SAR, pH and K). 09

	Total :	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

9. assess quality of environment
10. conduct analysis on characteristics of water and waste water

References:

21. APHA, Standard Methods for the Examination of Water and Wastewater, 21st Ed.
22. Washington, 2005.
23. Laboratory Manual for the Examination of water, wastewater soil Rump, H.H. and Krist, H.
24. Second Edition, VCH, Germany, 1992.
25. Methods of air sampling &analysis, JamesP.Lodge Jr(Editor) 3rd Edition, Lewis publishers,Inc,USA,1989.

17EV107		ENVIRONMENTAL MICROBIOLOGY LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

7. To train in the analysis of physical parameters of water and waste water
8. To train in the analysis of chemical parameters of water and waste water

List of Experiments:

43. Preparation of culture media
44. Isolation, culturing and Identification of Microorganisms
45. Microorganisms from polluted habitats (soil, water and air)
46. Measurement of growth of microorganisms, Assay of enzymes involved in biotransformation
47. Biodegradation of organic matter in waste water Analysis of air borne microorganisms
48. Staining of bacteria
49. Effect of pH, temperature on microbial growth
50. Pollutant removal using microbes from industrial effluent.
51. Effect of pesticides on soil microorganisms
52. Bacteriological analysis of wastewater (Coliforms, E.coli, Streptococcus) – MPN
53. Bacteriological analysis of wastewater (Coliforms, Streptococcus) - MF techniques
54. Effect of Heavy metals on microbial growth

55. Detection of Anaerobic bacteria (Clostridium sp.)		
56. Bioreactors		
	Total :	**45 Hours**
Course Outcomes:		
	After completion of the course, Student will be able to	
	7. Field oriented testing of water, wastewater and solid waste for microbial contamination.	
	8. Perform toxicity test.	
References:		
10. Standard methods for the examination of water and wastewater, American Public Health Association (21st edition) 2005.		
11. Charles Gerba, Environmental Microbiology: A laboratory manual, Elsevier Publications, 2012.		
12. Christon J. Hurst, Ronald L. Crawford, Jay L. Garland, David A. Lipson, Aaron L. Mills, and Linda D. Stetzenbach, Manual of Environmental Microbiology, 3rd Edition, ASM Press, 2007.		

17EV201		PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEMS	L	T	P	C
			3	0	0	3

Course Objectives:

To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.

Unit I	Introduction	10 Hours

Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth - Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process- reactors-batch-continuous type.

Unit II	Aerobic Treatment of Wastewater	10 Hours

Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfection – disposal options – reclamation and reuse – Flow charts, layout, PID, hydraulic profile, recent trends.

Unit III	Anaerobic Treatment of Wastewater	10 Hours

Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal – Nutrient removal systems – Flow chart, Layout and Hydraulic profile – Recent trends.

Unit IV	Sludge Treatment and Disposal	5 Hours

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

Unit V	Construction Operations and Maintenance Aspects	10 Hours

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and controlling of plant operations – capacity building - Retrofitting Case studies – sewage treatment plants – sludge management facilities.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

9. Develop conceptual schematics required for biological treatment of wastewater
10. Translate pertinent criteria into system requirements.

References:

17. Arceivala, S.J., Wastewater Treatment for Pollution Control, TMH, New Delhi, Second Edition, 2000.
18. Manual on "Sewerage and Sewage Treatment" CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
19. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
20. F.R. Spellman, Hand Book of Water and Wastewater Treatment Plant operations, CRC Press, New York (2009).

17EV202		AIR POLLUTION MONITORING AND CONTROL	L	T	P	C
			3	0	0	3

Course Objectives:	
	To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends

Unit I	Introduction	7 Hours

Structure and composition of Atmosphere – Sources and classification of air pollutants - Effects of air pollutants on human health, vegetation & animals, Materials & Structures – Effects of air Pollutants on the atmosphere, Soil & Water bodies – Long- term effects on the planet – Global Climate Change, Ozone Holes – Ambient Air Quality and Emission Standards – Air Pollution Indices – Emission Inventories – Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants.

Unit II	Air Pollution Modelling	5 Hours

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques - Air Pollution Climatology.

Unit III	Control Of Particulate Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working principle, Design and performance equations of Gravity Separators (cyclone) , Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Costing of APC equipment – Case studies for stationary and mobile sources.

Unit IV	Control of Gaseous Contaminants	11 Hours

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations - Costing of APC Equipment – Case studies for stationary and mobile sources.

Unit V	Indoor Air Quality Management	11 Hours

Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control – Membrane process - UV photolysis – Internal Combustion Engines - Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

	Total:	45 Hours

Course Outcomes:	
	After completion of the course, Student will be able to
	13. Apply sampling techniques
	14. Apply modelling techniques
	15. Suggest suitable air pollution prevention equipment's and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards

17EV203		INDUSTRIAL WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.

Unit I **Introduction** **8 Hours**

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

Unit II **Industrial Pollution Prevention & Waste Minimisation** **8 Hours**

Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

Unit III **Industrial Wastewater Treatment** **10 Hours**

Flow and Load Equalization – Solids Separation – Removal of Fats, Oil & Grease- Neutralization – Removal of Inorganic Constituents – Precipitation, Heavy metal removal , Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis& Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies.

Unit IV **Wastewater Reuse and Residual Management** **9 Hours**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects.

Unit V **Case Studies** **10 Hours**

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

17. Define the Principles of pollution prevention and mechanism of oxidation processes.
18. Suggest the suitable technologies for the treatment of wastewater.
19. Discuss about the wastewater characteristics
20. Design the treatment systems

17EV204		SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment.

Unit I **Sources, Classification and Regulatory Framework** **9 Hours**

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.

Unit II **Waste Characterization and Source Reduction** **8 Hours**

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

Unit III **Storage, Collection and Transport Of Wastes** **9 Hours**

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

Unit IV **Waste Processing Technologies** **10 Hours**

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

Unit V **Waste Disposal** **9 Hours**

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

13. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
14. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste
15. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges

17EV205		ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
			3	0	0	3

Course Objectives:

9. To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan.
10. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.

Unit I	Introduction	8 Hours

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public Participation in EIA.

Unit II	Impact Identification and Prediction	10 Hours

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative Impact Assessment.

Unit III	Social Impact Assessment and EIA Documentation	8 Hours

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	Environmental Management Plan	7 Hours

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	Environmental Risk Assessment and Management	12 Hours

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipathway exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

9. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
10. Know about the legal requirements of Environmental and Risk Assessment for projects.

17EV206		UNIT OPERATIONS AND PROCESSES LABORATORY	L	T	P	C
			0	0	2	1

Course Objectives:

9. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.
10. To develop the skill for conducting Treatability studies of water and wastewater treatment by various Unit Operations and Processes using laboratory scale models.

List of Experiments:

41. Coagulation and Flocculation 7
42. Batch studies on settling 10
43. Studies on Filtration- Characteristics of Filter media 7
44. Water softening 7
45. Adsorption studies/Kinetics 7
46. Reverse Osmosis- Silt Density Index 7
47. Kinetics of suspended growth process (activated sludge process)- Sludge volume Index 14
48. Anaerobic Reactor systems / kinetics (Demonstration) 10
49. Advanced Oxidation Processes – (Ozonation, Photocatalysis) 14
50. Disinfection for Drinking water 7

Total :	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

9. Conduct treatability studies for water and waste water treatment.
10. Design laboratory models for various unit operations and processes.

References:

17. Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
18. Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, Mc Graw Hill, New York, 1999.
19. Casey T.J., Unit Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.
20. David W.Hendricks, „Water Treatment Unit Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.

17EV001		AIR POLLUTION METEOROLOGY AND MODELING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I **Atmospheric Pollution** **9 Hours**

Atmospheric Pollution, type of pollutants, gaseous and particulate pollutants, size of atmospheric particles, emission inventory, various sources of emissions, bio-mass burning, pollution formation in combustion, Visibility and Acid Deposition Industrial pollution.

Unit II **Meteorology** **9 Hours**

Air pollution meteorology: sources of air pollution, methods for air pollution measurement and control, meteorological factors that contribute to air quality degradation, basic chemistry of the atmosphere and how it contributes to secondary pollutant formation. Effect of air pollution on Human health, material and vegetation, Deposition of particulate pollutants in the respiratory system.

Unit III **Transport Models** **9 Hours**

Atmospheric chemical transport models, box models, three-dimensional atmospheric chemical transport models, components of air quality forecasting and modelling, evaluation and validation, air quality standards and index, long range transport of pollutants. Back trajectory construction and applications

Unit IV **Dispersion Models** **9 Hours**

Transport and dispersion of air pollutants - wind velocity, wind speed and turbulence; estimating concentrations from point sources - the Gaussian Equation - atmospheric stability - Air pollution modelling and prediction - Plume rise, modelling techniques.

Unit V **Software Modelling** **9 Hours**

Exposure to computer models for air quality.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

7. Know the causes of climate change
8. Know the effects of climate change on various environments and various models.

References:

13. Rao.M.N. &RaoH.V.N., "Air Pollution", Tata McGraw Hill,2006.
14. Richard W.Boubel, Donald L. Fox, D.Bruce Turner& Arthur C. Stern, "Fundamentals of Air Pollution, Hardcover", 2007.
15. Kenneth Wark, Cecil F. Warn,"Air pollution its origin and control", 2007.
16. StevenC.Chapra, "Surface Water quality modeling", The McGraw-Hill- Companies Inc., New York, 1997.

17EV002		CLIMATE CHANGE AND MODELING	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

Unit I	Climate Change and Climate Variability	9 Hours

Introduction – Atmosphere - weather and Climate - climate parameters (Temperature ,Rainfall, Humidity, Wind etc) – Equations governing the atmosphere - Numerical Weather Prediction Models - Introduction to GCMs - Application in Climate Change Projections.

Unit II	IPCC SRES Scenarios	9 Hours

Intergovernmental Panel on Climate Change (IPCC) - An Overview - Key Assumptions - Scenario Family - Storyline (A1, B1, A2, B2).

Unit III	Global Climate MODEL (GCM) and Regional Climate Model (RCM)	9 Hours

Some typical GCMs (HadCM3Q-UK Met Office) - Issues with GCMs - Introduction to RCMs and LAMs - some typical RCMs like PRECIS, Sim CLIM, MAGICC/SCENGENE - Advantages and Disadvantages of GCMs and RCMs.

Unit IV	Downscaling Global Climate Model - An Overview	9 Hours

Need for downscaling - Selection of GCMs for regional climate change studies - Ensemble theory – Selection of - Ensembles, Model Domain (Spatial domain and temporal domain), Resolution and climate variables - Lateral boundary conditions - Methods of downscaling (Statistical and Dynamical) - examples from each and their limitations.

Unit V	Analysis /Post Processing	9 Hours

a. Model validation - post processing – Introduction to Analysis tools - Ferret, R, Grads, IDL, SPSS, ArcGIS
b. Climate change Impact - Vulnerability assessment – adaptation strategies.

	Total:	45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1.Know the causes of climate change

2.Know the effects of climate change on various environments and various models.

References:

13. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK.
14. McGuffie, K. and Henderson-Sellers, A. "A Climate Modelling Primer, Third Edition, John Wiley & Sons, Ltd, Chichester, UK. ,2005
15. Neelin David J, "Climate Change and Climate Modelling", Cambridge University Press
16. Thomas Stocker, "Introduction to Climate Modelling", Advances in Geophysical and Environmental Mechanics and Mathematics. Springer Publication.

17EV005		ENVIRONMENTAL POLICIES AND LEGISLATION	L	T	P	C
			3	0	0	3

Course Objectives:

To impart knowledge on the policies, legislations, institutional frame work and enforcement mechanisms for environmental management in India.

Unit I **Introduction** **9 Hours**

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration– Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework(SPCB/CPCB/MoEF)

Unit II **Water (P&CP) Act, 1974** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

Unit III **Air (P&CP) Act, 1981** **8 Hours**

Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation

Unit IV **Environment (Protection) Act 1986** **13 Hours**

Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

Unit V **Other Topics** **7 Hours**

Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

9. Know the National environmental legislations and the policies
10. plan programmes to comply with the legal requirements related to organizations

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17EV008		MEMBRANE TECHNOLOGIES FOR WATER AND WASTE WATER TREATMENT	L	T	P	C
			3	0	0	3

Course Objectives:

To introduce the concept and principles of membrane separation and its applications in water and wastewater treatment.

Unit I **Membrane Filtration Processes** **10 Hours**

Solid Liquid separation systems- Theory of Membrane separation – mass Transport Characteristics- Cross Flow filtration - Membrane Filtration- Flux and Pressure drop -Types and choice of membranes, porous, non-porous, symmetric and asymmetric – Plate and Frame, spiral wound and hollow fibre membranes – Liquid Membranes

Unit II **Membrane Systems** **10 Hours**

Microfiltration principles and applications – Ultra filtration principles and applications - Nano Filtration principles and applications – Reverse Osmosis: Theory and design of modules, assembly, plant process control and applications – Electro dialysis : Ion exchange membranes, process design- Pervaporation – Liquid membrane – Liquid Pertraction – Supported Liquid Membrane and Emulsion Liquid membrane - Membrane manufactures – Membrane Module/Element designs – Membrane System components – Design of Membrane systems - pump types and Pump selection– Plant operations – Economics of Membrane systems

Unit III **Membrane Bioreactors** **9 Hours**

Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations, Commercial Technologies, Case Studies.

Unit IV **Pretreatment Systems** **8 Hours**

Membrane Fouling – Control of Fouling and Concentration Polarisation-Pretreatment methods and strategies – monitoring of Pretreatment – Langlier Index, Silt Density Index, Chemical cleaning , Biofoulant control.

Unit V **Case Studies** **8 Hours**

Case studies on the design of membrane-based water and wastewater treatment systems – zero Liquid effluent discharge Plants – Desalination of brackish water.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be

13. familiar with main membrane processes, principles, separation mechanisms, and applications
14. understand the selection criteria for different membrane processes
15. know the principle of the most common membrane applications
16. Carry out design of project for a particular membrane technology application.

17EV009		REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MANAGEMENT	L	T	P	C
			3	0	0	3

Course Objectives:

13. To educate the students on aspects of Remote Sensing
14. Develop the different remote sensing technique
15. To educate the students on aspects of GIS and data management
16. Develop the GIS Applications for monitoring and management of environment

Unit I	**Remote Sensing Elements**	**8 Hours**

Historical Perspective, Principles of remote sensing, components of Remote Sensing, Energy source and electromagnetic radiation, Electromagnetic spectrum, Energy interaction, Spectral response pattern of earth surface features, Energy recording technology.

Unit II	**Remote Sensing Technology**	**9 Hours**

Classification of Remote Sensing Systems, Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR

Unit III	**Social Impact Assessment and EIA Documentation**	**9 Hours**

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials – Report preparation.

Unit IV	**Environmental Management Plan**	**10 Hours**

Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies.

Unit V	**Environmental Risk Assessment and Management**	**9 Hours**

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs.

Total:	**45 Hours**

Course Outcomes:

After completion of the course, Student will be able to

7. Understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
8. Know about the legal requirements of Environmental and Risk Assessment for projects.

GE6075 PROFESSIONALETHICSINENGINEERING LTPC

3 003

UNITI HUMANVALUES 10

Morals,values andEthics–Integrity–Workethic –Servicelearning–Civic virtue –Respectforothers–Livingpeacefully–Caring–Sharing–Honesty–Courage–Valuingtime–Cooperation–Commitment – Empathy – Self confidence– Character – Spirituality – Introduction to Yoga andmeditationforprofessionalexcellenceandstressmanagement.

UNITII ENGINEERINGETHICS 9

Sensesof'EngineeringEthics'–Varietyofmoralissues–Typesofinquiry–Moraldilemmas–MoralAutonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models ofprofessional roles - Theories about right action – Self-interest – Customs and Religion – Uses ofEthicalTheories

UNITIII ENGINEERINGAS SOCIALEXPERIMENTATION 9

Engineeringas Experimentation –Engineers as responsible Experimenters – Codes of Ethics – ABalancedOutlookonLaw.

UNITIV SAFETY,RESPONSIBILITIESANDRIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – OccupationalCrime–ProfessionalRights–EmployeeRights–IntellectualPropertyRights(IPR)–Discrimination

UNITV GLOBALISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – MoralLeadership–CodeofConduct–CorporateSocialResponsibility

TOTAL:45PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discussthe ethical issuesrelated to engineeringand realize the responsibilities and rights in thesociety

TEXTBOOKS:

1. MikeW.MartinandRolandSchinzinger,"EthicsinEngineering",TataMcGrawHill,NewDelhi,2003.
2. GovindarajanM,NatarajanS,SenthilKumarV.S,"EngineeringEthics",PrenticeHallofIndia,NewDelhi,2004.

REFERENCES:

1. Charles B.Fleddermann,"EngineeringEthics",Pearson Prentice Hall,New Jersey, 2004.
2. CharlesE.Harris,MichaelS.PritchardandMichaelJ.Rabins,"EngineeringEthics–ConceptsandCases",CengageLearning,2009
3. JohnRBoatright, "Ethics andtheConductofBusiness", PearsonEducation,NewDelhi,2003
4. EdmundGSeebauerandRobertLBarry,"FundametalsofEthicsforScientistsandEngineers",OxfordUniversityPress,Oxford,2001
5. LauraP.HartmanandJoeDesjardins,"BusinessEthics:DecisionMakingforPersonalIntegrityandSocial Responsibility"McGrawHill education,IndiaPvt. Ltd.,NewDelhi 2013.

GE6351 ENVIRONMENTALSCIENCEANDENGINEERING

UNITI ENVIRONMENT,ECOSYSTEMSAND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards,Biological hazards in the environment – conceptof an ecosystem – structure and function of anecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flowin the ecosystem – ecological succession processes – Introduction, types, characteristic features,structureandfunctionofthe(a)forestecosystem(b)grasslandecosystem(c)desertecosystem(d)aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversitydefinition: genetic, species and ecosystem diversity – biogeographical classification of India – value ofbiodiversity:consumptiveuse,productiveuse,social,ethical,aestheticandoptionvalues–Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots ofbiodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangeredandendemicspeciesofIndia–conservationofbiodiversity:In-situandex-situconservation of biodiversity. Field study of common plants, insects, birds Field study of simpleecosystems—pond,river,hillslopes,etc.

UNITII ENVIRONMENTAL POLLUTION 10

Definition — causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry-Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formationofsmog,PAN,acidrain,oxygenandozonechemistry;-Mitigationprocedures-Controlofparticulateandgaseousemission,ControlofSO$_2$,NO$_X$,COandHC)(b)Waterpollution:Physicaland chemical properties of terrestrial and marine water and their environmental significance; Waterquality parameters – physical, chemical and biological; absorption of heavy metals - Water treatmentprocesses. (c) Soil pollution - soil waste management: causes, effects and control measures ofmunicipal solid wastes — (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclearhazards–role of an individual in prevention of pollution — pollution case studies — Field study of localpollutedsite—Urban/Rural/Industrial/Agricultural.

UNITIII NATURALRESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining,dams and their effects on forests and tribal people — Water resources: Use and overutilization ofsurfaceandgroundwater, dams-benefitsandproblems—Mineralresources:Useandexploitation,environmental effects of extracting and using mineral resources, case studies — Food resources:World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture,fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energyneeds, renewable and non renewable energy sources, use of alternate energy sources. EnergyConversion processes — Biogas — production and uses, anaerobic digestion; case studies — Landresources:Landasaresource,landdegradation,maninducedlandslides,soil erosionanddesertification – role of an individual in conservation of natural resources – Equitable use of resourcesforsustainablelifestyles.IntroductiontoEnvironmentalBiochemistry:Proteins–Biochemicaldegradation of pollutants, Bioconversion of pollutants. Field study of local area to documentenvironmentalassets–river/forest/grassland/hill/mountain.

UNITIV SOCIAL ISSUESAND THE ENVIRONMENT 7

Fromunsustainable to sustainable development–urban problems related to energy –waterconservation, rain

ofpeople;itsproblemsandconcerns,casestudies–roleofnon-governmentalorganization-environmentalethics:Issuesandpossiblesolutions–12Principlesofgreenchemistry-nuclear

accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products –environment production act – Air act – Water act – Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme oflabelingofenvironmentallyfriendlyproducts(Ecomark).enforcementmachineryinvolvedinenvironmental legislation-central and state pollution control boards- disaster management: floods,earthquake,cycloneandlandslides.Publicawareness.

UNITV HUMANPOPULATIONANDTHEENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and childwelfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology inenvironmentandhumanhealth–Casestudies.

TOTAL:45PERIODS

TEXTBOOKS:

1. GilbertM.Masters,"IntroductiontoEnvironmentalEngineeringandScience",2ndedition,PearsonEducation,2004.
2. BennyJoseph,"Environmental ScienceandEngineering",TataMcGraw-Hill,NewDelhi,2006.

REFERENCES:

1. Trivedi.R.K.,"HandbookofEnvironmentalLaws,Rules,Guidelines,CompliancesandStandards",Vol.Iand II,EnviroMedia,3rd edition,BPBpublications,2010.
2. Cunningham,W.P.Cooper,T.H.Gorhani,"EnvironmentalEncyclopedia",JaicoPubl.,House,Mumbai,2001.
3. DharmendraS.Sengar,"Environmentallaw",PrenticehallofIndiaPVTLTD,NewDelhi,2007.
4. Rajagopalan,R,"EnvironmentalStudies-FromCrisis toCure", OxfordUniversityPress,2005.

ME6602 AUTOMOBILEENGINEERING LTPC

3003

OBJECTIVES:

- Tounderstandtheconstructionand workingprinciple ofvariouspartsofanautomobile.
- Tohavethepracticefor assemblinganddismantlingofenginepartsandtransmissionsystem

UNITI VEHICLE STRUCTUREAND ENGINES 9

Types of automobiles, vehicle construction and different layouts, chassis, frame andbody, Vehicle aerodynamics (various resistances and moments involved), IC engines –components-functions andmaterials,variablevalvetiming(VVT).

UNITII ENGINEAUXILIARYSYSTEMS 9

Electronically controlled gasoline injection system for SI engines, Electronically controlleddiesel injection system (Unit injector system, Rotary distributor type andcommon rail direct injection system), Electronic ignition system (Transistorized coil ignition system,capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by threeway catalyticconvertersystem,Emissionnorms(EuroandBS).

UNITIII TRANSMISSIONSYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive,transferbox, fluid flywheel,torque converter,propellershaft,slip joints, universal joints ,Differentialandrearaxle,HotchkissDriveandTorqueTubeDrive.

UNITIV STEERING,BRAKESANDSUSPENSION SYSTEMS 9

Steeringgeometryandtypesofsteeringgearbox-PowerSteering, Types of Front Axle,Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System(ABS),electronicbrakeforcedistribution(EBD)and TractionControl.

UNITV ALTERNATIVE ENERGY SOURCES 9

UseofNaturalGas,Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol andHydrogen in Automobiles-Engine modifications required –Performance, Combustion and EmissionCharacteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel CellNote: Practical Training in dismantling and assembling of Engine parts and Transmission Systemsshouldbe giventothestudents.

TOTAL:45PERIODS

OUTCOMES:

- Uponcompletionofthiscourse, the studentswillbeabletoidentifythedifferentcomponentsinautomobileengineering.
- Have clearunderstandingon differentauxiliaryand transmissionsystemsusual.

TEXTBOOKS:

1. KirpalSingh,"AutomobileEngineering",Vol1&2,SeventhEdition,StandardPublishers,NewDelhi,1997.
2. JainK.K.andAsthana.R.B,"AutomobileEngineering"TataMcGrawHillPublishers,NewDelhi,2002.

REFERENCES:

1. Newton ,Steeds andGaret,"MotorVehicles",Butterworth Publishers,1989.
2. JosephHeitner,"Automotive Mechanics," Second Edition, East-West Press,1999.

ME6701 POWERPLANTENGINEERING LTPC

3003

OBJECTIVES:

- ProvidinganoverviewofPowerPlantsanddetailingtheroleofMechanicalEngineersintheiroperationandmaintenance.

UNITI COALBASEDTHERMALPOWER PLANTS 10

Rankinecycle-improvisations,Layoutof moderncoalpowerplant, SuperCriticalBoilers,FBCBoilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants — Fuel andashhandling,Draughtsystem,Feed watertreatment.BinaryCyclesandCogenerationsystems.

UNITII DIESEL,GASTURBINEANDCOMBINED CYCLEPOWERPLANTS 10

Otto, Diesel, Dual &Brayton Cycle - Analysis &Optimisation.Components of Diesel and Gas Turbinepowerplants.CombinedCyclePowerPlants. Integrated GasifierbasedCombinedCyclesystems.

UNITIII NUCLEAR POWER PLANTS 7

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of NuclearReactors : Boil*ing Water Reactor* (BWR), P*ressurized Water Reactor* (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measuresforNuclearPowerplants.

UNITIV POWERFROMRENEWABLE ENERGY 10

Hydro Electric Power Plants — Classification, Typical Layout and associated components includingTurbines.Principle,Constructionandworkingof Wind,Tidal,*Solar*PhotoVoltaic(SPV),SolarThermal,GeoThermal, BiogasandFuelCellpowersystems.

UNITV ENERGY,ECONOMICANDENVIRONMENTALISSUESOFPOWERPLANTS 8

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria,relativemerits&demerits,Capital&OperatingCostofdifferentpowerplants.

Pollutioncontroltechnologies includingWasteDisposal OptionsforCoalandNuclearPowerPlants.

TOTAL:45PERIODS

TEXTBOOK:

1. Nag.P.K.,"PowerPlantEngineering",ThirdEdition,TataMcGraw–HillPublishingCompanyLtd., 2008.

REFERENCES:

1. El-Wakil.M.M.,"PowerPlantTechnology",TataMcGraw—HillPublishingCompanyLtd.,2010.
2. Black&Veatch,Springer, "PowerPlantEngineering", 1996.
3. ThomasC.Elliott,KaoChenandRobertC.Swanekamp,"PowerPlantEngineering",SecondEdition,Standard HandbookofMcGraw—Hill,1998.
4. GodfreyBoyle,"Renewableenergy",OpenUniversity,OxfordUniversityPressinassociationwiththeOpenUniversity,2004.

ME6016 ADVANCEDI.CENGINES

OBJECTIVES:

- Tounderstandthe underlyingprinciples ofoperation ofdifferentICEnginesandcomponents.
- Toprovideknowledgeonpollutant formation,control, alternatefuel etc.

UNITI SPARK IGNITIONENGINES 9

Mixturerequirements–Fuelinjectionsystems–Monopoint,Multipoint&Directinjection-Stagesofcombustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustionchambers.

UNITII COMPRESSIONIGNITION ENGINES 9

DieselFuelInjectionSystems-Stagesofcombustion–Knocking –Factorsaffectingknock– DirectandIndirectinjectionsystems–Combustionchambers–FuelSpraybehaviour– Spraystructureandspraypenetration–Airmotion-IntroductiontoTurbocharging.

UNITIII POLLUTANTFORMATIONAND CONTROL 9

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen,Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, SelectiveCatalyticReductionandParticulateTraps–Methodsofmeasurement– EmissionnormsandDrivingcycles.

UNITIV ALTERNATIVE FUELS 9

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties,Suitability,MeritsandDemerits-EngineModifications.

UNITV RECENTTRENDS 9

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometryturbochargers–CommonRailDirectInjectionSystems-HybridElectricVehicles–NOxAdsorbers- OnboardDiagnostics.

