MRSPTU M.SC (ENVIRONMENTAL SCIENCE & ENGINEERING) 2016 BATCH ONWARDS

M.SC (ENVIRONMENTAL SCIENCE & ENGINEERING) 2016 ONWARDS

(1st Year)

Total Contact Hours = 24 **Total Marks = 600** **Total Credits = 22**

SEMESTER 1st		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MESE2-101	Ecology and Environment	3	1	-	40	60	100	4
MESE2-102	Environmental Chemistry	3	1	-	40	60	100	4
MESE2-103	Physical Environment	3	1	-	40	60	100	4
MESE2-104	Ecology, Environmental Chemistry and Instrumental Analysis Lab	-	--	4	60	40	100	2
Departmental Elective – I (Select any one)		3	1	0	40	60	100	4
MESE2-156	Instrumental techniques for Chemical Analysis							
MESE2-157	Energy and Environment							
Departmental Elective – II (Select any one)		3	1	0	40	60	100	4
MESE2-158	Natural Resource Management							
MESE2-159	Environmental Nano Technology							
Total	**Theory = 5 Lab = 1**	**15**	**5**	**4**	**260**	**340**	**600**	**22**

Total Contact Hours = 24 **Total Marks = 600** **Total Credits = 22**

SEMESTER 2nd		Contact Hrs			Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MESE2-205	Water Pollution & Control Technologies	3	1	-	40	60	100	4
MESE2-206	Air, Noise, Soil: Pollution and Management	3	1	-	40	60	100	4
MESE2-207	Water, Air and Soil Sampling & Analysis Lab	-	-	4	60	40	100	2
Departmental Elective – III (Select any one)		3	1	0	40	60	100	4
MESE2-260	Solid and Hazardous Waste Management							
MESE2-261	Natural Hazards and Disaster Management							
Departmental Elective – IV (Select any one)		3	1	0	40	60	100	4
MESE2-262	Ecotoxicology and occupational safety							
MESE2-263	Environmental Awareness,planning & Laws							
Open Elective – I (Select any one)		3	1	0	40	60	100	4

Total	**Theory = 4 Lab = 1**	**15**	**5**	**4**	**260**	**340**	**600**	**22**

MRSPTU M.SC (ENVIRONMENTAL SCIENCE & ENGINEERING) 2016 BATCH ONWARDS

(2nd Year)

Total Contact Hours = 16 **Total Marks = 600** **Total Credits = 26**

SEMESTER 3rd		**Contact Hrs**			**Marks**			**Credits**
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MESE2-308	Industrial Water and Waste Water Treatment	3	1	-	40	60	100	4
MESE2-309	Research Methodology and Scientific Writing (Professional Skill)	3	1	-	60	40	100	4
MESE2-310	Seminar	-	-	-	60	40	100	3
MESE2-311	Project	-	-	-	60	40	100	7
Departmental Elective – V (Select any one)		3	1	0	40	60	100	4
MESE2-364	Environmental Microbiology							
MESE2-365	Environmental Biotechnology							
Open Elective – II (Select any one)		3	1	0	40	60	100	4
Total	**Theory = 3 Lab = 0**	**9**	**3**	**0**	**300**	**300**	**600**	**26**

Total Contact Hours = 4 **Total Marks = 100** **Total Credits = 20**

SEMESTER 4th		**Contact Hrs**			**Marks**			**Credits**
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MESE2-412	Environmental Impact Assessment and Auditing	3	1	-	40	60	100	4
MESE2-413	Thesis	0	0	0	Satisfactory / Unsatisfactory			16
Total	**Theory=1, Thesis**	**3**	**1**	**0**	**100**			**20**

Overall

Semester	**Marks**	**Credits**
1st	600	22
2nd	600	22
3rd	600	26
4th	100	20
Total	**1900**	**90**

MRSPTU M.SC (ENVIRONMENTAL SCIENCE & ENGINEERING) 2016 BATCH ONWARDS

ECOLOGY AND ENVIRONMENT

Subject Code –MESE2-101 **LTPC 3 1 0 4** **Duration:45 Hrs**

UNIT-I (10 Hrs)

An Introduction to Environmental Sciences

Definition, Principles and scope of Environmental Science; Earth, Man and Environment, Physico- chemical and biological factors in the Environment, Environmental issues: local and global scales; Environmental Education: Introduction, principles and scope; Environmental ethics.

UNIT-II (11 Hrs)

Ecology and Ecosystem Dynamics

Aims and scope of ecology, organizational levels of biosphere.

Concept and components of ecosystem, ecological pyramids, food chain, food web, energy transfers, energy flow models, ecosystem productivity, methods of measuring primary productivity, biogeochemical cycles- cycling of water and nutrients, Ecosystem stability, Cybernetics and ecosystem regulation, Gaia hypothesis. Types and characteristics of ecosystem-terrestrial (forest, desert, grassland) and aquatic (pond, marine), wetlands, estuaries, natural and man-made ecosystems, forest types in India.

UNIT-III (12 Hrs)

Population and Community ecology

Population characteristics, population interaction; prey-predator relationships, competition, exploitation, mutualism, Theories of population growth, population dynamics, regulation. Concept of metapopulation, demes and dispersal, niche- concept and types, keystone species, Flagship species and umbrella species; dominant species, ecotone, edge effect, ecotypes, plant indicators; ecological succession – types and mechanism, Theory of Island Biogeography, abundance and distribution of species; factors leading to commonness, rarity and vulnerability of extinction of species. Green data book

UNIT-IV (12 Hrs)

Biodiversity

Definition, levels of biodiversity, measurements of biodiversity, values of biodiversity. Hot spots of biodiversity, Biodiversity hotspots of India, threats to biodiversity. Biological Invasion: concept; pathways, process, mechanism, impacts, examples of major invasive species in India. Speciation- types and process, Causes of species extinction. Endangered and threatened species, IUCN Categories of threatened species, Red data book, List of threatened flora and fauna in India. Biodiversity conservation; Ecotourism, responsible tourism, role of inter-governmental, government and non-government organizations, legal initiatives for wildlife and forest conservation, wetland conservation, ecosystem management at national and international level; Convention on Biodiversity.

Recommended Books:

1. Agren, Goran I., 'Terrestrial Ecosystem Ecology: Principles and Applications', Swedish University of Agricultural Sciences, **2012.**
2. Day, W. John., W. M. Kemp, Alejandro Yáñez-Arancibia and Byron C. Crump, ' Estuarine Ecology' 2nd Edn., Wiley-Blackwell Publishers, **2012**.
3. Fatik B. Mandal. and Nepal C. Nandi, ' Biodiversity: Concepts, Conservation and Biofuture', Asian Books, **2013**.

4. Jorgensen, Sven Erik, 'Encylopedia of Ecology', Vol 1-5. Elsevier Publishers. Netherlands, **2008.**
5. B.D Joshi, C.P.M Tripathi and P.C Joshi, 'Biodiversity and Environmental Management', APH, New Delhi, **2009.**
6. P.C. Joshi and N. Joshi, ' Biodiversity and conservation', APH Publishing Co-operation, New Delhi, **2009.**
7. R. K Kohli, S. Jose, H. P Singh,and D. R Batish, 'Invasive Plants and Forest Ecosystems', CRC Press / Taylor and Francis**, 2009**.
8. M.V Lomolino, B.R Riddle, R.J.Whittaker and J.H.Brown, 'Biogeography',4th Edn.. Sinauer Associates, **2010.**
9. E.P Odum, M. Barrick, and , G.W Barret, ' Fundamentals of Ecology',5th Edn.,Thomson Brooks/Cole Publisher, California, **2005.**
10. B.N Pandey and M.K Jyoti, ' Ecology and Environment'. APH Publishing Co-operation, New Delhi, **2012.**
11. S.V.S Rana, ' Essentials of Ecology and Environmental science',5th Edn., PHI Learning Pvt. Ltd, **2013.**
12. P.D Sharma, ' Ecology and Environment', Rastogi Publications. New Delhi, **2009.**
13. T.M Smith and R.L. Smith, ' Elements of Ecology' 8th Edn., Benjamin Cummings**, 2012**.
14. John H Vandermeer, B.R. Riddle and J.H Brown, ' Population Ecology : First principle.'2nd Edn., Princeton University Press, **2013.**
15. J. Mitsch William, James G. Gosselink, Li Zhang, Christopher J. Anderson Wetland, 'Ecosystems', Wiley-Interscience, **1989.**

ENVIRONMENTAL CHEMISTRY

Subject Code –MESE2-102 **LTPC 3 1 0 4** **Duration:45 Hrs**

UNIT-1 (11 Hrs)

Chemistry for Environment

Fundamental of environmental chemistry: Mole Concept, Solution chemistry, solubility product, Solubility of gases, Phase change thermodynamics, Electrochemistry and redox reactions, Gibbs' free energy; Chemical potential; Activity and fugacity, Chemical kinetics and chemical equilibrium.Sources of natural and artificial radiations: Dosimetry, types of dosimeters, radioactive substances, applications and handling of isotopes and other radionuclides in environment.