TOTAL:45 PERIODS

TEXTBOOKS:

1. Ramalingam.K.K.,"InternalCombustionEngineFundamentals",ScitechPublications,2002.
2. Ganesan,"Internal Combustion Engines", IIEdition, TMH,2002.

REFERENCES:

1. Mathur.R.B.andR.P. Sharma,"InternalCombustionEngines".,DhanpatRai& Sons2007.
2. DuffySmith,"AutoFuelSystems",TheGoodHeartWillcoxCompany,Inc.,1987.
3. EricChowenitz,"Automobile Electronics",SAE Publications, 1995

GE6757 TOTALQUALITYMANAGEMENT

OBJECTIVES:

- Tofacilitate theunderstandingof Quality Managementprinciplesand process.

UNITI INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions ofproductand service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran andCrosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customersatisfaction,Customercomplaints,Customerretention-Costsofquality.

UNITII TQMPRINCIPLES 9

Leadership-Strategicqualityplanning,QualityCouncils-Employeeinvolvement-Motivation,Empowerment,TeamandTeamwork, QualitycirclesRecognitionandReward,Performanceappraisal -Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering,Supplierselection,SupplierRating.

UNITIII TQMTOOLS AND TECHNIQUESI 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology,applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark,Benchmarkingprocess-FMEA-Stages,Types.

UNITIV TQMTOOLS AND TECHNIQUES II 9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchiqualityloss function- TPM-Concepts,improvementneeds-Performancemeasures.

UNITV QUALITYSYSTEMS 9

NeedforISO9000-ISO9001-2008QualitySystem-Elements,Documentation,QualityAuditing-QS9000-ISO14000-Concepts,RequirementsandBenefits-TQMImplementationinmanufacturingandservicesectors..

TOTAL:45PERIODS

TEXTBOOK:

1. DaleH.Besterfiled,etat.,"TotalqualityManagement",ThirdEdition,PearsonEducationAsia,IndianReprint,2006.

REFERENCES:

1. JamesR.EvansandWilliamM.Lindsay,"TheManagementandControlofQuality",8th Edition,FirstIndianEdition,CengageLearning,2012.
2. Suganthi.LandAnandSamuel,"TotalQualityManagement",PrenticeHall(India)Pvt.Ltd.,2006.
3. Janakiraman.BandGopal.R.K.,"TotalQualityManagement-TextandCases",PrenticeHall(India)Pvt.Ltd.,2006.

ENVIRONMENTALSTUDIES	L	T	P	C
(Common to allB.E. / B.TechDegreeProgrammes)	3	0	0	3

1701CH201

COURSEOBJECTIVES:

1. Realize the interdisciplinaryand holistic nature of theenvironment.
2. Understand hownatural resourcesand environmentaffectthe qualityof life and stimulate the quest for sustainable development.
3. Recognize the socio-economic, politicaland ethical issues in environmentalscience.

UNIT I ECOSYSTEMS ANDBIODIVERSITY **10 Hours**

Conceptofanecosystem – structureandfunctionofanecosystem –producers,consumersanddecomposers– Oxygen cycle and Nitrogen cycle – energyflow in the ecosystem – ecological succession processes – Introduction,types,characteristicfeatures,structureandfunctionofthe(a)forest ecosystem (b)grassland ecosystem (c)desertecosystem (d)aquaticecosystems(ponds, streams,lakes,rivers,oceans,estuaries)– Introduction to biodiversity definition: genetic, species and ecosystemdiversity – value of biodiversity: consumptiveuse,productiveuse,social,ethical,aestheticandoptionvalues–hot–spotsofbiodiversity – threatstobiodiversity:habitatloss,poachingofwildlife,man–wildlifeconflicts–endangeredand endemic species of India–conservation of biodiversity:In-situ and ex-situ conservation of biodiversity. Documentation of the medicinalplants inyour native place.

UNIT II NATURALRESOURCES **10 Hours**

Forestresources:Useandover–exploitation,deforestation,casestudies–timberextraction,mining,dams andtheireffectsonforestsandtribalpeople–Waterresources:Useandoverutilizationofsurfaceandground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extractingandusingmineralresources,casestudies–Foodresources:Worldfoodproblems,changescaused byagricultureandovergrazing,effectsofmodernagriculture,fertilizer–pesticideproblems,waterlogging, salinity,casestudies–Energy resources:Growingenergy needs,renewableandnonrenewableenergy sources, useofalternateenergysources.EnergyConversionprocesses–Biogas–productionanduses,anaerobic digestion;casestudies–Landresources:Landasaresource,landdegradation,maninducedlandslides,soil erosionanddesertification–roleofanindividualinconservationofnaturalresources–Equitableuseof resources for sustainable lifestyles. Documentation of the effectof modern Agriculture in your nearbyVillage.**UNIT III ENVIRONMENTALPOLLUTION** **9 Hours** Definition–Source,causes,effectsandcontrolmeasuresof:(a)Airpollution–Mitigationprocedures–Controlofparticulateandgaseousemission,ControlofSO$_X$,NO$_X$,COandHC)–Technologyforcapturing CO_2(metallo-organicframeworks)(b)Waterpollution–Wastewatertreatmentprocesses.(c)Soilpollution –soilwaste management: causes,effectsandcontrolmeasuresof municipalsolidwastes –(d)Marine pollution(e) Noise pollution(f) Thermal pollution(g) Nuclear hazards–roleof an individual inpreventionof pollution–pollutioncasestudies.Documentationstudy oflocalpollutedsite–Urban/Rural/Industrial/ Agricultural.

UNIT IV SOCIALISSUESANDTHEENVIRONMENT **8 Hours** From unsustainabletosustainabledevelopment–urbanproblemsrelatedtoenergy–waterconservation,rain water harvesting,watershedmanagement–environmental ethics:Issues andpossiblesolutions–12Principles ofgreenchemistry –consumerismandwasteproducts–environmentprotectionact–Airact–Wateract–Wildlifeprotectionact–Forestconservationact–TheBiomedicalWaste(ManagementandHandling)Rules; 1998andamendments–schemeoflabelingofenvironmentally friendly products(Ecomark)centralandstate pollutioncontrolboards–disastermanagement:floods,earthquake–Publicawareness.Analyzetherecent steps taken bygovernmentof India to preventpollution (Green India andClean India).

UNIT V HUMANPOPULATIONANDTHEENVIRONMENT **8 Hours**

environmentandhumanhealth–humanrights–valueeducation–HIV/ AIDS–womenandchildwelfare–Environmentalimpactanalysis(EIA)–GIS–remotesensing–roleofinformationtechnology inenvironment andhumanhealth–Casestudies.Documentationstudy oftheHumanhealthandtheenvironmentinnearby Hospital (Statistical report).

TOTAL: 45 HOURS

FURTHER READING:

Human rights:E– waste andbiomedical waste – Identification of adulterants in foodmaterials

COURSEOUTCOMES:

On theSuccessfulcompletion of the course, Students willbe able to

CO1: Describe the importance ofecosystemand its conservation.
CO2: Differentiate various natural resourcesand the urgentneed to conserve the natural resources. CO3: Explain the different types of pollution and its effects.
CO4: Describe the various environmentalprotection acts.
CO5: Explain the major diseases,women, child developmentand the impacts ofpopulationexplosion.

REFERENCES:

1.Trivedi.R.K.,"Handbookof EnvironmentalLaws,Rules,Guidelines,CompliancesandStandards",Vol.I andII, EnviroMedia,3rd edition,BPBpublications,2010.
2.Cunningham,W.P.Cooper,T.H.Gorhani,"EnvironmentalEncyclopedia",JaicoPublishingHouse,Mumbai, 2001.
3.DharmendraS. Sengar,"Environmentallaw",PrenticehallofIndiaPVTLTD,NewDelhi,2007.
4.Rajagopalan.R,"EnvironmentalStudies-FromCrisistoCure",OxfordUniversityPress,2005.
5.BennyJoseph,"EnvironmentalScienceandEngineering",TataMcGraw-Hill,NewDelhi,2006.
6.https://en.wikipedia.org/wiki/Carbon_capture_and_storage
7.Ravikrishnan.A.,"EnvironmentalScienceandEngineering",SriKrishnaHi-techPublishingCompanyPvt. Ltd.

1701MGX01 **PROFESSIONALETHICS** **L T P C**
3 0 0 3

UNIT I HUMANVALUES **9 Hours**

MoralsandEthics- Honesty-Integrity- Values- WorkEthic- CivicVirtue-RespectforOthers- LivingPeacefully-CaringandSharing- Self-Confidence- Courage- Co-operation- Commitment- Empathy.

UNIT II ENGINEERINGETHICS ANDPROFESSIONALISM **9 Hours**

ScopeofEngineeringEthics'- Varietyofmoralissues- Typesofinquiry- Acceptingandsharing responsibility-Ethicaldilemmas-Moralautonomy-Kohlberg'sandGilligan'stheory-Consensus andcontroversy-ProfessionandProfessionalism-ModelsofProfessionalRoles-Rightaction theories- Sensesofcorporateresponsibility-Codesofethics:Importance- justification- limitation- Abuse-Sample codes NSPE-IEEE-Institution ofEngineers(India).

UNIT III ENGINEERINGAS SOCIAL EXPERIMENTATION **9 Hours**

Engineeringasexperimentation- Engineersasresponsibleexperimenters- Balancedoutlookon law- Cautiousoptimism-Safetyandrisk-Assessing andreducing risk-Safeexits-TheChallengercase study-BhopalGasTragedy-The Three Mile Island and Chernobyl.

UNIT IV WORKPLACE RESPONSIBILITIES AND RIGHTS **9 Hours**

FundamentalRights-ResponsibilitiesandDutiesofIndianCitizens- Teamwork- Ethicalcorporate climate-Collegialityandloyalty- Managingconflict- Respectforauthority- Collectivebargaining- Confidentiality-Conflictsof interest-Occupationalcrime-Professionalrights-Employee rights

UNIT V GLOBALISSUES **9 Hours**

Multinationalcorporations:Technologytransferandappropriatetechnology -Internationalrights promotingmorally justmeasures-Environmentalethics:Engineering,ecology-economics-Human andsentientcentred-andbioandecocentricethics- Computerethicsand internet- Engineersas managers-Consultingengineers-Engineers asexpert witnesses andadvisors-Moralleadership.

FORFURTHER READING/SEMINAR/CBS

TOTAL: 45HOURS

1.Sample code ofethicslike IETE, ASME, ASCE, Indian Institute ofMaterialsManagement.
2.Virtuesforlife

REFERENCES:

1. MikeWMartinandRolandSchinzinger,EthicsinEngineering,4thedition,TataMcGrawHill PublishingCompanyPvtLtd, New Delhi, 2014.
2. MGovindarajan,S Natarajanand VSSenthilKumar,Engineering Ethics, PHILearning Private Ltd, New Delhi, 2012.
3. RSNaagarazan,Atextbookonprofessionalethicsandhumanvalues,Newageinternational limited, New Delhi,2006.
4. CharlesE Harris,MichaelS Protchard andMichaelJRabins, EngineeringEthics- Conceptsand Cases,WadsworthThompson Learning, United States,2005.
5. http://www.slideworld.org/slidestag.aspx/human-values-and-Professional-ethics.

1901MCX01	ENVIRONMENTALSCIENCE	L	T	P	C
	(Common to allBranchesofB.E/B.Tech)	2	0	0	0

MODULEI ECOSYSTEMSANDBIODIVERSITY **10 Hours**

Conceptofanecosystem–structureandfunctionofanecosystem–producers, consumersanddecomposers-OxygencycleandNitrogencycle–energy flowintheecosystem–ecologicalsuccessionprocesses– Introduction, types,characteristicfeatures,structureandfunctionofthe(a)forestecosystem (b)grassland ecosystem (c)desertecosystem(d)aquaticecosystems(ponds,streams,lakes,rivers,oceans,estuaries)– Introduction to biodiversity definition: genetic, species and ecosystemdiversity – value of biodiversity: consumptiveuse,productiveuse,social,ethical,aestheticandoptionvalues–hot-spotsofbiodiversity– threatstobiodiversity:habitat loss,poachingofwildlife,man-wildlifeconflicts–endangeredandendemic speciesofIndia–conservationof biodiversity:In-situandex-situconservationofbiodiversity.Documentation of the medicinalplants inyour native place

MODULEII NATURALRESOURCES **10 Hours**

Forestresources:Use andover-exploitation,deforestation,casestudies- timberextraction,mining,damsand theireffectsonforestsandtribalpeople–Waterresources:Useandoverutilizationofsurfaceandground water,dams-benefitsandproblems–Mineral resources: Useandexploitation,environmental effectsof extractingandusingmineralresources,casestudies–Foodresources:Worldfoodproblems,changescaused by agricultureandovergrazing,effectsofmodernagriculture,fertilizer-pesticideproblems,waterlogging, salinity,casestudies–Energy resources: Growingenergy needs,renewableandnonrenewableenergysources, useofalternateenergy sources.Energy Conversionprocesses–Biogas–productionanduses,anaerobic digestion;casestudies –Landresources:Landasaresource,landdegradation,maninducedlandslides, soil erosionanddesertification–roleofanindividual inconservationofnatural resources–Equitableuseof resources for sustainable lifestyles.Documentation of the effectof modern Agriculture in your nearbyVillage

MODULEIII ENVIRONMENTALPOLLUTION **9 Hours**

Definition– Source, causes,effectsandcontrolmeasuresof:(a)Air pollution- Mitigationprocedures- Control ofparticulateandgaseousemission,ControlofSO$_X$,NO$_X$,COandHC)-TechnologyforcapturingCO$_2$ (metalloorganicframeworks)(b)Waterpollution–Wastewatertreatmentprocesses.(c)Soilpollution-soil wastemanagement:causes,effectsandcontrolmeasuresofmunicipalsolidwastes–(d)Marinepollution(e) Noisepollution(f)Thermalpollution(g)Nuclearhazards–roleofanindividualinpreventionofpollution– pollution case studies.Documentation studyof localpolluted site – Urban/Rural/Industrial/Agricultural.

MODULEIV SOCIALISSUESANDTHEENVIRONMENT **8 Hours**

Fromunsustainabletosustainabledevelopment–urbanproblemsrelatedtoenergy–waterconservation,rain waterharvesting,watershedmanagement-environmentalethics:Issuesandpossiblesolutions–12Principles ofgreenchemistry–consumerismandwasteproducts–environmentprotectionact–Airact–Wateract–Wildlifeprotectionact–Forestconservationact–TheBiomedicalWaste(ManagementandHandling)Rules; 1998andamendments-schemeoflabelingofenvironmentally friendly products(Ecomark)centralandstate pollutioncontrolboards- disastermanagement:floods,earthquake- Publicawareness.Analyzetherecentsteps taken bygovernmentofIndia to preventpollution (GreenIndia and Clean India)

MODULEV HUMANPOPULATIONANDTHEENVIRONMENT **8 Hours** Population growth, variation among nations – population explosion – family welfare programme– environmentandhumanhealth– humanrights–valueeducation–HIV/AIDS–womenandchildwelfare– Environmentalimpactanalysis(EIA)-GIS-remotesensing-roleofinformationtechnologyinenvironmentand human health – Case studies.
Documentation studyof the Human health andthe environment in nearbyHospital (Statistical report)

TOTAL: 45HOURS

REFERENCES:

1. Trivedi.R.K., "HandbookofEnvironmentalLaws, Rules, Guidelines,Compliancesand Standards", Vol. Iand II, Enviro Media, 3rd edition, BPBpublications, 2010.
2. Cunningham, W.P.Cooper,T.H.Gorhani, "EnvironmentalEncyclopedia", JaicoPubl., House, Mumbai, 2001.
3. Dharmendra S.Sengar, "Environmental law", Prentice hallof India PVT LTD,NewDelhi,2007.
4. Rajagopalan,R, "EnvironmentalStudies-FromCrisis to Cure", OxfordUniversityPress, 2005.
5. BennyJoseph, "EnvironmentalScience andEngineering", Tata McGraw-Hill, NewDelhi, 2006
6. Ravikrishnan"EnvironmentalScience andEngineering"SriKrishna Hi-tech Publishing CompanyPvt
7. https://en.wikipedia.org/wiki/Carbon_capture_and_storage

1703EV017 INDUSTRIAL WASTE MANAGEMENTL T P C 3 0 0 3

UNIT I INTRODUCTION Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management

UNIT II INDUSTRIAL POLLUTION PREVENTION & WASTE MINIMISATION

Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting Pollution Prevention Programs in Industries.

UNIT III INDUSTRIAL WASTEWATER TREATMENT

Flow and Load Equalisation – Solids Separation – Removal of Fats, Oil & Grease- Neutralisation – Removal of Inorganic Constituents – Precipitation, Heavy metal removal , Nitrogen & Phosphorous removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis& Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes – Treatability Studies

UNIT IV WASTEWATER REUSE AND RESIDUAL MANAGEMENT

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects

UNIT V CASE STUDIES

Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries

E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

NAGAPATTINAM – 611 002. TAMILNADU, INDIA

Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai

(Accredited by NAAC with 'A' Grade and NBA)

Email: principal@egspec.orgwebsite: www.egspec.orgPh: 04365-251112

1701CH201	ENVIRONMENTAL STUDIES (Common to all B.E. / B.Tech Degree Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. Realize the interdisciplinary and holistic nature of the environment.
2. Understand how natural resources and environment affect the quality of life and stimulate the quest for sustainable development.
3. Recognize the socio-economic, political and ethical issues in environmental science.

UNIT I ECOSYSTEMS AND BIODIVERSITY **10 Hours**

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – hot – spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Documentation of the medicinal plants in your native place.

UNIT II NATURAL RESOURCES **10 Hours**

Forest resources: Use and over – exploitation, deforestation, case studies – timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Documentation of the effect of modern Agriculture in your nearby Village.

UNIT III ENVIRONMENTAL POLLUTION **9 Hours**

Definition – Source, causes, effects and control measures of: (a) Air pollution – Mitigation procedures – Control of particulate and gaseous emission, Control of SO_X, NO_X, CO and HC) – Technology for capturing CO_2 (metallo- organic frame works) (b) Water pollution – Waste water treatment processes. (c) Soil pollution – soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – role of an individual in prevention of pollution – pollution case studies. Documentation study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **8 Hours**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – environmental ethics: Issues and possible solutions – 12 Principles of green chemistry – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments – scheme of labeling of environmentally friendly products (Ecomark) central and state pollution control boards – disaster management: floods, earthquake – Public awareness. Analyze the recent steps taken by government of India to prevent pollution (Green India and Clean India).

UNIT V HUMAN POPULATION AND THE ENVIRONMENT **8 Hours**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – Environmental impact analysis (EIA) – GIS – remote sensing – role of information technology in environment and human health – Case studies. Documentation study of the Human health and the environment in nearby Hospital (Statistical report).

TOTAL: 45 HOURS

SEMESTER –VI

1701MGX01		PROFESSIONAL ETHICS	L	T	P	C
			3	0	0	3
PREREQUISITE :	Basic Understanding of Human Values, Ethical thinking					

COURSE OBJECTIVES:

1. To understand Human values, ethical theory, codes of ethics, work place responsibilities and rights.
2. To understand engineering experimentation, global issues and contemporary ethical issues
3. To understand personal ethics, legal ethics, cultural associated ethics and engineer's responsibility.

UNIT I	HUMAN VALUES	9 Hours

Morals and Ethics - Honesty - Integrity - Values - Work Ethic - Civic Virtue - Respect for Others - Living Peacefully - Caring and Sharing - Self-Confidence - Courage - Co-operation - Commitment - Empathy.

UNIT II	ENGINEERING ETHICS AND PROFESSIONALISM	9 Hours

Scope of 'Engineering Ethics'- Variety of moral issues - Types of inquiry - Accepting and sharing responsibility - Ethical dilemmas - Moral autonomy - Kohlberg's and Gilligan's theory - Consensus and controversy - Profession and Professionalism - Models of Professional Roles - Right action theories - Senses of corporate responsibility - Codes of ethics: Importance - justification - limitation - Abuse - Sample codes NSPE - IEEE - Institution of Engineers (India).

UNIT III	ENGINEERING AS SOCIAL EXPERIMENTATION	9 Hours

Engineering as experimentation - Engineers as responsible experimenters - Balanced outlook on law - Cautious optimism - Safety and risk - Assessing and reducing risk - Safe exits - The Challenger case study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl.

UNIT IV	WORKPLACE RESPONSIBILITIES AND RIGHTS	9 Hours

Fundamental Rights - Responsibilities and Duties of Indian Citizens - Teamwork - Ethical corporate climate - Collegiality and loyalty - Managing conflict - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Professional rights - Employee rights

UNIT V	GLOBAL ISSUES	9 Hours

Multinational corporations: Technology transfer and appropriate technology - International rights promoting morally just measures - Environmental ethics: Engineering, ecology - economics - Human and sentient centred - and bio and eco centric ethics - Computer ethics and internet - Engineers as managers - Consulting engineers - Engineers as expert witnesses and advisors - Moral leadership.

	Total:	45 Hours

Further Reading:

1. Sample code of ethics like IETE, ASME, ASCE, Indian Institute of Materials Management.
2. Virtues for life

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1	Articulate engineering ethics theory with sustained lifelong learning to strengthen autonomous engineering decisions.
CO2	Be an example of faith, character and high professional ethics, and cherish the workplace responsibilities, rights of others, public's welfare, health and safety.
CO3	Contribute to shape a better world by taking responsible and ethical actions to improve the environment and the lives of world community.

1703CS030	CYBER FORENSICS	L	T	P	C
		3	0	0	3

PREREQUISITE: Cryptography and Network Security

COURSE OBJECTIVES:

1. Learn the security issues network layer and transport layer.
2. Be exposed to security issues of the application layer.
3. Learn computer forensics.
4. Be familiar with forensics tools.
5. Learn to analyze and validate forensics data.

UNIT I	NETWORK LAYER SECURITY &TRANSPORT LAYER SECURITY	9 Hours

IPSec Protocol - IP Authentication Header - IP ESP - Key Management Protocol for IPSec.Transport layer Security: SSL protocol, Cryptographic Computations – TLS Protocol.

UNIT II	E-MAIL SECURITY & FIREWALLS	9 Hours

PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions.

UNIT III	INTRODUCTION TO COMPUTER FORENSICS	9 Hours

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT IV	EVIDENCE COLLECTION AND FORENSICS TOOLS	9 Hours

Processing Crime and Incident Scenes – Working with Windows and DOS Systems. Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT V	ANALYSIS AND VALIDATION	9 Hours

Validating Forensics Data - Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics.

Total:	45 Hours

COURSE OUTCOMES:

After completion of the course, Students will be able to

CO1	Discuss the security issues network layer and transport layer.
CO2	Apply security principles in the application layer.
CO3	Explain computer forensics
CO4	Use forensics tools.
CO5	Analyze and validate forensics data.

References:

1. John R.Vacca, "Computer Forensics", Cengage Learning, 2005
2. Richard E.Smith, "Internet Cryptography", 3rd Edition Pearson Education, 2008.
3. Marjie T.Britz, "Computer Forensics and Cyber Crime": An Introduction", 3rd Edition, Prentice Hall, 2013.
4. https://nptel.ac.in/courses/106/106/106106178/

CS6004 **CYBER FORENSICS** **L T P C**
3 0 0 3

OBJECTIVES:
The student should be made to:
- Learn the security issues network layer and transport layer
- Be exposed to security issues of the application layer
- Learn computer forensics
- Be familiar with forensics tools
- Learn to analyze and validate forensics data

UNIT I NETWORK LAYER SECURITY &TRANSPORT LAYER SECURITY **9**
IPSec Protocol - IP Authentication Header - IP ESP - Key Management Protocol for IPSec . **Transport layer Security:** SSL protocol, Cryptographic Computations – TLS Protocol.

UNIT II E-MAIL SECURITY & FIREWALLS **9**
PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls - Firewall designs - SET for E-Commerce Transactions.

UNIT III INTRODUCTION TO COMPUTER FORENSICS **9**
Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT IV EVIDENCE COLLECTION AND FORENSICS TOOLS **9**
Processing Crime and Incident Scenes – Working with Windows and DOS Systems. **Current Computer Forensics Tools:** Software/ Hardware Tools.

UNIT V ANALYSIS AND VALIDATION **9**
Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the student should be able to:
- Discuss the security issues network layer and transport layer
- Apply security principles in the application layer
- Explain computer forensics
- Use forensics tools
- Analyze and validate forensics data

TEXT BOOKS:
1. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", Wiley Publications, 2003.
2. Nelson, Phillips, Enfinger, Steuart, "Computer Forensics and Investigations", Cengage Learning, India Edition, 2008.

REFERENCES:
1. John R.Vacca, "Computer Forensics", Cengage Learning, 2005
2. Richard E.Smith, "Internet Cryptography", 3rd Edition Pearson Education, 2008.
3. Marjie T.Britz, "Computer Forensics and Cyber Crime": An Introduction", 3rd Edition, Prentice Hall, 2013.

GE6083	DISASTER MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

GE6075 **PROFESSIONAL ETHICS IN ENGINEERING** L T P C 3 0 0 3

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

TEXTBOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity

GE6084 **HUMAN RIGHTS** L T P C
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I 9

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II 9

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III 9

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV 9

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V 9

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOMES:

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

GE6351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C 3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

- To find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: in-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds

Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards- role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources

for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.
Field study of local area to document environmental assets – river/forest/grassland/hill/mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environment at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions.
- Development and improvement in standard of living has lead to serious environmental disasters.

TEXT BOOKS:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd Edition, Pearson Education 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata Mc Graw-Hill, New Delhi, 2006.

REFERENCES:

1. R.K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standard", Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico Publ.,House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice Hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.

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GE6757	TOTAL QUALITY MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..

TOTAL: 45 PERIODS

OUTCOMES :

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXTBOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

GE6083	DISASTER MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc. Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

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19041T552		STARTUP OPPORTUNITIES FOR IT ENGINEERS	L	T	P	C
			0	0	2	1

AIM: This course helps you understand the process of entrepreneurship from a technology-oriented background

OURSE OBJECTIVES:

1. Learn what it takes to become a"technopreneur"
2. Explore various methods for identifyingopportunities
3. Learn how to conduct market research and provide evidence for the viability of the business idea
4. Develop a viable business proposition and learn to pitch your ideas for variousaudiences
5. Understand the dynamics of new venture development and teambuilding
6. Develop the ability to translate a business idea into marketing and financialplans

Course Contents

1. Introduction toStartups
2. Innovation &Entrepreneurship
3. Entrepreneurial Mindset, EntrepreneurialSkillset
4. Global Startup EcoSystem
5. IT based StartupTrends
6. Problems – Identification, Selection &Validation
7. Evolution of Technology &Startups
8. Startup OpportunityIdentification
9. Business Model Trends –Examples
10. Startup Idea & TechnologyLandscape
11. DigitalMarketing
12. Minimum Viable Product Development & Tools for CreatingMVPs
13. Patentability
14. Raising Capital & FundingModels
15. Legal Procedures &Launchpad

TOTAL: 30 HOURS

COURSE OUTCOMES:

	After completion of the course, Student will be able to
CO1	Explain Concepts of Innovation, Entrepreneurship and Startups in Technology
CO2	Develop Startup or Business ideas, minimum viable products and business models for real life problems

Evaluation Procedure

1. Assignment 1– Review of IT based Startups – 20Marks
2. Assignment 2– Problems, Problem Identification, Selection & Evaluation – 30Marks
3. Assignment 3 – Review of Business Models of IT based Startups – 20Marks
4. Presentation – Idea, Market Research Results, 1st MVP, Possible Fund Raising Model to be adopted, IP – 30Marks

REFERENCES:

1. The High-Performance Entrepreneur by SubrotoBagchi
2. The Law of Success in Sixteen Lessons Paperback by Napoleon Hill
3. The E-Myth Revisited: Why Most Small Businesses Don't Work and What to Do About It by Michael E. Gerber
4. https://www.edx.org/course/entrepreneurship-for-engineers

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1902MCX03		ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
			2	0	0	0

COURSE OBJECTIES:

1. The course aims at imparting basic principles of thought process, reasoning and inferencing. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society andnature.
2. Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
3. The course focuses on introduction to Indian Knowledge System, Indianperspective of modern scientific world-view and basic principles of Yoga and holistic health caresystem.

1. Basic Structure of Indian Knowledge System

(i) Vedas, (ii) Uveda (Ayuveda, Dhanuveda, Gandhaveda, SthaityaAdad) (iii) Vedang (Shiksha, Kalla, Nanrut, Grammar, JyotishaChhanda), (iv) Uraiga (Dharma Vastra, Shringa, Guarana, Tirmasra)

2. Modern Science and Indian KnowledgeSystem
3. Yoga and Holistic Healthcare
4. CaseStudies.

TOTAL: 30 HOURS

COURSE OUTCOMES:

After completion of the course, Student will be able to understand , connect up and explain basics of Indian Traditional knowledgemodern scientific perspective

REFERENCES:

1902MCX02		CONSTITUTION OF INDIA	L	T	P	C
			2	0	0	0

Course Content

The Constitution of India is the supreme law of India. Parliament of India can not make any law which violates the Fundamental Rights enumerated under the Part III of the Constitution. The Parliament of India has been empowered to amend the Constitution under Article 368, however, it cannot use this power to change the "basic structure" of the constitution, which has been ruled and explained by the Supreme Court of India in its historical judgments. The Constitution of India reflects the idea of "Constitutionalism" – a modern and progressive concept historically developed by the thinkers of "liberalism" – an ideology which has been recognized as one of the most popular political ideology and result of historical struggles against arbitrary use of sovereign power by state. The historic revolutions in France, England, America and particularly European Renaissance and Reformation movement have resulted into progressive legal reforms in the form of "constitutionalism" in manycountries.

The Constitution of India was made by borrowing models and principles from many countries including United Kingdom and America. The Constitution of India is not only a legal document but it also reflects social, political and economic perspectives of the Indian Society. It reflects India's legacy of "diversity". It has been said that Indian constitution reflects ideals of its freedom movement, however, few critics have argued that it does not truly incorporate our ownancient legal heritage and cultural values. No law can be "static" and therefore the Constitution of India has also been amended more than one hundred times. These amendments reflect political, social and economic developments since the year 1950. The Indian judiciary and particularly the Supreme Court of India has played an historic role as the guardian of people. It has been protecting not only basic ideals of the Constitution but also strengthened the same through progressive interpretations of the text of the Constitution. The judicial activism of the Supreme Court of India and its historic contributions has been recognized throughout the world and it gradually made it "as one of the strongest court in theworld".

Course content

1. Meaning of the constitution law andconstitutionalism
2. Historical perspective of the Constitution ofIndia
3. Salient features and characteristics of the Constitution ofIndia
4. Scheme of the fundamentalrights
5. The scheme of the Fundamental Duties and its legalstatus
6. The Directive Principles of State Policy – Its importance andimplementation
7. FederalstructureanddistributionoflegislativeandfinancialpowersbetweentheUnionandtheStates
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India
9. Amendment of the Constitutional Powers andProcedure
10. The historical perspectives of the constitutional amendments inIndia
11. Emergency Provisions : National Emergency, President Rule, FinancialEmergency
12. Local Self Government – Constitutional Scheme inIndia
13. Scheme of the Fundamental Right toEquality
14. Scheme of the Fundamental Right to certain Freedom under Article19
15. Scope of the Right to Life and Personal Liberty under Article21

	TOTAL:	30 HOURS

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1901MCX01		ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
			3	0	0	3
		(For B.E.,BME)				

Course Objectives:	The student should be made to:
	1. To study the nature and facts about environment.
	2. To finding and implementing scientific, technological, economic and political solutions to environmental problems
	3. To study the interrelationship between living organism and environment.
	4. To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
	5. To study the dynamic processes and understand the features of the earth"s interior and surface

UNIT I	ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY	9 Hours

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc

UNIT II	ENVIRONMENTAL POLLUTION	9 Hours

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III	NATURAL RESOURCES	9 Hours

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV	SOCIAL ISSUES AND THE ENVIRONMENT	9 Hours

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V	HUMAN POPULATION AND THE ENVIRONMENT	9 Hours

, Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies

	Total:	45 Hours

	Analyze the continuous pollution signals & systems and its biosignal applications.
Course Outcomes:	
	After completion of the course, Student will be able to
	1. Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection.
	2. Public awareness of environmental is at infant stage.
	3. Development and improvement in std. of living has lead to serious environmental disasters
	4. Ignorance and incomplete knowledge has lead to misconceptions
Text Book:	
1. Benny Joseph, _Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.	
2. Gilbert M.Masters, _Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.	
References:	
1. Benny Joseph, _Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.	
2. Dharmendra S. Sengar, _Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.	
3. 2. ErachBharucha, —Textbook of Environmental Studies‖, Universities Press(I) PVT, LTD, Hydrabad, 2015	
4. Rajagopalan, R, _Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.	
5. G. Tyler Miller and Scott E. Spoolman, —Environmental Science‖, Cengage Learning India PVT, LTD, Delhi, 2014.	

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1902BM404	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives:

1. To understand the basic theory of Bio potential Electrodes and Bio potential measurement.
2. To Understand the design of Bio potential amplifiers.
3. To know about bioelectric signals and amplifiers
4. To analyse the biomedical recording systems
5. Study the various non-electrical physiological measurement and bio chemical measurements.

UNIT I BIOPOTENTIAL ELECTRODES 9 Hours

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode–skin interface, half-cell potential, Contact impedance, polarization effects of electrode – non polarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - motion artifacts, measurement with two electrodes.

UNIT II BIOPOTENTIAL MEASUREMENTS 9 Hours

Bio signals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system, Principles of vector cardiography.EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. Recording of ERG, EOG and EGG

UNIT III BIOELECTRIC AMPLIFIERS 9 Hours

Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, Impedance matching circuit, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier., Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV MEASUREMENT OF NON-ELECTRICAL PARAMETERS9 Hours Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods -Auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers, Systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT V PATIENT MONITORING SYSTEMS 9 Hours

System concepts- Cardiac monitor-selection of system parameters, Bedside monitors, Central monitors, Heart rate meter, Pulse rate meter, sphygmomanometers- Holtermonitor and Cardiac stress test, Cardiac cauterization instrumentation- Organization and equipment used in ICCU & ITU.

Total: 45 Hours

Further Reading:

- Medical Imaging,Biomedical Image Processing.

Course Outcomes:

After completion of the course, Student will be able to

1. Comprehend and appreciate the significance and role of this course in the present contemporary world.
2. Describe the fundamentals of Bio potential recording.
3. Design various bio amplifiers.
4. Measure various physiological and bio chemical parameters
5. Understand the concepts of patient monitoring systems

Text Book:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", Pearson Education, 4th Edition, 2014.
2. R.S.Khandphur, " Handbook on Biomedical Instrumentation", 2014

References:

1. John G.Webster, "Medical Instrumentation Application and Design", John Wiley and Sons, New York, 4th Edition, 2009.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd Edition, 2014.
3. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", John Wiley and Sons, 3rd Edition, Reprint 2008.
4. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, Pearson Education India, 2nd Edition, 2015.
5. Myer Kutz, "Standard Handbook of Biomedical Engineering & Design", McGraw-Hill Publisher, 2003.

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1902BM603		Biomaterials	L	T	P	C
			3	0	0	3

Course Objectives: The student should be made to:

1. To Learn characteristics and classification of Biomaterials
2. TioUnderstand different metals, ceramics and its nanomaterials characteristics as biomaterials
3. To Learn polymeric materials and its combinations that could be used as a tissue replacement implants
4. To Get familiarized with the concepts of Nano Science and Technology
5. To Understand the concept of biocompatibility and the methods for biomaterials testing

Unit I — **INTRODUCTION TO BIO-MATERIALS** — **9 Hours**

Definition and classification of bio-materials, mechanical properties, visco elasticity, biomaterial performance, body response to implants, wound healing, blood compatibility, Nano scale phenomena.

Unit II — **METALLIC AND CERAMIC MATERIALS** — **9 Hours**

Metallic implants – Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bio inert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bio ceramics.

Unit III — **POLYMERIC IMPLANT MATERIALS** — **9 Hours**

Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Materials for ophthalmology: contact lens, intraocular lens. Membranes for plasma separation and Blood oxygenation, electro spinning: a new approach.

Unit IV — **TISSUE REPLACEMENT IMPLANTS** — **9 Hours**

Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Softtissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.

Unit V — **TESTING OF BIOMATERIALS** — **9 Hours**

Biocompatibility, blood compatibility and tissue compatibility tests, Toxicity tests, sensitization, carcinogenicity, mutagenicity and special tests, Invitro and Invivo testing; Sterilisation of implants and devices: ETO, gamma radiation, autoclaving. Effects of sterilization.

Total: 45 Hours

Further Reading:

Biopolymers

Course Outcomes:

At the end of the course, the student should be able to

1. Analyze different types of Biomaterials and its classification and apply the concept of nanotechnology towards biomaterials use.
2. Identify significant gap required to overcome challenges and further development in metallic and ceramic materials
3. Identify significant gap required to overcome challenges and further development in polymeric materials
4. Create combinations of materials that could be used as a tissue replacement implant.
5. Understand the testing standards applied for biomaterials.

Text books:

1. Sujata V. Bhatt, —Biomaterials‖, Second Edition, Narosa Publishing House, 2005.
2. Sreeram Ramakrishna, MuruganRamalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, —Biomaterials: A Nano Approach‖, CRC Press, 2010

References:

1. Myer Kutz, —Standard Handbook of Biomedical Engineering & Design‖, McGraw Hill, 2003
2. John Enderle, Joseph D. Bronzino, Susan M.Blanchard, —Introduction to Biomedical Engineering‖, Elsevier, 2005.
3. Park J.B., —Biomaterials Science and Engineering‖, Plenum Press, 1984.
4. A.C Anand, J F Kennedy, M.Miraftab, S.Rajendran,—Woodhead Medical Textiles and Biomaterials for Healthcare‖, Publishing Limited 2006
5. D F Williams, —Materials Science and Technology: Volume 14, Medical and Dental Materials: A comprehensive Treatment Volume‖, VCH Publishers 1992.
6. Monika Saini, Yashpal Singh, PoojaArora, VipinArora, and KratiJain. —Implant biomaterials: A comprehensive review‖, World Journal of Clinical Cases, 2015..

1902BM502		MEDICAL OPTICS	L	T	P	C
			3	0	0	3

Course Objectives:

1. To Discuss the optical properties of the tissues and the interactions of light with tissues.
2. To understand the instrumentation and components in Medical Optics.
3 To describe the Medical Lasers and their applications
4 To explain the optical diagnostic applications
5 To know the emerging optical diagnostic and therapeutic techniques

UNIT I	OPTICAL PROPERTIES OF THE TISSUES	9 Hours

Refraction, Scattering, absorption, light transport inside the tissue, tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles.

UNIT II	INSTRUMENTATION IN PHOTONICS	9 Hours

Instrumentation for absorption, scattering and emission measurements, excitation light sources – high pressure arc lamp, solid state LEDs, Lasers, optical filters, polarizer, solid state detectors, time resolved and phase resolved detectors.

UNIT III	APPLICATIONS OF LASERS	9 Hours

Lasers in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering.

UNIT IV	OPTICAL TOMOGRAPHY	9 Hours

Optical coherence tomography, Elastrography, Doppler optical coherence tomography, Application towards clinical imaging.

UNIT V	SPECIAL OPTICAL TECHNIQUES	9 Hours

Near field imaging of biological structures, in vitro clinical diagnostic, fluorescent spectroscopy, photodynamic therapy.

	Total:	45 Hours

Further Reading:

- Learn about laser Characteristics as applied to medicine and biology
- Non thermal diagnostic applications

Course Outcomes:

At the end of the course, the students should be able to:

1. Demonstrate knowledge of the fundamentals of optical properties of tissues
2. Analyze the components of instrumentation in Medical Photonics and Configurations
3. Describe surgical applications of lasers.
4. Describe photonics and its diagnostic applications.
5. Investigate emerging techniques in medical optics

Text Books:

1. Tuan VoDirh, —Biomedical Photonics – Handbook‖, CRC Press, Bocaraton, 2014.
2. Paras N. Prasad, —Introduction to Biophotonics‖, A. John Wiley and Sons, Inc. Publications, 2003

References:

1. MarkolfH.Niemz, —Laser-Tissue Interaction Fundamentals and Applications‖, Springer, 2007
2. G.David Baxter —Therapeutic Lasers – Theory and practice‖, Churchill Livingstone publications Edition-2001.
3. Leon Goldman, M.D., &R.James Rockwell, Jr., —Lasers in Medicine‖, Gordon and Breach, Science Publishers Inc., 1975.

E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

NAGAPATTINAM – 611 002. TAMILNADU, INDIA

Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai

(Accredited by NAAC with 'A' Grade and NBA)

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		Nanotechnology in Medicine	L	T	P	C
			3	0	0	3
		(For B.E.,BME)				

Course Objectives:	The student should be made to:	
	1. Learn various concepts of nanomedicine.	
	2. Understandnanobiomaterials and its biocompatibility	
	3. Know principles of bionanotechnology and nanostructures.	
UNIT I	**Introduction**	**9 Hours**
Introduction and Rationale for Nanotechnology in Cancer Therapy - Passive Targeting of Solid Tumors: Pathophysiological Principles and Physicochemical Aspects of Delivery Systems - Active Targeting Strategies in Cancer with a Focus on Potential Nanotechnology Applications Nanobiotechnology in Drug Delivery –Nanoscale Delivery of Therapeutics – Nano suspension Formulations Viruses as Nanomaterials for Drug Delivery		
UNIT II	**Nanobiomaterials And Biocompatibility**	**9 Hours**
Surface and Bulk Properties of Bio materials – Nanobiomaterials –NanoCeramics – Nanopolymers – Nano Silica – Hydroxy apatite – Carbon Based nanomaterials Surface modification – Textured and Porous Materials – Surface immobilized biomolecules – Cell-biomaterial interactions – immune response – In Vitro and In Vivo assessment of tissue compatibility		
UNIT III	**Structural & Functional Principles Of Bio Nano technology**	**9 Hours**
liposomes – neosomes-Phytosomes, Polysacharides – Peptides –Nucleic acids – DNA scaffolds – Enzymes-Biomolecular motors: linear, rotary mortors – Immunotoxins – Membrane transporters and pumps – Antibodies – monoclonal Antibodies – immunoconjugates – limitations of natural biomolecules		
UNIT IV	**Protein And DNA Based Nanostructures**	**9 Hours**
structure, chemistry and assembly – lipid chips – S – Layers as Templates – engineered nanopores – DNA–Protein Nanostructures DNA-based Metallic Nanowires and Networks, DNA–Gold-Nanoparticle Conjugates		
UNIT V	**Nano Bio-Analytics**	**9 Hours**
Luminescent Quantum Dots for Biological Labeling – Nanoparticle Molecular Labels – Surface Biology: Analysis of Biomolecular Structure by Atomic Force Microscopy and Molecular Pulling – Force Spectroscopy – Biofunctionalized Nanoparticles for Surface – Enhanced Raman Scattering and Surface Plasmon Resonance – Bioconjugated Silica Nanoparticles for Bioanalytical Applications		
	Total:	**45 Hours**
Further Readings:		
Nanorobots in Medicine,Nanoparticles in Medicine		
Course Outcomes:		
	After completion of the course, Student will be able to	
	1. Understand the Basics of Nanobiotechnology in Relation to Nanomedicine	
	2. Apply Relation of Nanobiotechnology to Nanomedicine	
	3. Explain the Biocompatibility issues of nanoparticles	
Text Books:		
1. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.(Unit I – V)		
2. Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004. (Unit I – V)		
References:		
1. Molecular Cell Biology,HarveyLodish, Published by W.H. Freeman & Company		
2. Biomaterials: A Nano Approach,S Ramakrishna, M Ramalingam, T.S. Sampath Kumar, Winston O. Soboyejo,Published by CRC Press		
3. Bionanotechnology: Lessons from Nature, D S. Goodsell, by John Wiley & Sons, Inc		
4. Nanobiotechnology: Concepts, Applications and Perspectives,(edited by C. M. Niemeyer and C. A. Mirkin), Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim,		
5. Nanobiotechnology: Concepts, Applications and Perspectives,Edited by Christof M. Niemeyer and Chad A. Mirkin, Wiley-VCH, 2004,ISBN 3527306587		

E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

NAGAPATTINAM – 611 002. TAMILNADU, INDIA

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1903BM006	BIO ANALYTICAL METHODS AND INSTRUMENTATION	L	T	P	C
		3	0	0	3
	(For B.E.,BME)				

Course Objectives: The student should be made to:

1. To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
2. To impart fundamental knowledge on gas chromatography and liquid chromatography.
3. To integrate a fundamental understanding of the underlining principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.
4. To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
5. To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT I **SPECTROPHOTOMETRY** **9 Hours**

Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry – FTIR spectrophotometry – Atomic absorption spectrophotometry – Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.

UNIT II **CHROMATOGRAPHY** **9 Hours**

General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.

UNIT III **INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING** **9 Hours**

Gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases.Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation – Dust and smoke measurements.

UNIT IV **pH METERS AND DISSOLVED COMPONENT ANALYZERS** **9 Hours**

Selective ion electrodes – Principle of pH and conductivity measurements – dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.

UNIT V **NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY** **9 Hours**

Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.

Total: 45 Hours

Course Outcomes:

After completion of the course, Student will be able to

1. Ability to understand the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.
2. Ability to assess and suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, important sources of interferences and errors, and also suggest alternative analytical methods for quality assurance.
3. Ability to critically evaluate the strengths and limitations of the various instrumental methods.
4. Ability to develop critical thinking for interpreting analytical data.
5. Ability to understand the working principle, types and applications of NMR and Mass spectroscopy

Further Readings:

Instrumental Methods of Chemical Analysis

Text Books:

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.
2. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2006

1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co. Ltd.,2nd Edition 2007.
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw-Hill, 5th Edition reprint 1985. (Digitized in 2007).
3. NPTEL lecture notes on, "Modern Instrumental methods of Analysis" by Dr.J.R. Mudakavi, IISC, Bangalore.

1903BM014		CLIMATE CHANGE AND ITS IMPACT	L	T	P	C
			3	0	0	3
		(For B.E.,BME)				

Course Objectives: The student should be made to:

1. To understand the basics of weather and climate
2. To have an insight on Atmospheric dynamics and transport of heat
3. To develop simple climate models and evaluate climate changes using models
4. To impart knowledge on the global warming
5. To Identify the impact of climate change on society

UNIT I **INTRODUCTION** **9 Hours**

Atmosphere – weather and Climate – climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect – Carbon cycle

UNIT II **ATMOSPHERIC DYNAMICS:** **9 Hours**

Atmosphere dynamics: law – isobaric heating and cooling – adiabatic lapse rates – equation of motion – solving and forecasting. Forces – Relative and absolute acceleration – Earths rotation coriolis on sphere – full equation of motion – Geostrophy;- Thermal winds -departures – smallscale motion. Radiation, convection and advections: sun and solar radiation – energy balance -terrestrial radiation and the atmosphere – Green house effect- Global warming – Global budget -radiative fluxes – heat transport. Atmosphere and ocean systems convecting and advecting heat. Surface and boundary layer – smaller scale weather system – larger scale weather system.

UNIT III **GLOBAL CLIMATE** **9 Hours**

Components and phenomena in the climate system: Time and space scales – interaction and parameterization problem. Gradients of Radiative forcing and energy transports by atmosphere and ocean – atmospheric circulation – latitude structure of the circulation – latitude – longitude dependence of climate features. Ocean circulation: latitude – longitude dependence of climate features – ocean vertical structure – ocean thermohaline circulation – land surface processes -carbon cycle.

UNIT IV **IMPACTS OF CLIMATE CHANGE** **9 Hours**

Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts-tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas

UNIT V **CLIMATE CHANGE MODELS** **9 Hours**

Constructing a climate model – climate system modeling – climate simulation and drift -Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming – climate change observed to date.

Total: 45 Hours

Further Readings:

Biological/ecological responses to climate change, Geoengineering

Course Outcomes:

After completion of the course, Student will be able to

1. The concepts of weather and climate
2. The principles of Atmospheric dynamics and transport of heat and air mass
3. The develop simple climate models and to predict climate change
4. ability to plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy

	5. understanding on the growing scientific consensus established through the IPCC as well as the complexities and uncertainties

Text Books:

1. Fundamentals of weather and climate (2nd Edition) Robin Moilveen (2010), Oxford University Press
2. Climate change and climate modeling, J. David Neelin (2011) Cambridge University press.

References:

1. Global Climate Change and Human Health: From Science to Practice George Luber (Editor), Jay Lemery (Editor) ISBN: 978-1-118-50557-1 November 2015, Jossey-Bass
2. ErachBharucha, —Textbook of Environmental Studies‖, Universities Press(I) PVT, LTD, Hydrabad, 2015.

1903BM0007		Telehealth Technology	L	T	P	C
			3	0	0	3
		(For B.E.,BME)				

Course Objectives: The student should be made to:

- To Learn the key principles for telemedicine and health.
- To Understand telemedical technology.
- To Know telemedical standards, mobile telemedicine and it applications.
- To understand themobile telemedicine concepts.
- To observe the Telemedicine Applicatilons and services.

UNIT I — TELEMEDICINE AND HEALTH — 9 Hours

History and Evolution of telemedicine, Functional diagram of telemedicine system, Telemedicine, Telehealth, Tele care, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II — TELEMEDICAL TECHNOLOGY — 9 Hours

Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN,POTS, ANT, ISDN, Internet, Air/ wireless communications: GSM satellite, and Micro wave, Modulation techniques, Types of Antenna, Integration and operational issues, Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication. Mobile hand held devices and mobile communication. Internet technology and telemedicine using world wide web (www). Video and audio conferencing. Clinical data – local and centralized.

UNIT III — TELEMEDICAL STANDARDS — 9 Hours

Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series (Video phone based ISBN) T. 120, H.324 (Video phone based PSTN), Video Conferencing, Real-time Telemedicine integrating doctors / Hospitals, Clinical laboratory data, Radiological data, and other clinically significant biomedical data, Administration of centralized medical data, security and confidentially of medical records and access control, Cyber laws related to telemedicine.

UNIT IV — MOBILE TELEMEDICINE — 9 Hours

Tele radiology: Definition, Basic parts of teleradiology system: Image Acquisition system Display system, Tele pathology, multimedia databases, color images of sufficient resolution, Dynamic range, spatial resolution, compression methods, Interactive control of color, Medical information storage and management for telemedicine- patient information medical history, test reports, medical images diagnosis and treatment. Hospital information system - Doctors, paramedics, facilities available. Pharmaceutical information system.

UNIT V — TELEMEDICAL APPLICATIONS — 9 Hours

Telemedicine access to health care services – health education and self care. · Introduction to robotics surgery, telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Electronic Documentation, e-health services security and interoperability., Telemedicine access to health care services – health education and self care, Business aspects - Project planning and costing. Usage of telemedicine

	Total:	**45 Hours**
Course Outcomes:		
	After completion of the course, Student will be able to	
	Apply multimedia technologies in telemedicine.	
	Explain Protocols behind encryption techniques for secure transmission of data.	
	Apply telehealth in healthcare.	
	understand themobile telemedicine concepts	
	To observe the Telemedicine Applicatilons and services.	
Further Readings:	To study the course on Radilogy	
Text Books:		
1. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002		
Reference Books		
1. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006		
2. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and Information Systems", Springer, 2003.		
3. Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.		
4. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.		
5. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 1997.		
6.MohanBansal, "Medical Informatics", Tata McGraw-Hill, 2004.		

1902BM702		REHABILITATION ENGINEERING	L	T	P	C
			3	0	0	4

Course Objectives:

1. To develop an understanding of the various rehabilitation aids so as to enable the student.
2. To design and apply them with confidence, to help the challenged people.
3. To understand the Electronic oriented Mobility Aids
4. To study the Auditory and speech devices
5. To understand the Visual sensory sytem and Augumentation

Unit I	**INTRODUCTION TO REHABILITATION**	**9 Hours**

Definition, Concept of Rehabilitation: Types of Physical Impairments, Principles of Assistive Technology Assessment, Principles of Rehabilitation Engineering- Key Engineering Principles, Key Ergonomic Principles, Engineering Concepts in Sensory & Motor rehabilitation

Unit II	**ORTHOTICS & PROSTHETICS IN REHABILITATION**	**9 Hours**

Types of orthosis -FO,AFO,KAFO,HKAFO and prosthesis ,Partial Foot Prostheses- Foot-ankle assembly, Trans femoral Prostheses, Prosthetic Hand, Advance and automated prosthetics and orthosis, Externally powered and Controlled orthotics & prosthetics, -FES system, Restoration of Hand function, Restoration of standing and walking.

Unit III	**MOBILITY AIDS**	**9 Hours**

Electronic Travel Appliances (ETA) : Path Sounder, Laser Cane, Ultrasonic Torch, Sonic Guide, Light Probes, Nottingham Obstacle Sensors, Electro cortical Prosthesis, Polarized Ultrasonic Travel aids, Materials used for wheel chairs, Type of Wheel Chairs, design of wheel Chair, Walking frames, Parallel bars, Rollators, Quadripods, Tripods & walking sticks, Crutches.

Unit IV	**AUDITORY AND SPEECH ASSIST DEVICES**	**9 Hours**

Types of deafness, hearing aids, application of DSP in hearing aids, Cochlear implants, Voice synthesizer, speech trainer

Unit V	**SENSORY AUGMENTATION AND SUBSTITUTIONS**	**9 Hours**

Classification of Visual Impairments, Prevention and cure of visual impairments, Visual Augmentation, Tactile vision substitution, auditory substitution and augmentation, tactile auditory substitution, Assistive devices for the visual impaired

	Total:	**45 Hours**

Further Reading:

Acquire experience in building and trouble-shooting simple electronic analog circuits

Course Outcomes:

1. Adapt at using various methods of circuit analysis, including simplified methods such as series-parallel reductions, voltage and current dividers, and the node method.
2. Develop the capability to analyze and design simple circuits containing non-linear elements such as transistors using the concepts of load lines, operating points and incremental analysis.

References:

1. Rory A Cooper, An Introduction to Rehabilitation Engineering, Taylor &Francics ,CRC press, 2006.
2. Joseph D.Bronzino,The Biomedical Engineering Handbook,Third Edition: Three Volume Set,CRC Press,2006
3. .MacLachlan M. and Gallagher P. Enabling Technologies – Body Image and Body Function, Churchill Livingstone, 2004
4. .Mann W.C. (ed). Smart Technology for Aging, Disability, and Independence – The State of The Science, Wiley, New Jersey, 2005.
5. .Muzumdar A. Powered Upper Limb Prostheses – Control, Implementation and Clinical Application. Springer, 2004

1901MGX007		Universal Human Values and Ethics	L	T	P	C
			3	0	0	3

Course Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Unit I	**Course Introduction - Need, Basic Guidelines, Content and Process for ValueEducation**	**9 Hours**

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

Unit II	**Understanding Harmony in the Human Being - Harmony in Myself**	**9 Hours**

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensureSanyam and Swasthya.