UNIT- II (12Hrs)

Air & Water Chemistry

Atmospheric chemistry: Composition of air, Chemical speciation, particles, ion and radicals, Formation of particulate matter, Photochemical reactions in the atmosphere, Chemistry of air pollutants, Photochemical smog, Acid rain, Chemistry of Ozone layer depletion, Greenhouse gases and Global warming, Thermal Pollution.Aquatic chemistry: Structure and properties of water, Water quality parameters, Physicochemical concepts of color, odour, turbidity, pH, conductivity, DO, COD, BOD, alkalinity, carbonates, redox potential, Pourbiax diagram.

UNIT- III (11 Hrs)

Soil and Geochemistry

Chemistry of Soil: Physio-chemical composition of soil, humus, Inorganic and organic components of soil, nutrients (NPK) in soil, significance of C:N ratio, Cation exchange capacity

(CEC), Reactions in soil solution, Ion exchange (Physiosorption), Ligand exchange (Chemisorption), Complexations, Chelation; Precipitation / dissolution.
Environmental geochemistry: Concept of major, trace and REE. Classification of trace elements, Mobility of trace elements, Geochemical cycles. Biochemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon monoxide, O3, PAN, MIC and other carcinogens.

UNIT- IV (12 Hrs)

Green Chemistry

Green chemistry and green technology: New trends in green chemistry, Basic principles, Atom economy concept and its environmental importance, Green reagents, Green solvents, Green technology: Microwave heating & pollution, Ultrasound technique, Industrial Ecology.

Recommended Books:

1. C Baird. and M.Cann , 'Environmental Chemistry', , W.H. Freeman, USA, **2008**
2. S. E Manahan, ' Fundamentals of Environmental Chemistry,' 3rd Edn., CRC Press, USA.
3. D. W Connell., 'Basic concepts of Environmental Chemistry,'2nd Edn, CRC Press, USA, **2005.**
4. J .Girard., ' Principles of Environmental Chemistry,' 2nd Edn, James & Barlett Publishers, USA, **2010.**
5. R M Harrison, ' Principles of Environmental Chemistry', RSC Publishing, UK, **2007.**
6. D. Hillel, 'Soil in the Environment: Crucible of Terrestrial Life', 1st Edn, Academic Press, USA, **2007.**
7. M .Lancaster, ' Green Chemistry: An Introductory Text', RSC Publishing, UK, **2002.**
8. S. E.Manahan, 'Green Chemistry and The Ten Commandments of Sustainability', 2nd Edn, Chem Char Inc. Publishers, USA, **2006.**
9. S. E. Manahan, 'Water Chemistry: Green Science and Technology of Nature's Most Renewable Resource, CRC Press, USA, **2010.**
10. J. H Clark. and D. J Macquarrie, 'Handbook of Green Chemistry and Technology', Wiley-Blackwell, UK, **2002.**

PHYSICAL ENVIRONMENT

Subject Code –MESE2-103 **LTPC** **Duration:45 Hrs**

3 1 0 4

UNIT-I (11 Hrs)

Earth processes

Structure and Composition of the Earth; Plate tectonics; Formation of oceans and landmasses; Mountain Building; Mass Movements; Volcanicity; Seismicity; Formation of lakes, rivers and streams; Wind; Glacial processes; Weathering and Erosion; Mass movement; Geological Time Scale.

UNIT-II (12Hrs)

Meteorology

Fundamentals of meteorology, Scales of meteorology, Parameters of meteorology- pressure, wind, temperature, humidity, radiation; Radiation Budget of Earth; Application of meteorological principles to transport and diffusion of pollutants, Topographic effects, cloud classification and formation.

UNIT-III (10 Hrs)

Climatology

The boundary layer, Radiations: Radiation laws, short wave and long wave radiations, Albedo, Emissivity, Inversion, Local microclimate, Greenhouse effect, Radiation balance, Precipitation, Atmospheric movements, Distribution of radiation, Rotation of earth- Coriolis acceleration, angular momentum, General meridional circulations, Hadley cells, Middle latitudes, Circulation of water and energy in atmosphere, Weather and Climate in India, El Nino, La Nina, seasons and monsoons, Climatic classification schemes, Biogeographical regions of the world, Climate change - Emissions and Global warming, impact on sea level in South Asian region, Environmental disruptions and their implications .