Unit III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**	**9 Hours**

13. Understanding harmony in the Family- the basic unit of human interaction
14. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;

	15. Understanding the meaning of *Vishwas*; Difference between intention and competence 16. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship 17. Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals 18. Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!	
Unit IV	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**	**9 Hours**
	19. Understanding the harmony in the Nature 20. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature 21. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space 22. Holistic perception of harmony at all levels of existence	
Unit V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics**	**9 Hours**
	23. Natural acceptance of human values 24. Definitiveness of Ethical Human Conduct 25. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 26. Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models 27. Case studies of typical holistic technologies, management models and production systems 28. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations	
	Total:	**45+15 Hours**
Further Reading:		
	Human values in Public domain	
Course Outcomes:		
	1. Understand the significance of value inputs in a classroom and start applying them in their life and profession	
	2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc..	
	3. Understand the value of harmonious relationship based on trust and respect in their life and profession	
	4. Understand the role of a human being in ensuring harmony in society and nature.	
	5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.	
Text Book		
1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics		

References:
1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2.E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3.Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4.Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5.A Nagraj, 1998, JeevanVidyaEkParichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers
8. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati
9. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
10. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books
12. B L Bajpai, 2004, Indian Ethos and Modern Management.

1902BM751 **HOSPITAL TRAINING** **L T P C**

0 0 0 1

OBJECTIVES:

The student should be made to

- Observe medical professionals at work in the wards and the roles of Allied Health Professionals;
- Provide access to healthcare Professionals to get a better understanding of their work;
- Demonstrate patient-care in a hospital setting.

ASSESSMENT:

- Students need to complete training in any leading Multi-speciality hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course incharges during the session.
- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

S.No.	Departments for visit
1	Cardiology
2	ENT
3	Ophthalmology
4	Orthopaedic and Physiotherapy
5	ICU/CCU
6	Operation Theatre
7	Neurology
8	Nephrology
9	Radiology
10	Nuclear Medicine
11	Pulmonology
12	Urology
13	Obstetrics and Gynaecology
14	Emergency Medicine

15	Biomedical Engineering Department
16	Histo Pathology
17	Biochemistry
18	Paediatric/Neonatal
19	Dental
20	Oncology
21	PAC's
22	Medical Records / Telemetry

TOTAL :15 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Advocate a patient-centred approach in healthcare
- Communicate with other health professionals in a respectful and responsible manner
- Recognize the importance of inter-professional collaboration in healthcare.
- Propose a patient-centred inter-professional health improvement plan based upon the patient's perceived needs
- Use the knowledge of one's own role and those of other professions to address the healthcare needs of populations and patients served.

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1904GE651		LIFE SKILLS: APTITUDE - II	L	T	P	C
			0	0	2	1

Course Objectives:

1. To brush up problem solving skill and to improve intellectual skill of the students
2. To be able to critically evaluate various real life situations by resorting to Analysis Of key issues and factors
3. To be able to demonstrate various principles involved in solving mathematical problems and thereby reducing the time taken for performing job functions.
4. To enhance analytical ability of students
5. To augment logical and critical thinking of Student

Unit I	**Partnership, Mixtures and Allegations, Problem on Ages, Simple Interest, Compound Interest**	**5 Hours**

Introduction Partnership - Relation between capitals, Period of investments and Shares- Problems on mixtures - Allegation rule - Problems on Allegation – Problems on ages - Definitions Simple Interest - Problems on interest and amount - Problems when rate of interest and time period are numerically equal - Definition and formula for amount in compound interest - Difference between simple interest and compound interest for 2 years on the same principle and time period.

Unit II	**Blood relations, , Clocks, Calendars**	**5 Hours**

Defining the various relations among the members of a family - Solving Blood Relation puzzles - Solving the problems on Blood Relations using symbols and notations - Finding the angle when the time is given - Finding the time when the angle is known - Relation between Angle, Minutes and Hours - Exceptional cases in clocks - Definition of a Leap Year - Finding the number of Odd days - Framing the year code for centuries - Finding the day of any random calendar date .

Unit III	**Time and Distance, Time and Work**	**5 Hours**

Relation between speed, distance and time - Converting kmph into m/s and vice versa - Problems on average speed - Problems on relative speed - Problems on trains - Problems on boats and streams - Problems on circular tracks - Problems on races - Problems on Unitary method - Relation between Men, Days, Hours and Work - Problems on Man-Day-Hours method - Problems on alternate days - Problems on Pipes and Cisterns.

Unit IV	**Data Interpretation and Data Sufficiency**	**5 Hours**

Problems on tabular form - Problems on Line Graphs - Problems on Bar Graphs - Problems on Pie Charts - Different models in Data Sufficiency - Problems on data redundancy

Unit V	**Analytical and Critical Reasoning**	**5 Hours**

Problems on Linear arrangement - Problems on Circular arrangement - Problems on Double line-up - Problems on Selections - Problems on Comparisons - Finding the Implications for compound statements - Finding the Negations for compound statements- Problems on assumption - Problems on conclusions - Problems on inferences - Problems on strengthening and weakening of arguments .

	Total:	**30 Hours**

ASSESSMENT PATTERN :

1. Two tests will be conducted (25 * 2) - 50 marks
2. Five assignments will be conducted (5*10) - 50 Marks

Course Outcomes:

After completion of the course, Student will be able to

1. Solve problems on Partnership, Mixture & Allegation and ages least time using shortcuts and apply real life situations

	2. Workout family relationships concepts, ability to visualize clocks & calendar and understand the logic behind a Sequence.
	3. Calculate concepts of speed, time and distance, understand timely completion using time and work.
	4. Learners should be able to understand various charts and interpreted data least time.
	5. Workout puzzles, ability to arrange things in an orderly fashion.

References:

1. Arun Sharma, 'How to Prepare for Quantitative Aptitude for the CAT', 7th edition, McGraw Hills publication, 2016.
2. Arun Sharma, 'How to Prepare for Logical Reasoning for CAT', 4th edition, McGraw Hills publication, 2017.
3. R S Agarwal, 'A modern approach to Logical reasoning', revised edition, S.Chand publication, 2017.
4. R S Agarwal, 'Quantitative Aptitude for Competitive Examinations', revised edition, S.Chand publication, 2017.
5. Rajesh Verma, "Fast Track Objective Arithmetic", 3rd edition, Arihant publication, 2018.
6. B.S. Sijwalii and InduSijwali, "A New Approach to REASONING Verbal & Non-Verbal", 2nd edition, Arihnat publication, 2014.

Syllabus of courses offered on cross cutting issues

1901MCX01	ENVIRONMENTAL STUDIES	L	T	P	C
		3	0	0	0

MODULE I ECOSYSTEMS AND BIODIVERSITY **10 Hours**

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers- Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Documentation of the medicinal plants in your native place

MODULE II NATURAL RESOURCES **10 Hours**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Documentation of the effect of modern Agriculture in your nearby Village

MODULE III ENVIRONMENTAL POLLUTION **9 Hours**

Definition – Source, causes, effects and control measures of: (a) Air pollution - Mitigation procedures- Control of particulate and gaseous emission, Control of SOX, NOx, CO and HC) -Technology for capturing CO2 (metallo organic frame works) (b) Water pollution – Waste water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies. Documentation study of local polluted site – Urban / Rural / Industrial / Agricultural

MODULE IV SOCIAL ISSUES AND THE ENVIRONMENT **8 Hours**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management -environmental ethics: Issues and possible solutions – 12 Principles of green chemistry – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark) central and state pollution control boards- disaster management: floods, earthquake- Public awareness. Analyze the recent steps taken by government of India to prevent pollution (Green India and Clean India)

MODULE V HUMAN POPULATION AND THE ENVIRONMENT **8 Hours**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA) -GIS-remote sensing-role of information technology in environment and human health – Case studies. Documentation study of the Human health and the environment in nearby Hospital (Statistical report)

E.G.S. PILLAY ENGINEERING COLLEGE (AUTONOMOUS)

NAGAPATTINAM – 611 002. TAMILNADU, INDIA
Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai
(Accredited by NAAC with 'A' Grade and NBA)
Email: principal@egspec.orgwebsite: www.egspec.orgPh: 04365-251112

1701MGX01	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
2. To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
3. To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights
4. To have an adequate knowledge about MNC"s, Business, Environmental, Computer Ethics, Honesty, Moral Leadership, sample Code of Conduct.
5. To use the engineering principles to update and maintain the technical skills.

Unit I	I ENGINEERING ETHICS	9 Hours

Senses of „Engineering Ethics" – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg"s theory – Gilligan"s theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

Unit II	II ENGINEERING AS SOCIAL EXPERIMENTATION	9 Hours

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

Unit III	ENGINEER'S RESPONSIBILITY FOR SAFETY	9 Hours

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator"s Approach to Risk - Case Studieson Chernobyl, Bhopal MIC and Sterlite copper.

Unit IV	RESPONSIBILITIES AND RIGHTS	9 Hours

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Unit V	GLOBAL ISSUES	9 Hours

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

Total: 45 Hours

Further Reading:

Case study on Hiroshima and Nagasaki

Course Outcomes:

After completion of the course, Student will be able to

1. Helps to examine situations and to internalize the need for applying Ethical principles, values to tackle with various situations.
2. Develop a responsible attitude towards Global issues
3. Envision the societal impact on the products/ projects
4. Understanding the code of ethics and standards
5. Apply ethics in society, discuss the global issues related to engineering and realize the responsibilities and rights in the society

References:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003

3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi 2004
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)

1703MG005	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn concepts, dimension quality and philosophies ofTQM.
2. To study the TQM principles and itsstrategies.
3. To impart knowledge on TQM tools for continuous improvement.

Unit I **INTRODUCTION** **9 Hours**

Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Analysis Techniques for Quality Costs - Basic concepts of Total Quality Management - Historical Review - Quality Statements - Strategic Planning, Deming Philosophy - Crosby philosophy - Continuous Process Improvement - JuranTrilogy, PDSA Cycle, 5S, Kaizen - Obstacles to TQM Implementation

Unit II **TQM PRINCIPLES** **9 Hours**

Principles of TQM, Leadership - Concepts - Role of Senior Management - Quality Council, Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement - Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits - Supplier Partnership - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures - Basic Concepts, Strategy, Performance Measure

Unit III **STATISTICAL PROCESS CONTROL (SPC)** **9 Hours**

The seven tools of quality - Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, NP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma - New seven Management tools

Unit IV **TQM TOOLS** **9 Hours**

Benchmarking - Reasons to Benchmark - Benchmarking Process, Quality Function Deployment(QFD)- House of Quality, QFD Process, and Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM) - Concept, Improvement Needs, and FMEA - Stages of FMEA- Casestudies

Unit V **QUALITY SYSTEMS** **9 Hours**

Concept, Requirements of ISO 9000 and Other Quality Systems - ISO 9000:2000 Quality System - Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2005 and 9001:2015, ISO 14000.

Total: **45 Hours**

Further Reading:

1. Case Study: TQM Quality and Environmental Concepts in real World Applications
2. Environment Management system

Course Outcomes:

After completion of the course, Student will be able to

1. Understand the concepts, dimension quality and philosophies ofTQM.
2. Understand the principles of TQM and itsstrategies.
3. Apply seven statistical quality and managementtools
4. Understand TQM tools for continuousimprovement.

	5. Understand the QMS andEMS
References:	
1.	Rathakrishnan, Gas Dynamics, 5th edition, PHI Learing Private Limited,2013.
2.	N. Gupta and B. Valarmathi, Total Quality Management, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi,2009.
3.	S. Kumar, Total Quality Management, Laxmi Publications Ltd. New Delhi,2006
4.	P.N. Muherjee, Total Quality Management, Prentice Hall of India, New Delhi,2006.
5.	DaleH.Besterfiled, Total Quality Management, Pearson Education Inc., New Delhi,2003.
6.	James R. Evans and William M. Lidsay, The Management and Control of Quality, South- Western2002.

1703MG001	**PRINCIPLES OF MANAGEMENT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives:

1. To enable the students to study the evolution of Management
2. To study the functions and principles of management
3. To learn the application of the principles in an organization

Unit I	**INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS**	**9 Hours**

Definition of Management – Science or Art – Manager Vs Entrepreneur - Types of managers - managerial roles and skills – Evolution of Management – Scientific, Human relations , System and contingency approaches – Types of Business organization - Sole proprietorship, partnership, Company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

Unit II	**PLANNING**	**9 Hours**

Nature and purpose of planning – Planning Process – Types of planning – Objectives – Setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

Unit III	**ORGANISING**	**9 Hours**

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – Delegation of authority – Centralization and Decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, Selection, Training and Development, Performance Management , Career planning and Management.

Unit IV	**DIRECTING**	**9 Hours**

Foundations of Individual and Group behaviour – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication –Communication and IT.

Unit V	**CONTROLLING**	**9 Hours**

System and process of controlling – Budgetary and non-budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

Total:	**45 Hours**

Further Reading:	
	1. Decision roles of managers.
	2. Motivational thoughts.
Course Outcomes:	
	After completion of the course, Student will be able to
	1. Explain the elements of Management and Organization.
	2. Summarize the types, policies, tools and techniques in Planning in Management

	3. Relate the job design and human resource management in Organizing
	4. Illustrate the skills of leadership and communication
	5. Interpret the controlling techniques in Management

References:

1. Stephen A. Robbins & David A. Decenzo& Mary Coulter, "Fundamentals of Management" 7 th Edition, Pearson Education, 2011.
2. Stephen P. Robbins & Mary Coulter, "Management", 10th Edition,Prentice Hall (India) Pvt. Ltd., 2009.
3. Robert Kreitner& Mamata Mohapatra, " Management", Biztantra, 2008.
4. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6 thEdition,Pearson Education, 2004.
5. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999
6. Harold Koontz & Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.

1703MG005	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives:

1. To learn concepts, dimension quality and philosophies of TQM.
2. To study the TQM principles and its strategies.
3. To impart knowledge on TQM tools for continuous improvement.

Unit I	**INTRODUCTION**	**9 Hours**

Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Analysis Techniques for Quality Costs - Basic concepts of Total Quality Management - Historical Review - Quality Statements - Strategic Planning, Deming Philosophy - Crosby philosophy - Continuous Process Improvement - JuranTrilogy, PDSA Cycle, 5S, Kaizen - Obstacles to TQM Implementation

Unit II	**TQM PRINCIPLES**	**9 Hours**

Principles of TQM, Leadership - Concepts - Role of Senior Management - Quality Council, Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement - Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits - Supplier Partnership - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures - Basic Concepts, Strategy, Performance Measure

Unit III	**STATISTICAL PROCESS CONTROL (SPC)**	**9 Hours**

The seven tools of quality - Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, NP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma - New seven Management tools

Unit IV	**TQM TOOLS**	**9 Hours**

Benchmarking - Reasons to Benchmark - Benchmarking Process, Quality Function Deployment(QFD)- House of Quality, QFD Process, and Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM) - Concept, Improvement Needs, and FMEA - Stages of FMEA- Case studies

Unit V	**QUALITY SYSTEMS**	**9 Hours**

Concept, Requirements of ISO 9000 and Other Quality Systems - ISO 9000:2000 Quality System - Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2005 and 9001:2015, ISO 14000.

Total:	**45 Hours**

Further Reading:

1. Case Study: TQM Quality and Environmental Concepts in real World Applications

	2. Environment Management system
Course Outcomes:	
	After completion of the course, Student will be able to
	1. Understand the concepts, dimension quality and philosophies of TQM.
	2. Understand the principles of TQM and its strategies.
	3. Apply seven statistical quality and management tools
	4. Understand TQM tools for continuous improvement.
	5. Understand the QMS and EMS
References:	
1. Rathakrishnan, Gas Dynamics, 5th edition, PHI Learing Private Limited,2013.	
2. N. Gupta and B. Valarmathi, Total Quality Management, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi,2009.	
3. S. Kumar, Total Quality Management, Laxmi Publications Ltd. New Delhi,2006	
4. P.N. Muherjee, Total Quality Management, Prentice Hall of India, New Delhi,2006.	
5. DaleH.Besterfiled, Total Quality Management, Pearson Education Inc., New Delhi,2003.	
6. James R. Evans and William M. Lidsay, The Management and Control of Quality, South- Western2002.	

1703EC031	**SATELLITE COMMUNICATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
Course Objectives:					
	1. To impart knowledge about the Satellite communication.				
	2. To enhance the students‟ knowledge in astronomy and space				
Unit I	**SATELLITE ORBITS**				**9 Hours**
Introduction - Spectrum allocations for satellite systems -Kepler„s Laws - orbital parameters - orbital perturbations - station keeping – Type of orbits - Geo stationary orbits – look angle determination- limits of visibility – eclipse -sub satellite point – sun transit outage - launching procedures - launch vehicles and propulsion.					
Unit II	**SPACE AND EARTH SEGMENT**				**9 Hours**
Spacecraft technology- structure- power supply- attitude and orbit control - thermal control and propulsion - communication subsystems - telemetry, tracking and command - TranspondersAntenna subsystem, Equipment reliability. Earth station technology -Receive only home TV systems - MATV – CATV – Transmit Receive Earth Stations.					
Unit III	**SATELLITE ACCESS**				**9 Hours**
Modulation and Multiplexing-Voice, Data, Video, Analog – digital transmission system-Digital video broadcast - multiple access: FDMA, TDMA, CDMA- assignment methods -spread spectrum communication -compression – encryption. Mobile satellite Service: GSM, GPS,communication between satellites					
Unit IV	**SATELLITE LINK DESIGN**				**9 Hours**
Introduction- Equivalent isotropic radiated power -Transmission Losses – Link power budget equation - System Noise, Carrier to Noise ratio – uplink – downlink – effects of rain – combined uplink and downlink C/N ratio –inter modulation noise - Interference between satellite circuits.					
Unit V	**SATELLITE APPLICATIONS**				**12 Hours**

Satellite mobile services – VSAT- Radarsat- GPS- Orbcomm-iridium- Direct Broadcast satellites (DBS) - Direct to home Broadcast (DTH) -Digital audio broadcast (DAB) – World space services, Business TV (BTV) – GRAMSAT - Specialized services: E mail, Video conferencing, Internet- INTELSAT Series- INSAT – INMARSAT. Remote sensing

	Total:	**45 Hours**

Further Reading:	
	Latesttrend in satellite communication, Recent launching satellites and its application, Communication between satellites, Comparison of satellite

Course Outcomes:	
	After completion of the course, Student will be able to
	1. Discuss orbital mechanics and launch methodologies.
	2. Describe various space subsystems.
	3. Explain different subsystems of earth segment
	4. Design and analyze link power budget for satellites
	5. Describe in various Satellite Applications

References:

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication SystemsEngineering", Prentice Hall/Pearson, 2007.
2. N.Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House BostanLondon, 1997.
4. Tri T. Ha, "Digital Satellite Communication", II nd edition, 1990.
5. Emanuel Fthenakis, "Manual of Satellite Communications", Mc Graw Hill Book Co., 1984.
6. Robert G. Winch, "Telecommunication Trans Mission Systems", Mc Graw-Hill Book Co., 1983
7. Brian Ackroyd, "World Satellite Communication and earth station Design", BSP professionalBooks, 1990.
8. G.B.Bleazard, "Introducing Satellite communications", NCC Publication, 1985.
9. M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan 2003.

1901MCX02		**INDIAN CONSTITUTION AND SOCIETY**	**L**	**T**	**P**	**C**
			1	**0**	**0**	**0**

Course Objectives:		
	1. Toknow about Indian constitution.	
	2. To know about central and state government functionalities in India.	
	3. To know about Indian society	
Unit I	**INTRODUCTION**	**6 Hours**
Historical Background - Constituent Assembly of India - Philosophical foundations of the Indian Constitution - Preamble - Fundamental Rights - Directive Principles of State Policy - Fundamental Duties - Citizenship - Constitutional Remedies for citizens.		
Unit II	**STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT**	**6 Hours**
Union Government - Structures of the Union Government and Functions - President- Vice President- Prime Minister - Cabinet - Parliament - Supreme Court of India - Judiciary view.		

Unit III	**STRUCTURE AND FUNCTION OF STATE GOVERNMENT**	**6 Hours**
State Government-Structure and Functions - Governor - Chief minister-Cabinet-State Legislature- Judicial System in States -High Courts and other sub ordinate Courts.		
Unit IV	**CONSTITUTION FUNCTIONS**	**6 Hours**
Indian Federal System -Center -State Relations- Constitutional Amendments - Constitutional Functionaries - Assessment of working of Parliamentary System in India.		
Unit V	**INDIAN SOCIETY**	**6 Hours**
Society: Nature, Meaning and definition; India Political Structure; Caste, Religion, Languages in India;Constitutional Remedies for citizens-Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections		
	Total:	**30 Hours**

Further Reading:	
	Indian penal codes.
Course Outcomes:	
	After completion of the course, Student will be able to
	1. Understand the functions of Indian government
	2. Understand and abide rules of the Indian constitution.
	3. Understand and appreciate diversity of Indian Culture

References:

1. Durga Das Baslli 'Introduction to the Constitution of India " Prentice Hall of India, New Delhi.
2. R.C.Agarwal, (1997) 'Indian Political System', S.Chand and Company, New Delhi.
3. Maciver and Page, • Society: An Introduction Analysis " Mac Milan India Ltd., New Delhi.
4. K.L.Sharma, (1997) 'Social Stratification in India: Issues and Themes', Jawaharlal NehruUniversity, New Delhi.

1701MGX01	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Basic understanding of business management
2. Basic understanding of human values

COURSE OBJECTIVES:

1. To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
2. To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
3. To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights
4. TohaveanadequateknowledgeaboutMNC"s,Business,Environmental,ComputerEthics, Honesty, Moral Leadership, sample Code of Conduct.
5. To use the engineering principles to update and maintain the technical skills.

Course Outcomes:

After completion of the course, Student will be able to

CO1 – Discuss about Engineering ethics by using various theorems(K2)
CO2 – Describe the role of engineering as social experimentation(K2)
CO3 – Explain the role of engineers for safety(K2)
CO4 –Discuss various responsibility and rights in professional ethics(K2)
CO5 – Discuss about various global issues and its impact in society(K2)

UNIT I ENGINEERING ETHICS **9 Hours**

Senses of „Engineering Ethics"– Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg"s theory – Gilligan"s theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION **9 Hours**

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY **9 Hours**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Case Studies on Chernobyl, Bhopal MIC and Sterlite copper.

UNIT IV RESPONSIBILITIES AND RIGHTS **9 Hours**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **9 Hours**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR:

1. Case study on Hiroshima and Nagasaki

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi 2004
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)
6. Nptel link: https://nptel.ac.in/courses/109/106/109106117/

1901MGX01	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To get idea about the principles of TQM

To understand the TQM tools and techniques.

COURSE OUTCOME

CO1 Understand the outline of Total quality management

CO2 Summarize the principles of Total quality management

CO3 Describe the tools and techniques of Total quality management by using six sigma concepts

CO4 Describe the tools and techniques of Total quality management by using quality function development

CO5 Discuss the quality systems of Total quality management

UNIT I INTRODUCTION **9 Hours**

Introduction – Need for quality – Evolution of quality – Definitions of quality – Dimensions of product and service quality – Basic concepts of TQM – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, and Customer retention – Costs of quality.

UNIT II TQM PRINCIPLES **9 Hours**

Leadership – Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, 5S, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I **9 Hours**

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II **9 Hours**

Control Charts – Process Capability – Concepts of Six Sigma – Quality Function Development (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.

UNIT V QUALITY SYSTEMS **9 Hours**

Need for ISO 9000 – ISO 9001-2008 Quality System – Elements, Documentation, Quality Auditing – QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors.

Total: 45 Hours

Reference(s)

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint 2006.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
3.Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

		L	T	P	C
1901MGX02	**Project Management and Finance**	**3**	**0**	**0**	**3**

COURSE OBJECTIVE

To understand the project management

To know about the project evaluation

COURSE OUTCOME

- **CO1** Understand about the project management and selection
- **CO2** Describe the implementation of project
- **CO3** Discuss about evaluation and auditing of project management
- **CO4** Summarize about the working capital management and budgeting
- **CO5** Discuss the finance and accounting of project management

UNIT I **PROJECTMANAGEMENT,PROJECTSELECTIONANDPROJECT** **9 Hours**

Objectives of project management: Types of Projects: Project Management Life Cycle: Project Selection: Feasibility study: Estimation of Project Cost, Cost of Capital, Network analysis Techniques: PERT, CPM, Government regulations and statutory for various projects:

UNIT II **PROJECTIMPLIMENTATION,MONITORINGAND CONTROL** **9 Hours**

Project representation: Role of project Managers, relevance with objective of organization, preliminary manipulations ,Basic Scheduling concepts :Resource leveling ,Resource allocation, Setting a baseline, Project management information system: Importance of contracts in projects: Team work in Project Management: Formation of Effective terms.

UNIT III **PROJECTEVALUATION,AUDITINGAND OTHER RELATED TOPICS IN PROJECT MANAGEMENT** **9 Hours**

Project Evaluation: Project auditing: Phase of project audit Project closure reports, computers, e-markets in Project Management:

UNIT IV **WORKINGCAPITALMANAGEMENTANDCAPITALBUDGETING** **9 Hours**

Current assets management: Estimation of working capital requirements: Capital budgeting: Capital budgeting methods: Present value method: Accounting rate of return methods.

UNIT V **FINANCEANDACCOUNTING** **9 Hours**

Source of finance: Term Loans: Capital Structure: Financial Institution Accounting Principles: Preparation and Interpretation of balance sheets, profit and loss statements, Fixed Assets, Current assets, Depreciation methods :Break even analysis:

Total: 45 Hours

Reference(s)

1. Project Management Institute "A Guide to the Project Management Body of Knowledge" PMBOK® Guide (Sixth Edition),Sept2017
2. James C.Van Horne, "Fundamentals of Financial Management" ,Person Education2004.
3. **KüsterJ.,Huber,**E.,**Lippmann,**R.,**Schmid,**A.,**Schneider,**E.,**Witschi,**U.,**Wüst,**R." Project Management Handbook",2015
4. Khanna,R.B., "Project Management", PHI 2011.
5. Prasanna Chandra, "Financial Management", TataMcGraw-Hill,2008.
6. By Carl S. Warren, James M. Reeve, Jonathan Duchac."Financial &Managerial Accounting",2016
7. Paneer Selvam,R., and Senthilkumar ,P., "Project Management", PHI, 2011.

1901MGX04	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

COURSE OUTCOME

CO1	Understand about the outline of management and its organization
CO2	Discuss the planning involved in management
CO3	Describe the nature of organizing structure in management
CO4	Understand the concept of directing in management
CO5	Discuss the concept of controlling in management

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management Science or Art Manager Vs Entrepreneur-types of managers- Managerial roles and skills Evolution of Management Scientific, Human Relations, System and Contingency approaches Types of Business organization- Sole proprietorship, partnership, Company-public and private sector enterprises- Organization culture and Environment Current Trends and issues in Management.

UNIT II PLANNING

Nature and purpose of planning-Planning process-Types of planning-Objectives-Setting objectives- Policies-Planning premises - Strategic Management- Planning Tools and Techniques-Decision making steps and process.

UNIT III ORGANISING

Nature and purpose Formal and informal organization - Organization chart - Organization Structure Types Line and staff authority – Departmentalization - delegation of authority - Centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development - Performance Management - Career planning and management.

UNIT IV DIRECTING

Foundations of individual and group behaviour-Motivation-Motivation theories - Motivational techniques-Job satisfaction - Job enrichment-Leadership-types and theories of leadership - Communication-Process of communication-Barrier in communication Effective communication -Communication and IT.

UNIT V CONTROLLING

System and process of controlling-Budgetary and non-Budgetary control techniques-Use of Computers and IT in Management control-Productivity problems and management-Control and Performance-Direct and preventive control-Reporting.

REFERENCES:

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education,7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008

1703MG002	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To learn concepts, dimension quality and philosophies of TQM.
2. To study the TQM principles and its strategies.
3. To impart knowledge on TQM tools for continuous improvement.

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1: Understand the concepts, dimension quality and philosophies of TQM.
CO2: Understand the principles of TQM and its strategies.
CO3: Apply seven statistical quality and management tools
CO4: Understand TQM tools for continuous improvement.
CO5: Understand the QMS and EMS

UNIT I INTRODUCTION **9 Hours**

Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Analysis Techniques for Quality Costs - Basic concepts of Total Quality Management - Historical Review - Quality Statements - Strategic Planning, Deming Philosophy - Crosby philosophy - Continuous Process Improvement - Juran Trilogy, PDSA Cycle, 5S, Kaizen - Obstacles to TQM Implementation

UNIT II TQM PRINCIPLES **9 Hours**

Principles of TQM, Leadership - Concepts - Role of Senior Management - Quality Council, Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement - Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits - Supplier Partnership - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures - Basic Concepts, Strategy, Performance Measure

UNIT III STATISTICAL PROCESS CONTROL (SPC) **9 Hours**

The seven tools of quality - Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, NP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma - New seven Management tools

UNIT IV TQM TOOLS **9 Hours**

Benchmarking - Reasons to Benchmark - Benchmarking Process, Quality Function Deployment (QFD)- House of Quality, QFD Process, and Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM) - Concept, Improvement Needs, and FMEA - Stages of FMEA- Case studies

UNIT V QUALITY SYSTEMS **9 Hours**

Concept, Requirements of ISO 9000 and Other Quality Systems - ISO 9000:2000 Quality System - Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2005 and 9001:2015, ISO 14000.

TOTAL: 45 HOURS

FURTHER READING:

1. Case Study: TQM Quality and Environmental Concepts in real World Applications
2. Environment Management system

REFERENCES:

1. Rathakrishnan, Gas Dynamics, 5th edition, PHI Learing Private Limited, 2013.
2. N. Gupta and B. Valarmathi, Total Quality Management, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2009.
3. S. Kumar, Total Quality Management, Laxmi Publications Ltd. New Delhi, 2006
4. P.N. Muherjee, Total Quality Management, Prentice Hall of India, New Delhi, 2006.
5. DaleH.Bester filed, Total Quality Management, Pearson Education Inc., New Delhi, 2003.
6. James R. Evans and William M. Lidsay, The Management and Control of Quality, South- Western 2002.

1703EE002	ELECTRICAL SAFETY AND MANAGEMENT	L	T	P	C
		3	0	0	3

PREREQUISITE :

Transmission & Distribution

COURSE OBJECTIVES:

1. To Understand the concepts of Indian rules and earthing.
2. To get knowledge in first aid and fire extinguishers operating procedures.
3. To understand the safety policy in management & organizations.

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1 Understand the Indian electricity rules and their significance.(K2)
CO2 Identify hazardous areas in Industrial sectors.(K2)
CO3 Describe the various steps in first aid and safety during electrical installation.(K2)
CO4 Investigate the various fire extinguishers and its mode of operation.(K3)
CO5 Make use of energy management and energy auditing procedures in industrial sectors. (K3).

UNIT I RULES &REGULATIONS **9 Hours**

Power sector organization and their roles; significance of IE rules & IE acts; general safety requirements: span, conductor configuration, spacing and clearing, sag, erection, hazards of electricity.

UNIT II INSTALLATION AND EARTHING OF EQUIPMENTS **9 Hours**

Classification of electrical installation; earthing of equipment bodies; electrical layout of switching devices and SC protection; safety in use of domestic appliances; safety documentation and work permit system; flash hazard calculations; tools and test equipments.

UNIT III SAFETY MANAGEMENT AND FIRST AID **9 Hours**

Safety aspects during commissioning-safety clearance notice before energizing, safety during maintenance, maintenance schedule; special tools; security grand; check list for plant security; effects of electric and electromagnetic fields in HV lines and substations; safety policy in management & organizations; first aid; basic principles; action taken after electrical shock; artificial respiration and methods.

UNIT IV FIRE EXTINGUISHERS **9 Hours**

Fundamentals of fire- initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system ;CO_2 and Halogen gas schemes; foam schemes.

UNIT V ENERGY MANAGEMENT &ENERGY AUDITING **9 Hours**

Objectives of energy management; energy efficient electrical systems; energy conservation and energy policy; renewable source of energy; energy auditing; types and tips for improvement in industry.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Brief about role of Bureau of Energy Efficiency (BEE) in energy conservation.
2. Implementation of engineering ethics in safety management.

REFERENCES:

1. Rao.S, Khanna.R.C, "Electrical safety, Fire safety engineering and safety management", Hanna publisher, Delhi, 2nd edition, 1998.
2. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth company, 1978.
2. Power Engineering Hand book, TNEB Engineers officers, Chennai, 2002.
3. John Codick, "Electrical safety hand book", McGraw Hill Inc., New Delhi, 2000.
4. The Indian electricity rules, 1956, authority regulations, 1979, Commercial Law Publication, Delhi, 1999.
5. V. Manoilov, "Fundamentals of electrical safety", Mir Publishers, MOSCOW,1975

1701MGX01	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Basic understanding of business management
2. Basic understanding of human values

COURSE OBJECTIVES:

1. To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
2. To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
3. To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights
4. TohaveanadequateknowledgeaboutMNC's,Business,Environmental,ComputerEthics, Honesty, Moral Leadership, sample Code of Conduct.
5. To use the engineering principles to update and maintain the technical skills.

Course Outcomes:

After completion of the course, Student will be able to

CO1 – Discuss about Engineering ethics by using various theorems(K2)
CO2 – Describe the role of engineering as social experimentation(K2)
CO3 – Explain the role of engineers for safety(K2)
CO4 –Discuss various responsibility and rights in professional ethics(K2)
CO5 – Discuss about various global issues and its impact in society(K2)

UNIT I ENGINEERING ETHICS **9 Hours**

Senses of „Engineering Ethics"– Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg"s theory – Gilligan"s theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION **9 Hours**

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY **9 Hours**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Case Studies on Chernobyl, Bhopal MIC and Sterlite copper.

UNIT IV RESPONSIBILITIES AND RIGHTS **9 Hours**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **9 Hours**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct. **TOTAL: 45 HOURS**

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR:

1. Case study on Hiroshima and Nagasaki

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi 2004
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, (2003)
6. Nptel link: https://nptel.ac.in/courses/109/106/109106117/

UNIT III SWITCHED RELUCTANCE MOTORS (SRM) 9

Constructional features – Rotary and Linear SRM - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control – Applications.

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power Converter Circuits and their controllers – Motor characteristics and control– Applications.

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) 9

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements– Applications.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to model and analyze electrical apparatus and their application to power system

TEXT BOOKS:

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
3. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

REFERENCES:

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London, 1982.
3. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
4. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

MG6851 PRINCIPLES OF MANAGEMENT **L T P C 3 0 0 3**

OBJECTIVES:

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS:

1. Stephen P. Robbins & Mary Coulter, " Management", Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", Pearson Education, 6th Edition, 2004.

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich "Essentials of Management" Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999.

Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

GE6075 **PROFESSIONAL ETHICS IN ENGINEERING** **L T P C 3 0 0 3**

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES **10**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -

Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

GE6757 TOTAL QUALITY MANAGEMENT **L T P C 3 0 0 3**

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal

Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

GE6757 TOTAL QUALITY MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES **9**

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal

- Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II **9**

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors.

TOTAL: 45 PERIODS

OUTCOMES:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

EC6002 ADVANCED DIGITAL SIGNAL PROCESSING **L T P C 3 0 0 3**

OBJECTIVES:

- To bring out the concepts related to stationary and non-stationary random signals
- To emphasize the importance of true estimation of power spectral density
- To introduce the design of linear and adaptive systems for filtering and linear prediction
- To introduce the concept of wavelet transforms in the context of image processing

UNIT I DISCRETE-TIME RANDOM SIGNALS **9**

Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, Power Spectral Density, Spectral Factorization, Innovations Representation and Process, Filtering random processes, ARMA, AR and MA processes.

1703MG002 **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

1. To learn concepts, dimension quality and philosophies of TQM.
2. To study the TQM principles and its strategies.
3. To impart knowledge on TQM tools for continuous improvement.

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1: Understand the concepts, dimension quality and philosophies of TQM.
CO2: Understand the principles of TQM and its strategies.
CO3: Apply seven statistical quality and management tools
CO4: Understand TQM tools for continuous improvement.
CO5: Understand the QMS and EMS

UNIT I INTRODUCTION **9 Hours**

Definition of Quality - Dimensions of Quality - Quality Planning - Quality costs - Analysis Techniques for Quality Costs - Basic concepts of Total Quality Management - Historical Review - Quality Statements - Strategic Planning, Deming Philosophy - Crosby philosophy - Continuous Process Improvement - Juran Trilogy, PDSA Cycle, 5S, Kaizen - Obstacles to TQM Implementation

UNIT II TQM PRINCIPLES **9 Hours**

Principles of TQM, Leadership - Concepts - Role of Senior Management - Quality Council, Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement - Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits - Supplier Partnership - Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures - Basic Concepts, Strategy, Performance Measure

UNIT III STATISTICAL PROCESS CONTROL (SPC) **9 Hours**

The seven tools of quality - Statistical Fundamentals - Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables X bar and R chart and attributes P, NP, C, and u charts, Industrial Examples, Process capability, Concept of six sigma - New seven Management tools

UNIT IV TQM TOOLS **9 Hours**

Benchmarking - Reasons to Benchmark - Benchmarking Process, Quality Function Deployment (QFD)- House of Quality, QFD Process, and Benefits - Taguchi Quality Loss Function - Total Productive Maintenance (TPM) - Concept, Improvement Needs, and FMEA - Stages of FMEA- Case studies

UNIT V QUALITY SYSTEMS **9 Hours**

Concept, Requirements of ISO 9000 and Other Quality Systems - ISO 9000:2000 Quality System - Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 9000:2005 and 9001:2015, ISO 14000.

TOTAL: 45 HOURS

FURTHER READING:

1. Case Study: TQM Quality and Environmental Concepts in real World Applications
2. Environment Management system

REFERENCES:

1. Rathakrishnan, Gas Dynamics, 5th edition, PHI Learing Private Limited, 2013.
2. N. Gupta and B. Valarmathi, Total Quality Management, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2009.
3. S. Kumar, Total Quality Management, Laxmi Publications Ltd. New Delhi, 2006
4. P.N. Muherjee, Total Quality Management, Prentice Hall of India, New Delhi, 2006.
5. DaleH.Bester filed, Total Quality Management, Pearson Education Inc., New Delhi, 2003.
6. James R. Evans and William M. Lidsay, The Management and Control of Quality, South- Western 2002.

1703EE002	ELECTRICAL SAFETY AND MANAGEMENT	L	T	P	C
		3	0	0	3

PREREQUISITE :

Transmission & Distribution

COURSE OBJECTIVES:

1. To Understand the concepts of Indian rules and earthing.
2. To get knowledge in first aid and fire extinguishers operating procedures.
3. To understand the safety policy in management & organizations.

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1 Understand the Indian electricity rules and their significance.(K2)
CO2 Identify hazardous areas in Industrial sectors.(K2)
CO3 Describe the various steps in first aid and safety during electrical installation.(K2)
CO4 Investigate the various fire extinguishers and its mode of operation.(K3)
CO5 Make use of energy management and energy auditing procedures in industrial sectors. (K3).

UNIT I RULES &REGULATIONS **9 Hours**

Power sector organization and their roles; significance of IE rules & IE acts; general safety requirements: span, conductor configuration, spacing and clearing, sag, erection, hazards of electricity.

UNIT II INSTALLATION AND EARTHING OF EQUIPMENTS **9 Hours**

Classification of electrical installation; earthing of equipment bodies; electrical layout of switching devices and SC protection; safety in use of domestic appliances; safety documentation and work permit system; flash hazard calculations; tools and test equipments.

UNIT III SAFETY MANAGEMENT AND FIRST AID **9 Hours**

Safety aspects during commissioning; safety clearance notice before energizing, safety during maintenance, maintenance schedule; special tools; security grand; check list for plant security; effects of electric and electromagnetic fields in HV lines and substations; safety policy in management & organizations; first aid; basic principles; action taken after electrical shock; artificial respiration and methods.

UNIT IV FIRE EXTINGUISHERS **9 Hours**

Fundamentals of fire- initiation of fires, types; extinguishing techniques, prevention of fire, types of fire extinguishers, fire detection and alarm system ;CO_2 and Halogen gas schemes; foam schemes.

UNIT V ENERGY MANAGEMENT &ENERGY AUDITING **9 Hours**

Objectives of energy management; energy efficient electrical systems; energy conservation and energy policy; renewable source of energy; energy auditing; types and tips for improvement in industry.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Brief about role of Bureau of Energy Efficiency (BEE) in energy conservation.
2. Implementation of engineering ethics in safety management.

REFERENCES:

1. Rao.S, Khanna.R.C, "Electrical safety, Fire safety engineering and safety management", Hanna publisher, Delhi, 2nd edition, 1998.
2. Cooper.W.F, "Electrical safety Engineering", Newnes-Butterworth company, 1978.
2. Power Engineering Hand book, TNEB Engineers officers, Chennai, 2002.
3. John Codick, "Electrical safety hand book", McGraw Hill Inc., New Delhi, 2000.
4. The Indian electricity rules, 1956, authority regulations, 1979, Commercial Law Publication, Delhi, 1999.
5. V. Manoilov, "Fundamentals of electrical safety", Mir Publishers, MOSCOW,1975

1901MCX02	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

1. To understand about Indian constitution and its structure
2. To obtain the knowledge in constitution function and Indian society

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- **CO1** Understand the background and foundations of Indian Constitution
- **CO2** Describe the structure and function of central government
- **CO3** Discuss the structure and function of state government
- **CO4** Explain the constitution functions and parliamentary system in India
- **CO5** Understand about the Indian society

MODULE I INTRODUCTION **6 Hours**

Historical Background -Constituent Assembly of India -Philosophical foundations of the Indian Constitution- Preamble - Fundamental Rights -Directive Principles of State Policy -Fundamental Duties –Citizenship - Constitutional Remedies for citizens.

MODULE II STRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT **6 Hours**

Union Government - Structures of the Union Government and Functions - President- Vice President- Prime Minister -Cabinet - Parliament - Supreme Court of India - Judiciary view

MODULE III STRUCTURE AND FUNCTION OF STATE GOVERNMENT **6 Hours**

State Government-Structure and Functions - Governor - Chief minister-Cabinet-State Legislature- Judicial System in States -High Courts and other sub ordinate Courts.

MODULE IV CONSTITUTION FUNCTIONS **6 Hours**

Indian Federal System -Center -State Relations- Constitutional Amendments - Constitutional Functionaries – Assessment of working of Parliamentary System in India

MODULE V INDIAN SOCIETY **6 Hours**

Society: Nature, Meaning and definition; India Political Structure; Caste, Religion, Languages in India; Constitutional Remedies for citizens-Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections

TOTAL: 30 HOURS

REFERENCES:

1. Durga Das Baslli "Introduction to the Constitution of India" Prentice Hall of India, New Delhi.
2. R.C. Agarwal, (1997) "Indian Political System", S. Chand and Company, New Delhi.
3. Maciver and Page, "Society: An Introduction Analysis " Mac Milan India Ltd., New Delhi
4. K.L. Sharma, (1997) 'Social Stratification in India: Issues and Themes', Jawaharlal Nehru University, New Delhi.

5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
6. S.Ghoshal, " Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009.

GE6083 **DISASTER MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS **9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) **9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj

Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT **9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA **9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS **9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man

Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

GE6075 PROFESSIONAL ETHICS IN ENGINEERING **L T P C 3 0 0 3**

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES **10**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -

GE6084	HUMAN RIGHTS	L T P C 3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I 9

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II 9

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III 9

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV 9

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V 9

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

1901MCX03	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
	(Common to All Branches)	2	0	0	0

COURSE OBJECTIVE

To understand Indian Traditional culture and philosophy
To understand the education system in India

COURSE OUTCOME

On the successful completion of the course, students will be able to

CO1 Describe the culture, literature and religion of India
CO2 Discuss the development of technology and Engineering in India
CO3 Summarize the education system in India

MODULE I INTRODUCTION TO CULTURE **6 Hours**

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

MODULE II INDIAN LANGUAGES, CULTURE AND LITERATURE **6 Hours**

Indian Languages and Literature-I: the role of Sanskrit, significance of scriptures to current society, Indian philosophies, other Sanskrit literature, literature of south India Indian Languages and Literature-II: Northern Indian languages & literature.

MODULE III RELIGION AND PHILOSOPHY **6 Hours**

Religion and Philosophy in ancient India, Religion and Philosophy in Medieval India, Religious Reform Movements in Modern India (selected movements only).

MODULE IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) **6 Hours**

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India.

MODULE V EDUCATION SYSTEM IN INDIA **6 Hours**

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India.

TOTAL 30 Hours

REFERENCES:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. S. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

1703EE004	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Measurement and instrumentation
2. Electron Devices and Circuits

COURSE OBJECTIVES:

1. To introduce Fundamentals of biomedical engineering.
2. To study the communication mechanics in a biomedical system with few examples.
3. To study measurement of important electrical and non-electrical parameters.
4. To understand the basic principles in imaging techniques.

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1 Have a basic knowledge in life assisting and therapeutic devices.
CO2 Explain the various sensing and measurement devices of electrical origin.
CO3 Discuss about the awareness of electrical safety of medical equipment's.
CO4 Elucidate the important and modern methods of imaging techniques.
CO5 Obligate latest knowledge of medical assistance / techniques and therapeutic.

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING AND TRANSDUCERS **09 Hours**

Cell and its structure – resting and action potential – nervous system- functional organization of the nervous system – structure of nervous system, neurons - synapse – basic components of a biomedical system- cardiovascular systems- respiratory systems -kidney and blood flow - biomechanics of bone - biomechanics of soft tissues - basic mechanics of spinal column and limbs -transducers – selection criteria.

UNIT II DIAGNOSTIC PROCEDURES AND NON ELECTRICAL PARAMETERS MEASUREMENT **09 Hours**

Measurement of blood pressure - cardiac output - heart rate - heart sound - pulmonary function measurements – spirometer – photo plethysmography, body plethysmography – blood gas analyzers, pH of blood –measurement of blood pCO2, pO2, finger-tip oximeter - ESR, GSR measurements.

UNIT III ELECTRO – PHYSIOLOGICAL MEASUREMENTS **09 Hours**

Physiological signals and transducers - Temperature measurements - Fibre optic temperature sensors. Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers –Isolation amplifier – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT IV IMAGING MODALITIES AND ANALYSIS **09 Hours**

Radio graphic and fluoroscopic techniques – computer tomography – MRI – ultrasonography – endoscopy – thermography –different types of biotelemetry systems - retinal imaging – imaging application in biometric systems - analysis of digital images. ECG, EEG, EMG, ERG – lead systems and recording methods.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES **09 Hours**

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialyzers – Lithotripsy - ICCU patient monitoring system - Nano Robots -Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Nucleonic instrumentation.
2. Plasmon resonance immunosensors.

REFERENCES:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, Fourth edition 2010.
1. Duane Knudson, "Fundamentals of Biomechanics", Springer, second Edition, 2007.
2. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, first Edition, 2011.
3. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", CRC Press LLC, Third Edition 2006.
4. Joseph J.carr and John M. Brown, "Introduction to Biomedical Equipment Technology", John Wiley And sons, New York, fourth Edition, 2012.

EI6704	BIOMEDICAL INSTRUMENTATION	L T P C 3 0 0 3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.

1702EE703	HIGH VOLTAGE ENGINEERING	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Power system analysis
2. Transmission and Distribution

COURSE OBJECTIVES:

1. Understand transient overvoltage and the protection of high voltage apparatus
2. Understand high voltage generation and measurement techniques in high voltage engineering
3. Specify testing methods and standards in high voltage equipment testing

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO 1 Describe the fundamentals of over voltages, causes of over voltages and protection against over voltages(K2)
CO2 Explain the breakdown mechanism in gaseous, liquid, and vacuum dielectrics(K2)
CO3 Review the methods of generation of high voltages and high currents(K2)
CO4 Summarize the measurement techniques of high voltages and high currents (K2)
CO5 Infer the high voltage testing of electrical power apparatus like insulator, bushing, circuit breaker, isolater and transformer(K2)

UNIT I OVERVOLTAGE PHENOMENON **9 Hours**

Electric field stresses; Estimation and control of electric stress; Natural causes of overvoltage; Lightning phenomenon; Mathematical modeling of lightning; Overvoltage due to switching surges; Surge voltage distribution and control.

UNIT II DIELECTRIC BREAKDOWN IN LIQUID, SOLID AND GASEOUS DIELECTRICS **9 Hours**

Breakdown mechanisms in liquid dielectric-Liquid dielectrics used in practice; Various processes of breakdown in solid dielectrics -Solid dielectrics used in practice; Ionization process; Corona discharge; Gaseous breakdown in uniform, Non uniform fields; selection of gases as insulating materials.

UNIT III GENERATION OF HIGH VOLTAGE AND CURRENT **9 Hours**

Generation of high DC voltage; Van de graff generator; Cascaded transformer ;Standard impulse wave shapes; Marx circuit generation of switching surges; Impulse current generation; Impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGE AND CURRENT **9 Hours**

Measurement of HVDC current and voltage; Measurement of high AC and impulse voltages; Measurement of high current: Direct, alternating and impulse current; Cathode Ray Oscilloscope measurement technique for impulse voltage and current.

UNIT V HIGH VOLTAGE TESTING AND INSULATION COORDINATION **9 Hours**

Principles of Insulation coordination; Testing of electrical apparatus- Insulators, Bushings, Circuit breakers , Cables ,Transformer ;Test standards ; Ratings of high voltage laboratories.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Power system transients
2. Indian testing standards of high voltage apparatus

REFERENCES:

1. S. Naidu and V. Kamaraju, "High Voltage Engineering", Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J. Kuffel, "High voltage Engineering fundamentals", Newness Second Edition Elsevier, New Delhi, 2005.
3. Subir Ray, "An Introduction to High Voltage Engineering", PHI Learning Private Limited, New Delhi, Second Edition, 2013.
4. C.L. Wadhwa, "High Voltage Engineering "New Age International, 2007.
5. Dieter Kind, Kurt Feser, "High Voltage test techniques", Newness, 2001.

		L	T	P	C
1703EE018	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	3	0	0	3

PREREQUISITE :

1. Renewable Energy Sources.
2. Power Electronics.

COURSE OBJECTIVES:

1. To design different power converters namely DC to DC and AC to AC converters for renewable energy systems.
2. To Provide knowledge about the stand alone and grid connected renewable energy systems.
3. To analyze and comprehend the various operating modes of wind electrical generators and solar energy systems.

COURSE OUTCOMES:

After completion of the course, Student will be able to

- CO1 List the various renewable energy sources and its impacts like wind, ocean, biomass, fuel cell, and hydrogen and hybrid energy system
- CO2 Describe the applications of various generators & power converters like PWM Inverters, Buck Boost converter, AC voltage controller and matrix inverter in solar and WECS
- CO3 Explain the need of hybrid energy systems and its impacts with case studies
- CO4 Explain the stand-alone and grid interactive issues related with solar & WECS.
- CO5 Illustrate P&O, INC and Hybrid algorithms for solar system

UNIT I INTRODUCTION TO RENEWABLE ENERGY CONVERSION 9 Hours

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9 Hours

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS 9 Hours

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, And array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS 9 Hours

Stand-alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system.

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9 Hours

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Case study on MPPT
2. Case study of hybrid energy system.

REFERENCES:

1. Rashid .M. H "Power electronics Hand book", Academic press, third edition, 2009.
2. Godfrey Boyle, "Renewable energy: power for a sustainable future" Oxford university ,third edition,2012.
3. Ion Bolder, "Variable speed generators", Portland CRC press, second edition, 2015.
4. Rai. G.D, "Non-conventional energy sources", Khanna publisher, New Delhi, fifth edition, 2013.
5. Gray L. Johnson, "Wind energy system", prentice hall inc, 1995.
6. Andrzej M. Trzynnadlowski, "Introduction to Modern Power Electronics", Second edition, Wiley India Pvt. Ltd, 2012.
7. http://nptel.ac.in/courses/108105058/17.

1703EE019	ELECTRICAL ENERGY GENERATION UTILIZATION AND CONSERVATION	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Power Plant Engineering
2. Electrical Drives and Control

COURSE OBJECTIVES:

1. To introduce the knowledge in Industrial applications of electric drives.
2. To introduce the energy saving concept by different ways of illumination and understand the different methods of electric heating and electric welding.
3. To study basic concepts and applications of solar photovoltaic power conversion system and comprehend the basic concepts of wind power conversion system.
4. To acquire the knowledge of tariff and economic aspects in power generation.

Course Outcomes:

After completion of the course, Student will be able to

CO1 Recall the tractive effort for the propulsion of train, traction motors, characteristics of traction motor control, track equipment and collection gear.

CO2 Explain the different light sources and various illumination systems for the lighting schemes

CO3 Discuss the different methods of electric heating and types of electric welding schemes employed in industries.

CO4 Explain the concept of solar radiation and Physical principles of the conversion of solar radiation into heat.

CO5 Describe the aerodynamic forces acting on the blade and basic components of a WECS.

CO6 Discuss the performance of a flat plate collector and cylindrical parabolic concentrating collector.

UNIT I ELECTRIC DRIVESAND TRACTION **9 Hours**

Fundamentals of electric drive: Types of electric drives - Merits of electric traction - choice of an electric motor - application of motors for particular services - traction motors - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear; Recent trends in electric traction.

UNIT II ILLUMINATION **9 Hours**

Introduction - definition and meaning of terms used in illumination engineering; Classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps: Design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting: energy saving lamps, LED.

UNIT III HEATINGAND WELDING **9 Hours**

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating –Types - Resistance heating - Arc furnaces - Induction heating - Dielectric heating - Electric welding – Types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV SOLAR RADIATION, SOLARENERGY COLLECTORS AND WIND ENERGY **9 Hours**

Introduction - solar radiation at the Earth's surface - solar radiation geometry; estimation of average solar radiation - flat plate collectors - cover system - concentrating collector - advantages and disadvantages of concentrating collectors - parabolic concentrating collector – Introduction - basic principles of wind energy conversion - site selection considerations – basic components of a WECS (Wind Energy Conversion System) - Classification of WECS.

UNIT V ENERGY AND ECONOMIC ASPECTS OF GENERATION **9 Hours**

Economic aspects of power generation; terms commonly used in system operation; various factors affecting cost of generation; load curves - load duration curves; connected load, maximum load, peak load, base load and peak load power plants, load factor, plant capacity factor, plant use factor, demand factor, diversity factor, cost of power plant, tariffs and types; comparison of site selection criteria, introduction to energy auditing.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Solar rooftop PV system calculation for a home
2. Case study on Energy Auditing and Energy Conservation

References:

		L	T	P	C
1901MCX01	ENVIRONMENTAL SCIENCE (Common to all Branches of B.E/ B.Tech)	2	0	0	0

COURSE OBJECTIVES:

1. To create awareness about environmental problems
2. To impart basic knowledge about environment
3. To develop and attitude of concern for the environment

COURSE OUTCOME

CO1	Describe the physical, chemical and biological components of the eco systems and their function.
CO2	Describe the water quality parameter and removal of pollutants
CO3	Describe the scientic principles to analysis various environment implications in day to day life.
CO4	Describe the various environmental protection acts for key social systems affecting the environment.
CO5	Summarize the major diseases, women welfare child development and the impacts of population explosion

MODULE I ECOSYSTEMS AND BIODIVERSITY **10 Hours**

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Documentation of the medicinal plants in your native place

MODULE II NATURAL RESOURCES **10 Hours**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

Documentation of the effect of modern Agriculture in your nearby Village

MODULE III ENVIRONMENTAL POLLUTION **9 Hours**

Definition – Source, causes, effects and control measures of: (a) Air pollution - Mitigation procedures- Control of particulate and gaseous emission, Control of SO_X, NO_x, CO and HC) -Technology for capturing CO_2 (metallo organic frame works)(b) Water pollution – Waste water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies.

Documentation study of local polluted site – Urban / Rural / Industrial / Agricultural.

MODULE IV SOCIAL ISSUES AND THE ENVIRONMENT **8 Hours**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management -environmental ethics: Issues and possible solutions – 12 Principles of green chemistry – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments-scheme of labeling of environmentally friendly products (Ecomark) central and state pollution control boards- disaster management: floods, earthquake- Public awareness. Analyze the recent steps taken by government of India to prevent pollution (Green India and Clean India)

MODULE V HUMAN POPULATION AND THE ENVIRONMENT **8 Hours**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA) -GIS-remote sensing-role of information technology in environment and human health – Case studies.

Documentation study of the Human health and the environment in nearby Hospital (Statistical report)

1903EE003	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Applied Chemistry
2. Electrical Machinery-I

COURSE OBJECTIVES:

1. To realize the importance of electric transportation systems
2. To understand the basics of electric vehicle components and configuration
3. To understand the various charging types, comfort and safety methods and application of electric vehicle in Smart grid

COURSE OUTCOMES:

After completion of the course, Student will be able to

- **CO1** Describe the importance and challenges of electric vehicles
- **CO2** Explain the IC engines and transportation system
- **CO3** Infer about various charging system and starting system
- **CO4** Discuss the energy storage system and battery technology in electric vehicles
- **CO5** Discuss the role power electronics and its benefits

MODULE I INTRODUCTION TO ELECTRIC VEHICLES **9 Hours**

Electric and hybrid electric vehicle- History, components, types, environmental impact of electric and HEVs, electric motor and engine performance; EV and ICEV comparison; EV market-Indian scenario.

MODULE II IC ENGINES AND POWER TRAIN COMPONENTS **9 Hours**

Vehicle motion and the dynamic equations for the vehicle; Vehicle mass and performance; Gears; Clutches; Brakes and transmission system; Fuel economy characteristics of internal combustion engine; Series drive train; parallel, series parallel and complex drive trains and power flow in each case.

MODULE III ELECTRIC VEHICLE ARCHITECTURE **9 Hours**

Basic architecture of EV drive trains; PHEV; Vehicle power plant and transmission characteristics; Power flow in HEVs; Sizing of components for different hybrid drive train topologies; Impact of EVs in utility grid; Case study- Design of a BEV/HEV.

MODULE IV ENERGY STORAGE SYSTEMS **9 Hours**

Battery- Energy storage, Simplified models of battery, Battery parameters, Li-ion battery and battery pack management; Flywheels- Modeling for energy storage in HEV/BEV; Fuel cell and super capacitor-based energy storage; Hybridization of various energy storage devices and its advantages; Energy management system.

MODULE V ELECTRIC MACHINES AND POWER ELECTRONICS FOR HYBRID ELECTRIC VEHICLES **9 Hours**

DC Motor drives- Principle of operation, performance and multi-quadrant control; Induction motor drives- Control and applications in EV/HEVs; Permanent magnet motors; Switch reluctance motor drives; Sizing the propulsion motor; Torque, constant power speed ratio and machine dimensions.

Electric drives- Applications in HEV/EVs, Classifications, DC-DC converters for EV and HEV applications, Multi quadrant DC-DC converters, DC-AC inverters for EV and HEV applications, Voltage control of DC-AC inverters using PWM.

TOTAL: 45 HOURS

REFERENCES:

1. Tom Denton, "Electric and Hybrid Vehicles", 2nd Edition, Routledge, 2020.
2. James Larminie and John Lowry, "Electric Vehicle Technology Explained", 2nd Edition, Wiley, 2012.
3. MehrdadEhsani, Yimin Gao, Stefano Lengo and KambizEbrahimi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles", 3rd Edition, CRC Press, 2019.
4. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC Press, 2016.
5. https://nptel.ac.in/courses/108/102/108102121/
6. https://nptel.ac.in/courses/108/103/108103009/
7. Tom Denton, "Electric and Hybrid Vehicles", 2nd Edition, Routledge, 2020.

1903EE008	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Basic Mechanical Engineering
2. Applied Chemistry

COURSE OBJECTIVES:

1. To have a detailed knowledge about energy sources available and their management.
2. To understand layout of various power plants and the function of various components of the Power plant.
3. To become familiar with operation of various power plants.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

- **CO1** Understand the construction and operation of Thermal power plants
- **CO2** Select the suitable turbine for hydro power plants.
- **CO3** Identify the required turbine, site for diesel and gas power plant.
- **CO4** Explain the reactor operation and selection of site in Nuclear power plant.
- **CO5** Describe the power generation from various renewable resources.

MODULE I COAL BASED THERMAL POWER PLANTS **9 Hours**

Energy Scenario- National and international context; Layout of modern coal power plant; Types of boiler- Super critical boilers, FBC boilers; Turbines; Condensers; Steam and heat rate; Subsystems of thermal power plants; Fuel and ash handling, draught system, feed water treatment.

MODULE II HYDRO POWER PLANTS **9 Hours**

Introduction to hydro power plant; Layout of dams- Types; Selection of water turbine, advantages and disadvantages; Selection of site for hydro power plant; Pumped storage hydro power plant.

MODULE III DIESEL AND GAS POWER PLANTS **9 Hours**

Types, open and closed cycle gas turbine; Work output and thermal efficiency; Inter cooling; Regeneration- Advantages and disadvantages; Diesel engine power plant; Component and layout.

MODULE IV NUCLEAR POWER PLANTS **9 Hours**

Basics of nuclear energy; Layout and subsystems of nuclear power plants; Nuclear fission and fusion; Types of reactor, working of nuclear reactors, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canada Deuterium- Uranium Reactor (CANDU), breeder, gas cooled reactors; Safety measures for nuclear power plants.

MODULE V RENEWABLE ENERGY BASED POWER PLANTS **9 Hours**

Typical layout, construction and working of wind, tidal, solar photo voltaic, solar thermal, geo thermal and biogas power plants.

TOTAL: 45 HOURS

REFERENCES:

1. P.K. Nag, "Power Plant Engineering", 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., 2014.
2. M.M. El-Wakil, "Power Plant Technology", Tata McGraw-Hill Publishing Company Ltd., 2010.
3. Black &Veatch, "Power Plant Engineering",Springer,1996.
4. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Standard Handbook of Power Plant Engineering", 3rd Edition, McGraw-Hill, 2004.
5. Godfrey Boyle, "Renewable energy" Oxford University Press in association with the Open University, 2004.
6. http://nptel.ac.in/courses/108108077/

1903EE014	ELECTRICAL ENERGY GENERATION UTILIZATION AND CONSERVATION	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Power Plant Engineering
2. Electrical Drives and Control

COURSE OBJECTIVES:

1. To impart knowledge on Generation of electrical power by conventional andNon–conventional methods.
2. To introduce the energy saving concept by different ways of illumination and understand the different methods of electric heating and electric welding.
3. To introduce the knowledge in industrial applications of electric drives and traction.
4. To acquire the knowledge of tariff and economic aspects in power generation.

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1 To understand the electric traction systems and their performance and industrial application of electric drives.
CO2 To understand the principles and design of illumination systems.
CO3 To analyze the methods of heating and welding.
CO4 Able to impart knowledge on generation of electrical power by solar and wind energy.
CO5 To obtain the knowledge on tariff and economic aspects of generation.

MODULE I POWER GENERATION **9 Hours**

Conventional Methods: Review of Thermal, Hydro and Nuclear based power generation.
Nonconventional methods: Tidal waves, Wind, Geothermal, Solar, Bio-mass, Municipal waste, Cogeneration, Effect of distributed generation on power system operation.

MODULE II ILLUMINATION **9 Hours**

Introduction - Definition and meaning of terms used in illumination engineering, Classification of light sources - Incandescent lamps, Sodium vapor lamps, Mercury vapor lamps, Fluorescent lamps; Design of illumination systems - Indoor lighting schemes, Factory lighting halls, Outdoor lighting schemes, Flood lighting, Street lighting, Energy saving lamps, LED.

M ODULE IV HEATINGAND WELDING **9 Hours**

Electric heating: Introduction, Advantages of electric heating, Modes of heat transfer, Methods of electric heating, Types - Resistance heating, Arc furnaces, Induction heating, Dielectric heating,
Electric welding: Types - Resistance welding, Arc welding, Power supply for arc welding, Radiation welding.

MODULE IV ELECTRIC DRIVE AND TRACTION **9 Hours**

Fundamentals of electric drive, Types of electric drives, Merits of electric traction, Requirements of electric traction system, Supply systems, Mechanics of train movement, Traction motors and control, Braking, Recent trends in Electric traction.

MODULE V ENERGY AND ECONOMIC ASPECTS OF GENERATION **9 Hours**

Economic aspects of power generation, Various factors affecting cost of generation, Load curves - Load duration curves, Connected load, Maximum load, Peak load, Base load and peak load power plants, Load factor, Plant capacity factor, Plant use factor, Demand factor, Diversity factor, Cost of power plant, Tariffs and types, Comparison of site selection criteria, Introduction to energy auditing.

TOTAL: 45 HOURS

FURTHER READING:

1. Solar rooftop PV system calculation for a home
2. Case study on Energy Auditing and Energy Conservation

REFERENC ES:

1. N.V. Surya Narayana, "Utilization of Electric Power", Wiley Eastern Limited, New Age International Limited, 1993.
2. J.B.Gupta, "Utilization Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. R.K.Rajput, "Utilization of Electric Power", Laxmi publications Private Limited., 2007.
4. C.L.Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New AgeInternational Private Ltd, 2014.
5. H.Partab, "Utilization of Electrical Energy", Dhanpat Rai and Co., New Delhi, 2004.

1903EE026	ELECTRONIC WASTE MANAGEMENT ISSUES AND CHALLENGES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To understand the overview of electronic waste
To understand the impact and management of E waste

COURSE OUTCOME

CO1 Understand the outline of electronic waste
CO2 Discuss the issues in environmental and health issues
CO3 Describe the E waste management in India
CO4 Understand the process of recycling and recovery of materials from e-waste
CO5 Summarize the best practices in efficient management of e-waste

MODULE I OVERVIEW OF ELECTRONIC WASTE **9 Hours**

E-waste growth; Digital dump yard; Minimization of E-waste; Hazardous substances waste- Electrical and electronic equipment, batteries, plastic and flame retardants, circuit boards; Characteristics of pollutants, Pollutants in waste electrical and electronic equipment.

MODULE II ENVIRONMENTAL AND PUBLIC HEALTH ISSUES **9 Hours**

WEEE-flows; Quantity; Characteristics of a WEEE; Socio economic matters; Indian and international perspective; Health and safety implications; Toxicity concerns; Hazardous substances; E-waste health risk assessment; Case study.

MODULE III E-WASTE MANAGEMENT IN INDIA **9 Hours**

Current Indian scenario; Environmental regulations for E-waste in India; Classification of E-waste; Components of E-waste; E-waste recycling and technology currently used in India; Mechanical processing and Biotechnology; Awareness creation; Challenges faced by formal recyclers in Delhi-NCR; Case study.

MODULE IV RECYCLING AND RECOVERY OF MATERIALS FROM E-WASTE **9 Hours**

Recycling process for the recovery of metal and materials; Recovery and recycling technologies; Bioleaching and biotechnological initiatives; Nano particles synthesis; Hydrometallurgical techniques; Pyrometallurgy.

MODULE V BEST PRATICES IN EFFICIENT MANAGEMENT OF E-WASTE **9 Hours**

Current practices of E-waste management in different countries- China, Brazil, Argentina, Nigeria, Pakistan, Srilanka; Policy comparison between developing and developed countries; Sustainable E-waste management.

TOTAL: 45 HOURS

REFERENCES:

1. Rakesh Johri, "E-waste: Implications, Regulations and Management in India and Current Global Best Practices", The Energy and Resources Institute (TERI) press, New Delhi, 2008.
2. M.N.Vara Prasad and Meththika Vithanage, "Electronic Waste Management and Treatment Technology", Butterworth-Heinmann (Elsevier), 2019.
3. R.E.Hester and R.M.Harrison, " Electronic Waste Management", RSC publishing, 2009
4. MeththikaVithanage and Anwesha Borthakur, "Handbook of Electronic Waste Management", Elsevier Science, 2019.
5. Inamuddin and Abdullah M. Asiri, "E-waste Recycling and Management", Springer International Publishing, 2019.
6. https://nptel.ac.in/courses/105/105/105105169/

1903EE028	ENERGY CONSERVATION AND ENERGY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVE

To understand about energy auditing
To understand about electrical and thermal system auditing

COURSE OUTCOME

After completion of the course, Student will be able to

- **CO1** Explain about energy auditing
- **CO2** Describe the electrical system auditing
- **CO3** Discuss the mechanical system auditing
- **CO4** Understand the energy conservation in major utilities
- **CO5** Summarize the role of energy economics in auditing

MODULE I INTRODUCTION TO ENERGY AUDITING **9 Hours**

Energy, Power, Past and present scenario of World- National energy consumption data; Environmental aspects associated with energy utilization; Energy Auditing- Need, Types, Methodology and Barriers; Role of energy managers; Instruments for energy auditing.

MODULE II ELECTRICAL SYSTEMS **9 Hours**

Components of EB billing; HT and LT supply; Transformers; Cable sizing; Concept of capacitors; Power factor improvement; Harmonics; Electric motors- Motor efficiency computation, Energy efficient motors.

MODULE III THERMAL SYSTEMS **9 Hours**

Stoichiometry; Boilers; Furnaces and Thermic fluid heaters; Efficiency computation and Encon measures; Steam- Distribution and usage, Steam traps, Condensate recovery, Flash steam utilization, Insulators and Refractories

MODULE IV ENERGY CONSERVATION IN MAJOR UTILITIES **9 Hours**

Energy conservation in pumps, fans, blowers, compressed air systems, refrigeration and air conditioning Systems, cooling towers, DG sets.

MODULE V ENERGY ECONOMICS **9 Hours**

Energy economics- Discount rate, Payback period, Internal rate of return, Net recent value, Life cycle costing, ESCO concept.

TOTAL: 45 HOURS

REFERENCES:

1. Witte. L.C., P.S. Schmidt and D.R. Brown, "Industrial Energy Management and Utilization", Hemisphere Publishing Corporation, Washington, 1988.
2. Callaghn, P.W., "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use of Energy", Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.
6. https://beeindia.gov.in/content/energy-auditors

1703EE009 **POWER SYSTEM TRANSIENTS** **L T P C**
3 0 0 3

PREREQUISITE :

1. Transmission and Distribution.
2. Power Electronics.

COURSE OBJECTIVES:

1. To study the generation of switching transients and their control.
2. To study the mechanism of lighting strokes and travelling waves.
3. To compute the transients in travelling waves &integrated power system.

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1 Understand about the causes, types and effects of transients
CO2 Investigate the phenomenon of switching transients and its effect
CO3 Investigate the phenomenon of lightning transients and its effect
CO4 Compute the transient response of travelling waves on transmission line
CO5 Discuss the transients in integrated power system

UNIT I INTRODUCTION AND SURVEY OF TRANSIENTS **9 Hours**

Review and importance of the study of transients , causes for transients; RL circuit transient with sine wave excitation ; double frequency transients ; different types of power system transients - effect of transients on power systems ,role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS **9 Hours**

Over voltages due to switching transients - resistance switching, load switching, normal and abnormal switching transients; current suppression, current chopping; capacitance switching-capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients; ferro resonance.

UNIT III LIGHTNING TRANSIENTS **9 Hours**

Review of the theories in the formation of clouds and charge formation; rate of charging of thunder clouds; mechanism of lightning discharges and characteristics of lightning strokes; model for lightning stroke; factors contributing to good line design - protection from lightning.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE **9 Hours**

Computation of transients; transient response of systems with series and shunt lumped parameters and distributed lines ;traveling wave concept -step response, Bewely's lattice diagram; standing waves and natural frequencies; reflection and refraction of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM **9 Hours**

The short line and kilometric fault ;distribution of voltages in a power system; line dropping and load rejection ; voltage transients on closing and reclosing lines ; over voltage induced by faults ;switching surges on integrated system; qualitative application of EMTP for transient computation.

Total: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Analysis Power System Transient Using Wavelet Transform.
2. Case Study about the Effect of transients developed in Home appliances.

REFERENCES:

1. Allan Greenwood, "Electrical Transients in Power Systems", Wiley Inter Science, New York, 2nd Edition, 2010.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., 2nd Edition, 2009.
3. Indulkar.C.S, Kothari.D.P, Ramalingam.K, 'Power System Transients – A statistical approach', PHI Learning Private Limited, 2nd Edition, 2010.
4. Ramanujam.R, "Computational Electromagnetic Transients: Modeling, Solution Methods and Simulation" I K International Publishing House Pvt. Ltd, 2014.
5. Sakis Meliopoulis.A.P, "Power System Grounding and Transients: An Introduction" CRC Press; 1st Edition 2015

1703EE010 **ELECTRIC AND HYBRID VEHICLES** **L T P C**
3 0 0 3

PREREQUISITE :

1. Applied Chemistry
2. Electrical Machinery-I

COURSE OBJECTIVES:

1. To realize the importance of electric transportation systems
2. To understand the basics of electric vehicle components and configuration
3. To understand the various charging types, comfort and safety methods and application of electric vehicle in Smart grid

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1 Describe the importance and challenges of electric vehicles
CO2 Discuss the energy storage system and battery technology in electric vehicles
CO3 Infer about various charging system and starting system
CO4 Explain the role of hybrid electric vehicle with its safety
CO5 Discuss the emerging technologies and its benefits

UNIT I ELECTRIC VEHICLES **9 Hours**

History of modern transportation; importance of different transportation development strategies to future oil supply; introduction to electric vehicles; history of hybrid and electric vehicles, social, environmental importance and key challenges of hybrid and electric vehicles; specifications of PHEVS, BEVS, EVS; plug-in hybrid vehicle characteristics; the future of electric vehicles.

UNIT II ENERGY STORAGE AND BATTERY TECHNOLOGY **9 Hours**

Introduction to Energy Storage system; Battery Requirements for HEVs, PHEVs, and EVs; Types of batteries; Properties of batteries; Working principle and construction of lead-acid, nickel cadmium, nickel metal hydride, lithium ion Batteries; Maintenance and charging of batteries; Diagnosing lead-acid battery faults; Advanced battery technology; Developments in electrical storage; Case studies.

UNIT III CHARGING AND STARTING SYSTEMS **9 Hours**

Requirements of the charging system; Charging system principles; Alternators and charging circuits; Diagnosing charging system faults; Advanced charging system technology; New developments in charging systems; Requirements of the starting system; Starter motors and circuits; Types of starter motor; Diagnosing starting system faults; Advanced starting system technology; New developments in starting systems; Case studies.

UNIT IV HYBRID ELECTRIC VEHICLE DRIVE TRAIN AND SAFETY **9 Hours**

Requirement of drive train; Architecture of hybrid drive train; Sizing of components- Series configuration, Parallel configuration, parallel and series configuration; Security-Airbags and belt tensioners, Diagnosing comfort and safety system faults, Advanced comfort and safety systems technology; New developments in comfort and safety systems

UNIT V EMERGING TECHNOLOGIES **9 Hours**

Introduction-Electric Vehicle Supply Equipment, Smart vehicles in smart grid; Vehicle-to-grid technologies-Unidirectional and Bidirectional; Need of Charging Station Selection (CSS) server, Smart grid technologies-Applications / Benefits, Smart meter, Smart charger; Purpose and benefits; Ethics in road safety.

Total: 45 Hours

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. Wireless charging of electric vehicles.
2. Monitoring and control of driverless electric vehicle.

REFERENCES:

1. M. Ehsani, Y. Gao, and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, Second Edition, 2009.
2. Tom Denton, "Automobile Electrical and Electronic Systems", Elsevier Butterworth-Heinemann, Fourth Edition, 2011.
3. Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, First Edition, 2014.
4. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition, CRC Press, 2011.
5. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, Second Edition, 2015.
6. NPTEL Course, "Historical Journey of Hybrids and Electric Vehicle", by Dr. Praveen Kumar and Prof. S. Majhi, IIT-Guwahati.

1703EE024	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Physics

COURSE OBJECTIVES:

1. To understand the classification and availability of energy resources.
2. To analyze the issues related with harnessing of energy generation from renewable energy sources.
3. To design an energy generation system with locally available renewable energy resources.

COURSE OUTCOMES:

After completion of the course, Student will be able to

CO1 Acquire the knowledge about various renewable energy sources.
CO2 Explain the technological basis for harnessing renewable energy sources.
CO3 Gain knowledge of low electrical energy generation.
CO4 Identify various available renewable energy sources and techniques to utilize them effectively.
CO5 Acquire the knowledge of modern energy conversion technologies.

UNIT I INTRODUCTION TO ENERGY SOURCES **9 Hours**

Energy consumption as a measure of prosperity; world energy scenario – distributed generation – deregulation and restructured electricity market.

UNIT II SOLAR ENERGY **9 Hours**

Solar radiation and its measurements – solar constant-solar radiation at the earth's surface- solar radiation geometry-solar radiation measurements- solar energy collectors - flat plate collectors - concentrating collectors - solar electric power generation: solar photovoltaic – principle of photovoltaic conversion of solar energy – types of PV cells and fabrication.

UNIT III WIND ENERGY **9 Hours**

Introduction – power in the wind - forces on blades and thrust on turbines – wind energy conversion – site selection considerations - basic components of WECS – classification- advantages and disadvantages.

UNIT IV BIOENERGY **9 Hours**

Introduction – biomass conversion technologies – bio gas generation – factors affecting bio digestion or generation of gas – classification of bio gas plants – advantages and disadvantages –materials used for biogas plant – selection of site for biogas plant.

UNIT V INTRODUCTION TO ALTERNATE SOURCES **9 Hours**

Mini & micro hydel plant – magneto hydro dynamic power (MHD) – introduction – MHD systems – thermo electric power – basic principles – thermionic generation – thermo nuclear energy – the basic: nuclear fusion reactor, ocean, tidal, fuel cells.

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR : **45 HOURS**

1. Energy Storage Systems
2. Power Converters for Stand Alone and Grid Connected Renewable Energy Systems

REFERENCES:

1. G. D. Rai, "Non-Conventional Energy Sources", 5th Edition, Eleventh Reprint, Khanna Publishers, 2014.
2. B. H. Khan, "Non-conventional Energy Resources", 2nd Edition, Tata McGraw Hill, 2009, New Delhi.
3. S. P. Sukhatme, "Solar Energy; Principles of Thermal Collection and Storage", 3rd Edition, Tata McGraw Hill, 2008, New Delhi.
4. Bent Sorensen, "Renewable Energy – Conversion, Transmission and Storage", 2nd Edition, Academic Press, 2000, New York.
5. Godfrey Boyle, "Renewable Energy; Power for a sustainable future", 3rd Edition, Oxford University Press, 2012.
6. Khandelwal KC, Mahdi SS, "Biogas Technology – A Practical Handbook", Tata McGraw Hill, 1998.

guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

TOTAL : 30 PERIODS

OUTCOMES:

- Ability to review, prepare and present technological developments
- Ability to face the placement interviews

EE6701 **HIGH VOLTAGE ENGINEERING** **LT P C 3 0 0 3**

OBJECTIVES:

- To understand the various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS **9**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary overvoltages, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against overvoltages.

UNIT II DIELECTRIC BREAKDOWN **9**

Gaseous breakdown in uniform and non-uniform fields – Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics.

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS **9**

Generation of High DC, AC, impulse voltages and currents - Triggering and control of impulse generators.

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS **9**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION **9**

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second

EE6801 ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION

LT P C
3 0 0 3

OBJECTIVES:

- To analyze the various concepts behind renewable energy resources.
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To introduce knowledge on Solar Radiation and Solar Energy Collectors
- To introduce concepts of Wind Energy and its utilization

UNIT I ELECTRIC DRIVES AND TRACTION 9

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION 9

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.

UNIT III HEATING AND WELDING 9

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV SOLAR RADIATION AND SOLAR ENERGY COLLECTORS 9

Introduction - solar constant - solar radiation at the Earth's surface - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency - concentrating collector - advantages and disadvantages of concentrating collectors - performance analysis of a cylindrical - parabolic concentrating collector – Feedin Invertors.

UNIT V WIND ENERGY 9

Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind Turbines - analysis of aerodynamic forces acting on the blade - performances of wind.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.

TEXT BOOKS:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age International Limited,1993.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. G.D.Rai, "Non-Conventional Energy Sources", Khanna Publications Ltd., New Delhi, 1997.

REFERENCES:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited.,2007.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc, 2002.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006, 2011.
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008.

REFERENCES:

1. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers, 2004.
3. Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control" Springer, 2012.

EE6005 **POWER QUALITY** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the power quality problem
- To educate on production of voltages sags, over voltages and harmonics and methods of control.
- To study overvoltage problems
- To study the sources and effect of harmonics in power system
- To impart knowledge on various methods of power quality monitoring.

UNIT I INTRODUCTION TO POWER QUALITY **9**

Terms and definitions: Overloading - under voltage - over voltage. Concepts of transients - short duration variations such as interruption - long duration variation such as sustained interruption. Sags and swells - voltage sag - voltage swell - voltage imbalance - voltage fluctuation - power frequency variations. International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II VOLTAGE SAGS AND INTERRUPTIONS **9**

Sources of sags and interruptions - estimating voltage sag performance. Thevenin's equivalent source - analysis and calculation of various faulted condition. Voltage sag due to induction motor starting. Estimation of the sag severity - mitigation of voltage sags, active series compensators. Static transfer switches and fast transfer switches.

UNIT III OVERVOLTAGES **9**

Sources of over voltages - Capacitor switching - lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding - line

arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT IV HARMONICS **9**

Harmonic sources from commercial and industrial loads, locating harmonic sources.Power system response characteristics - Harmonics Vs transients. Effect of harmonics - harmonic distortion - voltage and current distortion - harmonic indices - inter harmonics – resonance. Harmonic distortion evaluation - devices for controlling harmonic distortion - passive and active filters. IEEE and IEC standards.

UNIT V POWER QUALITY MONITORING **9**

Monitoring considerations - monitoring and diagnostic techniques for various power quality problems - modeling of power quality (harmonics and voltage sag) problems by mathematical simulation tools - power line disturbance analyzer – quality measurement equipment - harmonic / spectrum analyzer - flicker meters - disturbance analyzer. Applications of expert systems for power quality monitoring.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill,2003.(For Chapters1,2,3, 4 and 5).
2. **Eswald.F.Fudis and M.A.S.Masoum, "Power Q**uality in Power System and Electrical Machines," Elseviar Academic Press, 2013.
3. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', Wiley, 2011.

REFERENCES:

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)
2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5)
3. G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2007.
4. E.Aeha and M.Madrigal, "Power System Harmonics, Computer Modelling and Analysis, " Wiley India, 2012.
5. R.S.Vedam, M.S.Sarma, "Power Quality – VAR Compensation in Power Systems," CRC Press 2013.
6. C. Sankaran, 'Power Quality', CRC press, Taylor & Francis group, 2002.

Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

UNIT IV INTRODUCTION TO ARM PROCESSOR **9**

ARM Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy –ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems.

UNIT V ARM ORGANIZATION **9**

3-Stage Pipeline ARM Organization– 5-Stage Pipeline ARM Organization–ARM Instruction Execution- ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.

TOTAL: 45 PERIODS

OUTCOMES:

- To understand and apply computing platform and software for engineering problems.
- To understand ethical issues, environmental impact and acquire management skills.

TEXT BOOKS:

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.

REFERENCE:

1. Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey Printice Hall of India, 2007.

EE6009 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS **L T P C 3 0 0 3**

OBJECTIVES:

- To Provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

UNIT I INTRODUCTION **9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION **9**

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS 9

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS 9

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.

TEXT BOOK:

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi,2009.

REFERENCES:

1. Rashid .M. H "power electronics Hand book", Academic press, 2001.
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.
5. Andrzej M. Trzynnadlowski, 'Introduction to Modern Power Electronics', Second edition, wiley India Pvt. Ltd, 2012.

EE6010 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
- To analyze HVDC converters.
- To study about the HVDC system control.
- To analyze harmonics and design of filters.
- To model and analysis the DC system under study state.

UNIT I INTRODUCTION 9

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

1701CH201	ENVIRONMENTAL STUDIES (Common to all B.E. / B. Tech Degree Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. Realize the interdisciplinary and holistic nature of the environment.
2. Understand how natural resources and environment affect the quality of life and stimulate the quest for sustainable development.
3. Recognize the socio-economic, political and ethical issues in environmental science.

COURSE OUTCOMES:

On the Successful completion of the course, Students will be able to

CO1: Describe the importance of ecosystem and its conservation.
CO2: Differentiate various natural resources and the urgent need to conserve the natural resources.
CO3: Explain the different types of pollution and its effects.
CO4: Describe the various environmental protection acts.
CO5: Explain the major diseases, women, child development and the impacts of population explosion.

UNIT I ECOSYSTEMS AND BIODIVERSITY **10 Hours**

Concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – hot – spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man – wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Documentation of the medicinal plants in your native place.

UNIT II NATURAL RESOURCES **10 Hours**

Forest resources: Use and over – exploitation, deforestation, case studies – timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer – pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and nonrenewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosionanddesertification–roleofanindividualinconservationofnaturalresources–Equitableuseof
Resources for sustainable lifestyles. Documentation of the effect of modern Agriculture in your nearby Village.

UNIT III ENVIRONMENTAL POLLUTION **9 Hours**

Definition – Source, causes, effects and control measures of: (a) Air pollution – Mitigation procedures – Control of particulate and gaseous emission, Control of SO_X, NO_x, CO and HC) – Technology for capturing CO_2(metallo-organicframeworks)(b)Waterpollution–Wastewatertreatmentprocesses.(c)Soilpollution – soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution(e)Noisepollution(f)Thermalpollution(g)Nuclearhazards–roleofanindividualinpreventionof pollution – pollution case studies. Documentation study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **8 Hours**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – environmental ethics: Issues and possible solutions – 12 Principles of green chemistry – consumerism and waste products – environment protection act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments – scheme of labeling of environmentally friendly products (Ecomark) central and state pollution control boards – disaster management: floods, earthquake – Public awareness. Analyze the recent steps taken by government of India to prevent pollution (Green India and Clean India).

UNIT V HUMAN POPULATION AND THE ENVIRONMENT **8 Hours**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – Environmental impact analysis (EIA) – GIS – remote sensing – role of information technology in environment and human health – Case studies. Documentation study of the Human health and the environment in nearby Hospital (Statistical report).

1702EE304	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

PREREQUISITE :

1. Basic Mechanical Engineering
2. Applied Chemistry

COURSE OBJECTIVES:

1. To have a detailed knowledge about energy sources available and their management.
2. To understand layout of various power plants and the function of various components of the Power plant.
3. To become familiar with operation of various power plants.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1 Understand the construction and operation of Thermal power plants.(K2)
CO2 Select the suitable turbine for hydro power plants. (K2)
CO3 Identify the required turbine, site for diesel and gas power plant. (K2)
CO4 Explain the reactor operation and selection of site in Nuclear power plant. (K2)
CO5 Describe the power generation from various renewable resources. (K2)

UNIT I COAL BASED THERMAL POWER PLANTS **9 Hours**

Layout of modern coal power plant; types of boiler; super critical boilers, FBC boilers; Turbines; condensers; steam and heat rate; subsystems of thermal power plants – fuel and ash handling, draught system, feed water Treatment; Energy Scenario – National, international context.

UNIT II HYDRO POWER PLANTS **9 Hours**

Introduction to hydro power plant – layout of dams; types, selection of water turbine, advantages and Disadvantages; selection of site for hydro power plant; pumped storage hydro power plant.

UNIT III DIESEL AND GAS POWER PLANTS **9 Hours**

Types, open and closed cycle gas turbine, work output & thermal efficiency; inter cooling – regeneration - Advantages and disadvantages; Diesel engine power plant - component and layout.

UNIT IV NUCLEAR POWER PLANTS **9 Hours**

Basics of nuclear energy - layout and subsystems of nuclear power plants, nuclear fission and fusion; types of reactor, working of nuclear reactors, boiling water reactor (BWR), pressurized water reactor(PWR), Canada deuterium- uranium reactor (CANDU), breeder, gas cooled reactors; safety measures for nuclear power plants.

UNIT V POWER FROM RENEWABLE ENERGY **9 Hours**

Typical layout and associated components including turbines; Principle; Construction and working of wind, tidal, solar photo voltaic, solar thermal, geo thermal, biogas.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR :

1. MHD/OTEC power plants
2. New and alternate energy sources

REFERENCES:

1. P.K. Nag, -PowerPlantEngineering,Tata McGraw-HillPublishing CompanyLtd., Third Edition, 2014.
2. M.M. El-Wakil, -PowerPlantTechnologyl, Tata McGraw-HillPublishing CompanyLtd., 2010.
3. Black &Veatch,-PowerPlantEngineeringlSpringer, 1996.
4. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, —Standard Handbook of Power Plant Engineering| Third Edition, McGraw-Hill, 2004.
5. Godfrey Boyle, —Renewable energy| Oxford University Press in association with the Open University, 2004.

GE6351 **ENVIRONMENTAL SCIENCE AND ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY **12**

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION **10**

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies –
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES **10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical

degradation of pollutants, Bioconversion of pollutants.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT **7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act – The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides.
Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT **6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS :

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.

REFERENCES :

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press 2005.

TEXT BOOKS:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi , 2007.
2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.

REFERENCES:

1. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
2. N.Senthil Kumar, M.Saravanan, S.Jeevananthan, 'Microprocessors and Microcontrollers', Oxford,2013.
3. Valder – Perez, "Microcontroller – Fundamentals and Applications with Pic," Yeesdee Publishers, Tayler & Francis, 2013.

ME6701 **POWER PLANT ENGINEERING** **L T P C 3 0 0 3**

OBJECTIVES:

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

UNIT I COAL BASED THERMAL POWER PLANTS **10**

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS **10**

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS **7**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling *Water Reactor* (BWR), Pressurized *Water Reactor* (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY **10**

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar* Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS **8**

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Students can able to understand different types of power plant, and its functions and their flow lines and issues related to them.
- Analyse and solve energy and economic related issues in power sectors.

TEXT BOOK:

1. P.K. Nag, Power Plant Engineering, Tata McGraw – Hill Publishing Company Ltd., Third Edition, 2008.

REFERENCES:

1. M.M. El-Wakil, Power Plant Technology, Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Black & Veatch, Springer, Power Plant Engineering, 1996.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, Standard Handbook of Power Plant Engineering, Second Edition, McGraw – Hill, 1998.
4. Godfrey Boyle, Renewable energy, Open University, Oxford University Press in association with the Open University, 2004.

EE6503 **POWER ELECTRONICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To get an overview of different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of controlled rectifiers
- To study the operation, switching techniques and basics topologies of DC-DC switching regulators.
- To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To study the operation of AC voltage controller and various configurations.

UNIT I POWERSEMI-CONDUCTOR DEVICES **9**

Study of switching devices, Diode, SCR,TRIAC, GTO, BJT, MOSFET, IGBT-Static and Dynamic characteristics - Triggering and commutation circuit for SCR- Design of Driver and snubber circuit.

UNIT II PHASE-CONTROLLED CONVERTERS **9**

2-pulse,3-pulse and 6-pulseconverters– performance parameters –Effect of source inductance— Gate Circuit Schemes for Phase Control–Dual converters.

UNIT III DC TO DC CONVERTER **9**

Step-down and step-up chopper-control strategy–Forced commutated chopper–Voltage commutated, Current commutated, Load commutated, Switched mode regulators- Buck, boost, buck- boost converter, Introduction to Resonant Converters.

UNIT IV OPTIMAL CONTROL 9

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.

UNIT V OPTIMAL ESTIMATION 9

Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems- Kalman Filter- Application examples..

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to apply advanced control theory to practical engineering problems.

TEXT BOOKS :

1. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.
2. G. J. Thaler, " Automatic Control Systems", Jaico Publishing House, 1993.
3. M.Gopal, Modern Control System Theory, New Age International Publishers, 2002.

REFERENCES:

1. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
2. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
3. K. Ogata, 'Modern Control Engineering', 4th edition, PHI, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
5. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

EE6002 POWER SYSTEM TRANSIENTS **L T P C 3 0 0 3**

OBJECTIVES:

- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lighting strokes and the production of lighting surges.
- To study the propagation, reflection and refraction of travelling waves.
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I INTRODUCTION AND SURVEY 9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS 9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient

voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT III LIGHTNING TRANSIENTS **9**

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS **9**

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM **9**

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCES:

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.

1701MGX01	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

PREREQUISITE:

1. Basic understanding of business management
2. Basic understanding of human values

COURSE OBJECTIVES:

1. To provide basic knowledge about engineering Ethics, Variety of moral issues and Moral dilemmas, Professional Ideals and Virtues
2. To provide basic familiarity about Engineers as responsible Experimenters, Research Ethics, Codes of Ethics, Industrial Standards, Exposure to Safety and Risk, Risk Benefit Analysis
3. To have an idea about the Collegiality and Loyalty, Collective Bargaining, Confidentiality, Occupational Crime, Professional, Employee, Intellectual Property Rights
4. To have an adequate knowledge about MNC"s, Business, Environmental, Computer Ethics, Honesty, Moral Leadership, sample Code of Conduct.
5. To use the engineering principles to update and maintain the technical skills.

UNIT I ENGINEERING ETHICS **9 Hours**

Senses of „Engineering Ethics" – Variety of moral issues – Types of inquiry – Moral dilemmas – Morai Autonomy – Kohlberg"s theory – Gilligan"s theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION **9 Hours**

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY **9 Hours**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator"s Approach to Risk - Case Studies on Chernobyl, Bhopal MIC and Sterlite copper.

UNIT IV RESPONSIBILITIES AND RIGHTS **9 Hours**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES **9 Hours**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TOTAL: 45 HOURS

FURTHER READING / CONTENT BEYOND SYLLABUS / SEMINAR:

1. Case study on Hiroshima and Nagasaki

COURSE OUTCOMES:

At the end of this course, Students will be able to,

CO1: Articulate engineering ethics theory with sustained lifelong learning to strengthen autonomous engineering decisions.

CO2: Fortify the competency with facts and evidences to responsibly confront moral issues raised by technological activities, and serve in responsible positions of leadership.

CO3: Contribute to shape a better world by taking responsible and ethical actions to improve the environment and the lives of world community.

CO4: Be an example of faith, character and high professional ethics, and cherish the workplace responsibilities, rights of others, public's welfare, health and safety.

CO5: Be Proficient in analytical abilities for moral problem solving in engineering situations through exploration and assessment of ethical problems supported by established experiments.

REFERENCES:

1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999.
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi 2004

	CYBER FORENSICS	L	T	P	C
		3	0	0	3

AIM: This course will understand and learn various cyber forensics and security techniques in real time environment

COURSE OBJECTIVES:

1. Learn the security issues network layer and transport layer
2. Be exposed to security issues of the application layer
3. Learn computer forensics
4. Be familiar with forensics tools
5. Learn to analyze and validate forensics data

UNIT I NETWORK LAYER AND TRANSPORT LAYER SECURITY — **9 Hours**

Network layer security: IPSec Protocol – IP Authentication Header – IP ESP –Key Management Protocol for IPSec– Transport layer Security: SSL protocol–Cryptographic Computations – TLS Protocol.

UNIT II E-MAIL SECURITY & FIREWALLS — **9 Hours**

PGP– S/MIME– Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology–Types of Firewalls –Firewall designs – SET for E-Commerce Transactions

UNIT III COMPUTER FORENSICS — **9 Hours**

Traditional Computer Crimes–Problems associated with Computer Crime–Identity Theft & Identity Fraud– Types of CF techniques –Incident and incident response methodology – Forensic duplication and investigation– Preparation for IR: Creating response tool kit and IR team. – Forensics Technology and Systems – Understanding Computer Investigation – Data Acquisition.

UNIT IV EVIDENCE COLLECTION AND FORENSICS TOOLS — **9 Hours**

Processing Crime and Incident Scenes – Working with Windows and DOS Systems– Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT V ANALYSIS AND VALIDATION — **9 Hours**

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

TOTAL: 45 Hours

COURSE OUTCOMES:

At the end of this course, students will be able to,

CO1: Discuss the security issues network layer and transport layer
CO2: Apply security principles in the application layer
CO3: Explain computer forensics tools
CO4: Understand the evidence collection and use forensic tools
CO5: Analysis and Validate various forensics data

REFERENCES:

1. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", Wiley Publications, 2014.
2. Nelson, Phillips, Enfinger, Steuart, "Computer Forensics and Investigations", Cengage Learning, India Edition, 2012
3. John R.Vacca, "Computer Forensics", Cengage Learning, 2013
4. Richard E.Smith, "Internet Cryptography", 3rd Edition Pearson Education, 2012.
5. MarjieT.Britz, "Computer Forensics and Cyber Crime": An Introduction", 3 rd Edition, Prentice Hall, 2013.
6. http://nptel.ac.in/

1703MG002	PRINCIPLES OF MANAGEMENT (New)	L	T	P	C
		3	0	0	3

AIM: The aim of this course is to address broad and general guideline that regulates decision making and behavior within a group or organization

COURSE OBJECTIVES:

1. To enable the students to study the evolution of Management
2. To relate, discuss, understand and present management principles, process and procedures.
3. To knowledge and understanding of the principles of management will enable the student manager or employee

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9 Hours

Definition of Management – Science or Art – Manager Vs Entrepreneur - Types of managers - managerial roles and skills – Evolution of Management – Scientific, Human relations , System and contingency approaches.

UNIT II	PLANNING	9 Hours

Nature and purpose of planning – Planning Process – Types of planning – Objectives – Setting objectives – policies – Planning premises – Planning Tools and Techniques – Decision making steps and process.

UNIT III	ORGANISING	9 Hours

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – Delegation of authority – Centralization and Decentralization – Job Design.

UNIT IV	DIRECTING	9 Hours

Foundations of Individual and Group behaviour – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication –Communication and IT

UNIT V	CONTROLLING	9 Hours

System and process of controlling – Budgetary and non-budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting

	TOTAL:	45 Hours

FURTHER READING: Decision roles of manager, Motivational thoughts.

COURSE OUTCOMES

At the end of this course, students will be able to,

CO1: Explain the elements of Management and Organization.
CO2: Summarize the types, policies, tools and techniques in Planning in Management
CO3: Relate the job design and human resource management in Organizing
CO4: Illustrate the skills of leadership and communication
CO5: Interpret the controlling techniques in Management

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" 7 th Edition, Pearson Education, 2011.
2. Harold Koontz & Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.
3. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.
4. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6 th Edition,Pearson Education, 2004.
5. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999

4. http://nptel.ac.in

17O3MG003	HUMAN RIGHTS New	L	T	P	C
		3	0	0	3

AIM: To sensitize the Engineering students to various aspects of Human Rights.

COURSE OBJECTIVES:

1. To define the term human rights and understand why it is important.
2. To sensitize the Engineering students to various aspects of Human Rights
3. To know the historical foundations and current practice of protecting human rights

UNIT I	FOUNDATION OF HUMAN RIGHTS	9 Hours

Meaning and concepts of human rights- Notion and classification of Rights –three generations of human rights- Basis and sources of human rights – Theories of human rights

UNIT II	SOCIAL AND ECONOMICAL IMPACT OF HUMAN RIGHTS	9 Hours

Social Hierarchy, prejudices and exploitation- Economic problems: poverty, illiteracy, food security and habitation – Rural to urban migration: domestic displace to persons- Human rights of SC, ST, OBC and Minorities. Mechanisms for the protection of the rights of disadvantaged groups.

UNIT III	HUMAN RIGHTS OF THE WOMEN, CHILDREN AND WORKERS	9 Hours

Gender Bias, Harassment and offenses against women – Special laws and institutional mechanism for the protection of women's rights- Nature and Issues in child rights in India and mechanism for the protection of the child rights. (UN Convention, UNESCO Convention, and ILO Conventions) – Occupational health hazards: Bonded and un organized workers: Protection mechanisms.

UNIT IV	ENVIRONMENTAL IMPACT OF HUMAN RIGHTS	9 Hours

Forest depletion and pollution of reverse system (culprits and victims)- hazards waste and discarded technological instruments-National and international obligation and Laws: RIO and KYOTO Declarations- Pollution control Mechanisms- Measures taken in India

UNIT V	HUMAN RIGHTS AND DUTIES IN INTERNATIONAL PERSPECTIVE	9 Hours

Emergence of international humanitarian law- UN charter provisions of human rights- the role of the UN security council and other international organization- Amnesty and red cross- International convention on elimination of all forms of racial discrimination

	TOTAL:	45 Hours

FURTHER READING: Role of NGO, Human Rights Education: Problems and Prospects

COURSE OUTCOMES:

At the end of this course, students will be able to,

CO1: Understand the principles and institutions of international human rights law, including their origins, assumptions, contents, limits and potential

CO2: Promote human rights through legal as well as non-legal means

CO3: Understand different forms of promoting and implementing human rights, domestically as well as on the international level

CO4: Identify, contextualize and use information about the human rights

CO5: Participate in legal, political and other debates involving human rights in a knowledgeable and constructive way

17CSIT023	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. Learn the foundations of Human Computer Interaction.
2. Be familiar with the design technologies for individuals and persons with disabilities.
3. Be aware of mobile HCI.
4. Learn the guidelines for user interface.

UNIT I	PRINCIPLES OF HCI	9 Hours

History and Foundations of HCI – Human: Human Capabilities –I/O channels – Memory – Reasoning and problem solving: The computer: Devices –Memory – processing and networks; The Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms

UNIT II	THE DESIGN PROCESS	9 Hours

Interactive Design fundamentals – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in the software process: software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules –Implementation Tools – Evaluation and User Support.

UNIT III	MODELS AND THEORIES	9 Hours

User models: Cognitive models –Socio-organizational issues and stake holder requirements –Task Models and Dialogs: analysing tasks – dialog notations and design – Communication and collaboration models: Groupware and Computer-supported Collaborative Work Ubiquitous Computing – Virtual Reality and Augmented Reality – Hypertext, Multimedia and the World Wide Web

UNIT IV	MOBILE HCI	9 Hours

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

UNIT V	WEB INTERFACE DESIGN	9 Hours

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Future of HCI – Case Studies

COURSE OUTCOMES:	TOTAL:	45 Hours

At the end of this course, students will be able to,

CO1: Design effective dialog for HCI.
CO2: Design effective HCI for individuals and persons with disabilities.
CO3: Assess the importance of user feedback.
CO4: Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.
CO5: Develop meaningful user interface.

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition,Pearson Education, 2014.
2. Brian Fling, "Mobile Design and Development", First Edition, O"Reilly Media Inc., 2012.
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O"Reilly, 2009

Learning in Feed forward Artificial Neural Networks, MIT Press A Bradford Book, 2012

www.nptel.ac.in

ITT028	BUSINESS INTELLIGENCE	L	T	P	C
		3	0	0	3

AIM: To learn the concepts on business intelligence and strategic plans

PREREQUISITE: Software Engineering and Project Management

COURSE OBJECTIVES:

1. Be exposed with the basic rudiments of business intelligence system
2. Understand the modeling aspects behind Business Intelligence
3. Understand of the business intelligence life cycle and the techniques used in it
4. Be exposed with different data analysis tools and techniques

UNIT I BUSINESS INTELLIGENCE — **9 Hours**

Effective and timely decisions – Data, information and knowledge – Role of mathematical models – Business intelligence architectures: Cycle of a business intelligence analysis – Enabling factors in business intelligence projects – Development of a business intelligence system – Ethics and business intelligence.

UNIT II KNOWLEDGE DELIVERY — **9 Hours**

The business intelligence user types, Standard reports, Interactive Analysis and Ad Hoc Querying, Parameterized Reports and Self-Service Reporting, dimensional analysis, Alerts/Notifications, Visualization: Charts, Graphs, Widgets, Scorecards and Dashboards, Geographic Visualization, Integrated Analytics, Considerations: Optimizing the Presentation for the Right Message.

UNIT III BUSINESS INTELLIGENCE MODELS — **9 Hours**

Efficiency measures – The CCR model: Definition of target objectives- Peer groups – Identification of good operating practices: cross efficiency analysis – Virtual inputs and outputs

UNIT IV BUSINESS INTELLIGENCE APPLICATIONS — **9 Hours**

Pattern matching – cluster analysis, outlier analysis - Emerging Technologies - Machine Learning – BI Search & Text Analytics - Advanced Visualization – Rich Report

UNIT V CASE STUDY — **9 Hours**

Google Analytics Instant Activation - IBM Watson Cognitive Computing - IoT and Azure Stream Analytics - Coca-Cola Amatil: Trax Retail Execution - AgilOne Advanced Analytics

TOTAL: 45 Hours

COURSE OUTCOMES:

At the end of this course, students will be able to,

- CO1: Explain the fundamentals of business intelligence.
- CO2: Link data mining with business intelligence.
- CO3: Apply various modeling techniques.
- CO4: Explain the data analysis and knowledge delivery stages.
- CO5: Apply business intelligence methods to various situations and decide on appropriate technique.

REFERENCES:

1. Efraim Turban, Ramesh Sharda, Dursun Delen, "Decision Support and Business Intelligence Systems", 9th Edition, Pearson 2015.
2. Larissa T. Moss, S. Atre, "Business Intelligence Roadmap: The Complete Project Lifecycle of Decision Making", Addison Wesley, 2013.
3. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications, 2011.
4. [illegible] "Business Intelligence: The Savvy Manager's Guide", Second Edition, 2012.
5. [illegible] Thornthwaite, Joy Mundy, Bob Becker, "The Data Warehouse Lifecycle [illegible]

HUMANITIES AND SCIENCES ELECTIVE I

1901MGX04	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

AIM: The aim of this course is to address broad and general guideline that regulates decision making and behavior within a group or organization

COURSE OBJECTIVES:

1. To enable the students to study the evolution of Management
2. To relate, discuss, understand and present management principles, process and procedures.
3. To knowledge and understanding of the principles of management will enable the student manager or employee

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9 Hours

Definition of Management – Science or Art – Manager Vs Entrepreneur - Types of managers - managerial roles and skills – Evolution of Management – Scientific, Human relations , System and contingency approaches.

UNIT II	PLANNING	9 Hours

Nature and purpose of planning – Planning Process – Types of planning – Objectives – Setting objectives – policies – Planning premises – Planning Tools and Techniques – Decision making steps and process.

UNIT III	ORGANISING	9 Hours

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – Delegation of authority – Centralization and Decentralization – Job Design.

UNIT IV	DIRECTING	9 Hours

Foundations of Individual and Group behaviour – Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – Types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication –Communication and IT

UNIT V	CONTROLLING	9 Hours

System and process of controlling – Budgetary and non-budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting

	TOTAL:	45 Hours

1901MGX05	ENGINEERING ECONOMICS AND FINANCE	L	T	P	C
		3	0	0	3

AIM: The aim of this course is to study engineering economics and finance accounting in demand supply, cost estimation and pricing

COURSE OBJECTIVES:

1. To enable the students to study the engineering economics and finance
2. To relate, discuss, understand and present economics and finance accounting in demand supply, cost estimation and pricing methods

UNIT I	INTRODUCTION	9 Hours

Managerial Economics-Relationship with other disciplines-Firms: Types, objectives and goals-Managerial decisions-Decision analysis.

UNIT II	DEMAND & SUPPLY ANALYSIS	9 Hours

Demand-Types of demand-Determinants of demand-Demand function-Demand elasticity-Demand forecasting-Supply-Determinants of supply-Supply function-Supply elasticity

UNIT III	PRODUCTION AND COST ANALYSIS	9 Hours

Production function-Returns to scale-Production optimization-Least cost input-Isoquants-Managerial uses of production function.Cost Concepts-Cost function-Determinants of cost-Short run and Long run cost curves-Cost Output Decision-Estimation of Cost

UNIT IV	PRICING	9 Hours

Determinants of Price-Pricing under different objectives and different market structures-Price discrimination-Pricing methods in practice

UNIT V	ELEMENTARY TREATMENT	9 Hours

FINANCIAL ACCOUNTING: Balance sheet and related concepts-Profit & Loss Statement and related concepts-Financial Ratio Analysis-Cash flow analysis-Funds flow analysis-Comparative financial statements-Analysis & Interpretation of financial statements.

CAPITAL BUDGETING: Investments-Risks and return evaluation of investment decision-Average rate of return-Payback Period-Net Present Value-Internal rate of return.

	TOTAL:	45 Hours

COURSE OUTCOMES

At the end of this course, students will able to,

CO1: Explain the elements of Engineering Economics and Financial accounting methods
CO2: Summarize the types, policies, tools and techniques in demand and supply
CO3: Relate the production and cost analysis of management
CO4: Illustrate the pricing methods in Economics and Financial accounting
CO5: Interpret the Elementary treatment techniques in Economics and Financial accounting

REFERENCES:

1. R. Kesavan, C.Elanchezhian and T.Sundar Selwyn, "Engineering Economics and Financial Accounting", Laxmi Publications 2011
2. Maheswaran. S.N., "Management Accounting and Financial Control", Sultan Chand, 2011
3. James. C., Vanhorn, "Fundamentals of Financial Management" PHI, 2012
4. Charles T.Homgren, "Cost Accounting", PHI, 2012

19O1MGX06	HUMAN RESOURCE DEVELOPMENT IN IT	L	T	P	C
		3	0	0	3

AIM: The aim of this course is to address the need for skilled professionals who can contribute effectively towards Human resource development and to engage the participants on contemporary issues pertaining to the management of quality in IT Industries

COURSE OBJECTIVES:

1. To learn concepts, human resource development
2. To study the Macro and Micro perspective methods
3. To impart knowledge on Human resource skills and development

UNIT I	**MACRO PERSPECTIVE**	**9 Hours**

HRD Concept, Origin and Need, HRD as a Total System; Approaches to HRD; Human Development and HRD; HRD at Macro and Micro Climate.

UNIT II	**MICRO PERSPECTIVE**	**9 Hours**

Areas of HRD: HRD Interventions Performance Appraisal, Potential Appraisal, Feedback and Performance Coaching, Training, Career Planning, OD or Systems Development, Rewards, Employee Welfare and Quality of Work Life and Human Resource Information; Staffing for HRD: Roles of HR Developer; Physical and Financial Resources for HRD; HR Accounting; HRD Audit, Strategic HRD

UNIT III	**INSTRUCTIONAL TECHNOLOGY**	**9 Hours**

Learning and HRD; Models and Curriculum; Principles of Learning; Group and Individual Learning; Transactional Analysis; Assessment Centre; Behaviour Modeling and Self Directed Learning; Evaluating the HRD

UNIT IV	**HUMAN RESOURCE TRAINING AND DEVELOPMENT**	**9 Hours**

Concept and Importance; Assessing Training Needs; Designing and Evaluating T&D Programmes; Role, Responsibilities and challenges to Training Managers

UNIT V	**TRAINING METHODS**	**9 Hours**

Training with in Industry (TWI): On the Job & Off the Job Training; Management Development: Lecture Method; Role Play; In-basket Exercise; Simulation; Vestibule Training; Management Games; Case Study; Programmed Instruction; Team Development; Sensitivity Training; Globalization challenges and Strategies of Training Program, Review on T&D Programmes in India.

TOTAL:	**45 Hours**

COURSE OUTCOMES

At the end of this course, students will able to,

CO1: Understand the concepts, Human resource development
CO2: Compare and Contrast the principles of Micro and Marco development process
CO3: Use various instructional technology and learning methods in Human resource development
CO4: Understand Human resource development concepts and challenges
CO5: Compare and Correlate various training methods in HRD

REFERENCES:

1. Nadler, Leonard : Corporat Human Resource Development, Van Nostrand Reinhold, ASTD, New York .
2. Rao, T.V and Pareek, Udai: Designing and Managing Human Resource Systems, Oxford IBH Pub. Pvt.Ltd., New Delhi . 2015.
3. Rao, T.V: Readings in HRD, Oxford IBH Pub. Pvt. Ltd., New Delhi , 2014.
4. Viramani, B.R and Seth, Parmila: Evaluating Management Development, Vision Books, New Delhi .
5. Rao, T.V.(et.al): HRD in the New Economic Environment, Tata McGraw-Hill Pub.Pvt, Ltd., New Delhi , 2013.
6. Rao, T.V: HRD Audit, Sage Publications, New Delhi . 2016
7. ILO, Teaching and Training Methods for Management Development Hand Book, McGraw-Hill , New York .
8. Rao, T.V: Human Resource Development, Sage Publications, New Delhi .

19011HS001	Innovation & Entrepreneurship Fundamentals	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art or engineering. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions

COURSE OBJECTIVES:

1. Cultivate the mindset and skills of successful entrepreneurs
2. Lead innovative teams
3. Develop and refine your strategy in today's fast-changing, dynamic markets
4. Grow your customer base through inbound and outbound marketing

Module I	Entrepreneurship Basics	9 Hours

Entrepreneurship Basics – Skills, Mindset, Myth vs Fact, Entrepreneurial Leadership: Navigating Uncertainty, Critical lessons in entrepreneurial leadership, innovation, teamwork, communications, and problem-solving & Risk management. Business Opportunity Identification, Idea Validation, Case Study : Entrepreneurs Story

Module II	Innovation & Creativity	9 Hours

Analyzing the Current Business Scenario, Innovation and Creativity- An Introduction, Innovation in Current Environment, Types of Innovation, School of Innovation. Challenges of Innovation, Steps of Innovation Management, Idea Management System, Divergent V/s Convergent Thinking, Design Thinking and Entrepreneurship

Module III	Business Models & Strategies for Innovation	9 Hours

Experimentation in Innovation Management, Idea Championship, Participation for Innovation, Co-creation for Innovation, Proto typing to Incubation. What is a Business Model, Who is an Entrepreneur, Social

Entrepreneurship, Blue Ocean Strategy-I, Blue Ocean Strategy-II

Module IV	Marketing & Sustainability of Innovation	9 Hours

Marketing of Innovation, Technology Innovation Process, Technological Innovation Management Planning, Technological Innovation Management Strategies, Technology Forecasting. Sustainability Innovation and Entrepreneurship, Innovation Sustainable Conditions, Innovation: Context and Pattern, SME'S strategic involvement in sustainable development, Exploration of business models for material efficiency services

Module V	Managing Innovation : IPR	9 Hours

Management of Innovation, creation of IPR ,Management of Innovation, creation of IPR, Types of IPR, Patents and Copyrights, Patents in India, Business Models and value proposition, Business Model Failure: Reasons and Remedies, Incubators : Business Vs Technology, Managing Investor for Innovation , Future markets and Innovation needs for India.

TOTAL: 45 HOURS

Course Outcomes:

1. Explain the basics of Entrepreneurship & Innovation
2. Analyze Leadership Styles and compare them
3. Choose business models based on the requirement and justify with cases
4. Develop a method or mechanism for Innovation marketing and sustainability
5. Develop a Business Model and Strategy framework and demonstrate through presentation

FURTHER READING:

1. 8 Steps To Innovation : Going From Jugaad To Excellence- Book by Rishikesha T. Krishnan and Vinay Dabholkar
2. Innovation and Entrepreneurship Book by Peter Drucker
3. HBS series on Innovation and Entrepreneurship

REFERENCES:

1. The Lean Startup Book by Eric Ries, 2013
2. Zero to One Book by Blake Masters and Peter Thiel, 2014
3. Founders at Work: Stories of Startups' Early Days Book by Jessica Livingston, 2001
4. Crossing the Chasm Book by Geoffrey Moore, 1991
5. Hooked: How to Build Habit-Forming Products Book by Nir Eyal, 2013
6. Rework Book by David Heinemeier Hansson and Jason Fried, 2010
7. https://nptel.ac.in/courses/127/105/127105007/

1901HS002	Intellectual Property Rights for Engineers	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art or engineering.

This course covers the fundamental aspects of intellectual property (IP): copyright and related rights, trademarks, patents, geographical indications, and industrial designs. It also covers contemporary issues impacting the IP field such as: new plant varieties, unfair competition, enforcement of IP rights and emerging issues in IP.

COURSE OBJECTIVES:

1. A foundation in the basic concepts of IP
2. Better understanding of the relationship between IP and other policy areas such as health, climate change, traditional knowledge and emerging technologies
3. Practical learning experience in technology transfer and IP license negotiations
4. Experience of learning from renowned experts in a multicultural environment and

	joining an alumni of students sharing a similar interest in IP	
	5. The chance to identify areas for further IP study	
Module I	**Introduction**	**9 Hours**
Overview of IP, Copyright, Trademarks, Geographical Indicators, Industrial Designs, Patents, Unfair competition, Enforcement of IP Rights, Emerging Issues in IP & IP Management		
Module II	**Copyrights & Trademarks**	**6 Hours**
The concept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, Formats & Filing Procedures		
Module III	**Geographical Indicators & Industrial Designs**	**6 Hours**
ncept, Case Study, Historical background, Principles, Notion of Work, Rights and Limitations, & Filing Procedures		
Module IV	**Patents**	**15 Hours**
The Macro-Economic Impact of the Patent System, The Patent Application Process, The Different Layers of the International Patent System and Regional Patent Protection Mechanisms, Kinds of Intellectual Property Protection Based on Types of Inventions, Legal Issues of the Patenting Process, Enforcement, New Issues, Important Cases and Discussions, IP and Development - Flexibilities and Public Domain under Patents, Patent Search		
Module V	**Patent Cooperation Treaty**	**9 Hours**
What is PCT? Use of PCT, Preparing a PCT Application, PCT Services, Patent Agent and Common Representatives, International Search, International Examination		
		TOTAL: 45 HOURS

Course Outcomes:

1. Explain various types of IPRs specific to Engineering
2. Explain concepts such as Copyrights, Trademarks, GIs and Industrial designs
3. Explain basic concepts of Engineering Patents
4. Explain concept of Patent Search and various methods to do it
5. Develop a sample PCT Application and explain examination procedures

FURTHER READING:

1. Intellectual Property Rights by Pandey Neeraj & Dharni Khushdeep, 2014
2. Fundamentals of IPR: for students, Industrialist and patent lawyers, Ramakrishna B & Anil Kumar HS, 2017 Drucker

REFERENCES:

1. Law relating to IPR by Dr MK Bandarai, Central Law Publication, 2014
2. Introduction to Intellectual Property Rights, H.S. Chawla, Oxfors & IBH Publishing, 2020
3. Introduction to IPR by JP Mishra, Central Law Publications
4. https://patents.google.comIntroduction to IPR books

HS003	STARTUP ENTREPRENEURSHIP	L	T	P	E
		3	0	0	3

PREREQUISITE :

The course assumes no prior skill or background in design, art, engineering, or science It is open to all undergraduates and graduate students with an interest in learning Entrepreneurship, and is especially recommended for those students planning venture creation and other kinds of entrepreneurial interventions

COURSE OBJECTIVES:

1. Understand the terminology and conceptual of Entrepreneurship & Startups
2. Understand real time problem solving methodologies with tools

	3. Recognize the ethical and social dilemmas and obligations of the practice of design of solutions
	4. Diagnose common adoption barriers in individuals, groups and organizations.
	5. Develop a design theory from independent and qualitative research and observations
	6. Participate in and lead innovation in creative and collaborative settings
	7. Undertake complex and unstructured problem-solving challenges in unfamiliar domains

Module I	**Entrepreneurship & Startup Basics**	**5 Hours**
Entrepreneurship basics – Skill Set, Mindset, Examples, Startup basics overview, Indian Startup ecosystem, Problems – Identification, Selection, Evaluation, Validation, Teaming		
Module II	**Customer Discovery Process**	**7 Hours**
Customer Discovery Process, Opportunity Identification, Evaluating Opportunities, Customer discovery – at least 15 interviews. Results presentation and hypothesis refinement. Focus on customer segments of the business model canvas.		
Module III	**Ideation**	**5 Hours**
Ideation – Brainstorming, Technology driven Ideation, Continued customer discovery and updates to hypothesis. Focus on value proposition of business model canvas.		
Module IV	**Market Analysis**	**6 Hours**
Market Analysis – Perform market research, Competitive advantage landscape, Market Size, Go-To Market Strategies, Continued customer discovery and updates to hypothesis. Focus on channels of business model canvas.		
Mid-term presentation on startup idea, refined hypothesis through customer discovery		
Module V	**Minimum Viable Product**	**5 Hours**
Minimum Viable Product Validation: Product market fit, use customer discovery in defining the MVP, Build Proof Of Concepts for specific customer use-cases. Focus on metrics of business model canvas.		
Module VI	**Business Models**	**7 Hours**
Business Models/Metrics – Chosen business model for the venture, Focus on key resources/activities of business model canvas. Start customer validation phase.		
Module VII	**Pivoting**	**3 Hours**
Pivoting - Pivot product and business models based on customer discovery and validation, Choose pivot option. Focus on cost structures and partners of business model canvas. Continued customer validation.		
Mid-term presentation on startup prototype, preliminary results from customer validation, prototype refinements and plan.		
Module VIII	**IP/Legal**	**4 Hours**
IP/Legal: Importance of IP, Protect IP, Licensing IP, IP based Entrepreneurship; Examples, Continued customer validation.		
Module IX	**Capital**	**3 Hours**
Capital: Capital requirement for the venture, Raising capital & increments, Continued customer validation. Liquidity/Exit: Liquidity events, Trade-offs		
Final presentations of startup idea, refined prototype, customer validation, and future plans		
TOTAL: 45 HOURS		

Course Outcomes:

1. Detail Entrepreneurship and Startup Basics
2. Employ the methods and tools of Problem Solving in business context
3. Project Startup Idea Development Process and Methodologies through Real Problem Solving
4. Develop Startup Prototype through Customer Validation and Business Models
5. Explain Intellectual Property Rights and its importance in business context

OTHER READING:

1. The Startup Owner's Manual: The Step-By-Step Guide for Building a Great Company by Steve Blank
2. Value Proposition Design: How to Create Products and Services Customers Want (Strategyzer) by Alexander Osterwalder
3. Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers by Alexander Osterwalder
4. The Four Steps to the Epiphany, Steven Blank

REFERENCES:

1. Creative Confidence: Unleashing the Creative Potential Within Us All Book by David M. Kelley and

19011HS004	Business Model Innovation	L	T	P	C
		3	0	0	3

PREREQUISITE:	
	The course assumes no prior skill or background in design, art, engineering, or prototyping. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions

COURSE OBJECTIVES:	
	1. Understand the Business Model Canvas
	2. Master the different types of Innovation
	3. Design Innovative Business Models
	4. Differentiate from Competition
	5. Understand purchasing psychology
	6. Define innovative revenue models

Module I	**Introduction to Business Models**	**9 Hours**
Introduction to Business Model Generation, Business Model Canvas, Examples: Uber Innovation Model, Facebook. Customers, Value Proposition, Sales & Delivery Channels, Customer Relationships, Revenue Streams. Resources, Activities, Partners		
Module II	**Introduction to Designing Innovative Business Models, Product and Design Innovation**	**9 Hours**
Disrupting Markets, Examples; AirBnb model, Better Product, Success stories of Tinder and Uber – Case [illegible], Visual Design, Tesla Innovation Model		
Module III	**Customer Innovation: Customer niches, Sales & Delivery Channels, Marketing**	**9 Hours**
Disrupting Customer Relationships, Acquire first time customer, Disrupting Customer segments, Focus on underserved market niche, Disrupt delivery Channels, Digital Sales channel		
Module IV	**Resource Driven Innovation**	**6 Hours**
New product development strategies, Innovative production techniques, Automation of small and medium companies		
Module V	**Revenue Model Innovation & Purchasing Psychology**	**12 Hours**

1901MGX07	UNIVERSAL HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	3

AIM: The aim of this course is to give advanced understanding of the essential elements of the ethical and professional practice of psychology, dedicated to improving standards of behavior expected by professional

COURSE OBJECTIVES:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

MODULE I	COURSE INTRODUCTION - NEED, BASIC GUIDELINES, CONTENT AND PROCESS FOR VALUE EDUCATION	9 Hours

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

MODULE II	UNDERSTANDING HARMONY IN THE HUMAN BEING - HARMONY IN MYSELF	9 Hours

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Swasthya

MODULE III	UNDERSTANDING HARMONY IN THE FAMILY AND SOCIETY- HARMONY IN HUMAN-HUMAN RELATIONSHIP	9 Hours

13. Understanding harmony in the Family- the basic unit of human interaction
14. Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti;
Trust (Vishwas) and Respect (Samman) as the foundational values of relationship
15. Understanding the meaning of Vishwas; Difference between intention and competence
16. Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship
17. Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals
18. Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family!

MODULE IV	UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE	9 Hours

19. Understanding the harmony in the Nature
20. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
21. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space
22. Holistic perception of harmony at all levels of existence

MODULE V	IMPLICATIONS OF THE ABOVE HOLISTIC UNDERSTANDING OF HARMONY ON PROFESSIONAL ETHICS	9 Hours

23. Natural acceptance of human values
24. Definitiveness of Ethical Human Conduct
25. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
26. Competence in Professional Ethics:

a) Ability to utilize the professional competence for augmenting universal human order,

2. Written Test [50 marks]

19011IS006	DESIGN THINKING FOR INNOVATION	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art, engineering, or prototyping. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions

COURSE OBJECTIVES:

1. Understand the terminology and conceptual models used in design disciplines
2. Understand how teaching and learning occurs in the design process
3. Recognize the ethical and social dilemmas and obligations of the practice of design
4. Diagnose common adoption barriers in individuals, groups and organizations.
5. Develop a design theory from independent and qualitative research and observations
6. Participate in and lead innovation in creative and collaborative settings
7. Undertake complex and unstructured problem-solving challenges in unfamiliar domains

Module I	**Introduction to Design Thinking**	**8 Hours**

Human Centered Design, Why Design Thinking, 5-Step Design Thinking Process, Applications, Creative Confidence, The culture of Innovation

Module II	**Design Thinking Approach**	**12 Hours**

IDEO's method of Design Thinking, Divergent Thinking & Innovation Funnel, Customer Journey Maps to uncover Innovation Opportunities, Case Study : Turing Creative Ideas into Viable Companies

Module III	**Exploring Design Thinking ToolKit**	**5 Hours**

Discovery, Interpretation, Ideation, Experimentation, Evolution

Module IV	**Design Challenge Project : Phase-1**	**5 Hours**

Define a Challenge, Project Plan, How Might We statements, Project Timeline, Project Checklist

Module V	**Design Challenge Project : Phase-2**	**15 Hours**

Discovery – Understand the Challenge, Prepare Research, Gather Inspiration, Interpretation – Tell Stories, Search for meaning, Frame Opportunities, Ideation – Generate Ideas, Refine Ideas, Experimentation – Make Prototypes, Get Feedback, Evolution – Track Learnings, Engage Others

TOTAL: 45 HOURS

Course Outcomes:	
1. Describe Key Concepts and basics of Design Thinking Principles 2. Elaborate the Design Thinking Approach through IDEO's method & Customer Journey Maps 3. Conduct user interviews and synthesize learnings to uncover insights and identify opportunities for innovation 4. Develop Design Driven Innovative Solutions to RealWorld Problems	
FURTHER READING:	
	1. Design for Social Impact : How to by IDEO.org 2. Design Thinking ToolKit by IDEO.org 3. The Field guide to Human Centered Design by IDEO.org
REFERENCES:	
1. Creative Confidence: Unleashing the Creative Potential Within Us All Book by David M. Kelley and Tom Kelley, 2013	
2. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation Book by Tim Brown, 2009	
3. The art of Innovation by Tom Kelly, 2011	
4. Design Thinking for Strategic Innovation: What They Can't Teach You at Business Or Design School Book by Idris Mootee, 2013	
5. The Design of Everyday Things Book by Don Norman, 1988	
6. The Design Thinking Playbook: Mindful Digital Transformation of Teams, Products, Services, Businesses and Ecosystems Book by Michael Lewrick, 2017	
7. https://nptel.ac.in/courses/109104109/	

Assessment Procedure:-

3. Quiz [3] 10 Marks Each – 5%
4. Class Participation – 5%
5. Assignment [Case Study based]– 10%
6. Poster Presentation – My Game Changer – 5%
7. Written Test [50 marks] – 20%
8. Design Project
    1. Mid Term Presentation1 – 15%
    2. Mid Term Presentation2 – 15%
    3. Final Presentation – 25%

1901HS007	INDIAN PATENT LAW & PATENT DRAFTING	L	T	P	C
		3	0	0	3
PREREQUISITE:					
	The course assumes no prior skill or background in design, art or engineering. The course shall give an in-depth understanding of patent law to engineers and scientists. This course will help person with a science background to understand the fundamentals of patent law, know the requirements of patentability, learn how to read and interpret patent specifications, analyze patent office procedures and court cases and develop the basic understanding for drafting a patent specification, how to draft a patent application and patent searching.				
COURSE OBJECTIVES:					
	1. Understand Indian Patent Laws				
	2. Apply the knowledge of drafting patents to draft own patent				
	3. Understand Patent searching concepts				
	4. Understand patent specifications and structure				
	5. The chance to identify areas for further IP study				
Module I	**Indian Patent Law**				**9 Hours**
Introduction to the Indian Patent System Patent Laws as Concepts; Understanding the Patents Act, 1970; Understanding the Patents Rules, 2003;Preliminary Sections; Preliminary Rules; What's New in the Patents (Amendment) Rules, 2016; Easy way to read the Patents Act and Rules, Patentability of Inventions Statutory Exceptions to Patentability; Novelty and Anticipation; Inventive Step; Capable of Industrial Application; Person Skilled in the Art					

Module II	**Patent Specification**	**9 Hours**
Patent Specification Provisional and Complete Specifications; Structure of a Patent Specification—Title, Abstract, Description, Claims, etc.; Reading a Patent Specification—Fair basis, Enabling Disclosure, Definiteness, Priority; Introduction to Patent Drafting, Patent Application—Who Can Apply, True and First Inventor, How to Make a Patent Application, What to include in a Patent Application, Types of Patent Applications, Patents of Addition, Dating of Application;		
Module III	**Prior Art Search & Preparing Patent Application**	**6 Hours**
Prior Art, Significance, Search Prior art, Obtaining Disclosures, Identify patentable inventions, understanding invention		
Module IV	**Patent Drafting**	**12 Hours**
Drafting Claims – Parts of claim, Types of claim, Examples – Apparatus or Device Claims, Product by Process Claim, Design Claim, Plant Claim, Software Claim. Drafting - Detailed description or specification. Drawings, Background, Abstract, Summary		
Module V	**Patent Search**	**9 Hours**
Public search databases IPO EPO USPTO Patent Scope, Subscribed databases search, Differences between public search and subscribed database search, Types of Patent search, Patentability Search, Validity Search, Analysis of Patent Search with illustration (examples from different technology areas)		
Course Outcomes:		**TOTAL: 45 HOURS**
1. Explain Indian Patent Law according to the requirement 2. Interpret Patent Application based on parts of patent specification 3. Apply Prior Art search to identify patentability of invention 4. Develop/Draft a Patent Document including key aspects of a patent application 5. Use different Patent search mechanism to understand patentability		
FURTHER READING:		
1. Feroz Ali, The Law of Patents, LexisNexis 2. Ronald D. Slusky, Invention Analysis and Claiming – A Patent Lawyer's Guide, Second Edition, American Bar Association, 2012. 3. Patent Search: Tools and Techniques- David Hunt 4. Unfolding IPRs; Rajesh Singh, Sanjeev Kumar, Paritek Innovations, 2019		
REFERENCES:		
1. Feroz Ali, The Touchstone Effect – The Impact of Pre-grant Opposition on Patents, LexisNexis, 2009.		
2. Patent Search Work Book – Created by the course proposer		
3. Introduction to IPR by JP Mishra, Central Law Publications		
4. https://patents.google.com		

Assessment Procedure:-

- ✓ Test-1 – 40%
- ✓ Test-2 – 40%
- ✓ Assignment – 20%

		L	T	P	C
19OIHS008	**IP MANAGEMENT & COMMERCIALIZATION**	3	0	0	3
PREREQUISITE:					
The course assumes no prior skill or background in design, art or engineering. The course, Intellectual Property Management, focuses on intellectual property from the perspective of 'why' and 'how' for participants who have already covered the basics of 'what' Intellectual Property is. In the first three modules, it teaches about the economic significance of IP. Using management examples and established industry methodologies, it elaborates on IP asset					

	identification, IP incubation, IP commercialization, IP valuation, and IP taxation. In the last three modules it offers an in-depth look at commercial activities in the digital area by looking at e-commerce and IP, digital management of creative works, and the strategic management of IP.
COURSE OBJECTIVES:	
	1. Understand IP Management Concepts
	2. Use the knowledge for IP Valuation
	3. Understand IP Management strategies
	4. Understand Concepts on Innovation Protection
	5. The chance to identify areas for further IP study

Module I	**Intellectual Property Management**	**9 Hours**
Intellectual Property Management: Introduction and an Overview, Economic Perspectives on Intellectual Property Management, Innovation and Intellectual Property Protection		
Module II	**Innovation Management Strategies**	**9 Hours**
Innovation Strategy, Open Innovation, Crowd Sourcing, Managing Change in Innovation, Types of Innovation, Building blocks of effective Innovation Management system		
Module III	**IP Management strategies**	**9 Hours**
Intellectual Property Value and Finance, Intellectual Property and Commercialization, On line Intellectual Property Management, Strategy for Intellectual Property Management, Open Source and Development - Managing IP Flexibilities and Public Domain, Case studies on Intellectual Property Management		
Module IV	**IP Commercialization**	**12 Hours**
Market analysis, IP Audit, IP Valuation, Financing and Raising capitals using IPRs, Protecting IPRs, IP Management for strengthening Business, Technology Commercialization through Licensing		
Module V	**IPR in E-Commerce & Promoting IPRs**	**6 Hours**
Domain Names, Websites, Revealing Products on Internet, Using Trademarks. Promoting – Branding, Marketing, Advertising, Packaging		**TOTAL: 45 HOURS**

Course Outcomes:

1. Explain IP Management & Innovation Management Concepts
2. Apply IP Commercialization Strategies for business improvement and SME development
3. Explain how to promote IPRs in Business Context

FURTHER READING:

1. Patent IPR Licensing- Technology Commercialization – Innovation Marketing: Guide Book for Researchers, Innovators, 2017, Association of Indian Innovators

REFERENCES:

1. Feroz Ali, The Touchstone Effect – The Impact of Pre-grant Opposition on Patents, LexisNexis, 2009.
2. Patent Search Work Book – Created by the course proposer
3. Introduction to IPR by JP Mishra, Central Law Publications
4. https://innolytics-innovation.com/innovation-management/

Assessment Procedure:-

- ✓ Test-1 – 40%
- ✓ Test-2 – 40%
- ✓ Assignment – 20%

HSS Elective – III

1901HS005	SOCIAL ENTREPRENEURSHIP	L	T	P	C
		3	0	0	3

PREREQUISITE:

The course assumes no prior skill or background in design, art or engineering. It is open to all undergraduates and graduate students with an interest in learning design thinking, and is especially recommended for those students planning social-venture and other kinds of design interventions

COURSE OBJECTIVES:

1. Shift the status quo of the world's greatest challenges, fueled by inspiring examples of social entrepreneurship in action
2. Think like a social entrepreneur to tackle problems across public, private, and nonprofit sectors
3. Carve your own path for making change, whether that be founding an enterprise, serving on a board, or supporting social entrepreneurs in other creative ways

Module I	Introduction to Social Entrepreneurship	12 Hours

Social Entrepreneurship – Introduction to Donors Choose, Samasource, Aravind Eyecare, Transformative change, Starting with a Crazy Idea, Activity : Life Map, Identify Mission – Identify a social problem, Understand problem, Understand Customer, Activity : Passion Skill Problem

Module II	Change & Sustainability	12 Hours

Understand a theory of change, Framework for measuring impact, Measurement approach, Impact approach for your own enterprise, Activity : Develop a theory of change; Sustainability – Planning for impact, Achieving financial sustainability, Building financial sustainability, Social Enterprises Revenue Engine, Activity : Solutions Map

Module III	Bring an Idea to Scale	5 Hours

Think about Scale, Scaling impact, Tips to scale smart, Ways to scale, Activity : Build a launch plan, Reflection

Module IV	Lean Startup Principles for Social Sector	8 Hours

Lean mindset, Lean startup principles, Build-Measure-Learn loop, Doing Lean, Lean Principles for Social Sector, Activity : Develop your value proposition, Hypothesis Generation

Module V	Business Models for Social Enterprise	8 Hours

Introduction to Business model canvas, Integrating Impact model and business model, Types of business models, Innovations in social entrepreneurship model, Activity : Business model canvas sprints

TOTAL: 45 HOURS

Course Outcomes:

1. Explain Social Entrepreneurship Principles and solving biggest problems
2. Demonstrate Solutions for social problems using Change methods & Sustainability Maps
3. Build a Scale model for an Idea to solve a social problem