UNIT-IV (12 Hrs)

Oceanography

Sea water properties, Chemistry of seawater, Wind driven circulations in upper oceans, Waves, Tides and Currents, Upwelling and El Nino, Deep Ocean Circulations, Marine Resources, Marine flora and fauna- Benthic and Pelagic Communities, Marine Pollution, Global Warming and Oceans - Greenhouse effect, Ocean warming, Sea level rise, Acidification, Carbon sequestration.

Recommended Books:

1. F.G.Bell, 'Environmental Geology: Principles and Practicre',Blackwell Science Publisher, USA**, 1998**.
2. H. J. Critchfield , ' General Climatology', PHI Learning, New Delhi **2009.**
3.V.S Kale and A.Gupta, ' Introduction to Geomorphology', Orient Longman, Bangalore. **2001.**
3. S.Singh, 'Physical Geography', Prayag Pustak Bhavan, Allahabad **2011**.
4. A.N Strahler, 'An Introduction to Physical Geography, ' John Wiley & Sons, UK **1996**
5. D.S. Lal , 'Climatology', Sharda Pustak **2011.**

INSTRUMENTAL TECHNIQUES FOR CHEMICAL ANALYSIS

Subject Code –MESE2-156 **LTPC** **Duration: 37Hrs**

3 1 0 4

UNIT-I (6 Hrs)

Quantitative analysis

Acid-base, complexometric, precipitation and redox titrimetry. Gravimetric analysis – total solids, suspended solids and volatile solids.

UNIT-II (11 Hrs)

Spectrometric and Thermogravimetric Methods

Theory of spectrophotometry and colorimetry, calculating absorption maxima, Beer-Lambert's Law, classification of methods of colour measurement, instrumentation single beam and double beam, photometric errors, applications of spectrophotometry to inorganic and organic compounds (quantitative measurements), UV-Visible spectrophotometer, atomic absorption (AAS) and Emission spectroscopy (AES), instrumentation, interferences, applications, various non-flame emission sources, Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES), instrumentation and applications of ICP-AES, Comparison of ICP-AES with AAS. Principle, working and applications of Flame photometer.Thermogravimetric Analysis, Differential Scanning Calorimetry

UNIT-III (10 Hrs)

Instruments

pH meter, Conductivity meter, TDS meter, DO meter, Salinity meter, Ion Selective Coulometry, Anode and cathode stripping voltammetry, dropping mercury electrode (DME), merits and demerits of DME.Theory, Principle and instrumentation and application in environment for the techniques:a) FTIR b) XRD c) TEM d) SEM.

UNIT-IV (10 Hrs)

Separation/ Chromatographic Techniques

Partition coefficient, chromatography, general chromatography, chromatographic methods: Paper, Thin Layer chromatography, Column, High Performance Thin Layer Chromatography (HPTLC), Gas Chromatography (GSC and GLC), GC-MS, High Pressure Liquid Chromatography, Ion Exchange chromatography, Ion/Size Exclusion Chromatography and Electrophoresis.

Recommended Books:

1. D.A.Skoog, F.L Holler. and S.RCrouch, 'Principles of instrumental analysis', Thomson Brooks/Cole Publishers, USA , **2007.**
2. G.Svehla, 'Vogel's qualitative inorganic analysis', 7th Edn., Prentice Hall, USA **1996.**
3. G.Wiersma, ' Environmental monitoring', CRC Press, UK **2004.**
4. A. D Eaton, L.S Clesceri, E.W. Rice and A.E Greenberg, 'Standard methods for examination of water and wastewater ,'21st Edn.. American Public Health Association, American Water Worker Association, Water Environment Federation, USA **2005.**
5. G. W Ewing, ' Instrumental methods of chemical analysis,' 5th Edn., McGraw Hill Publications, USA **1985.**
6. P.Patnaik, 'Handbook of environmental analysis', CRC Press, USA **2010.**
7. S. K. Shukla, and P. R.Srivastava, 'Methodology for environmental monitoring and assessment', Commonwealth Publishers, New Delhi **1992.**

ENERGY AND ENVIRONMENT

Subject Code –MESE2-157 **LTPC 3 1 0 4** **Duration:37 Hrs**

UNIT-1 (7 Hrs)

Introduction

Introduction to energy sources, Energy scenario in world and India, Potential and perspectives of various energy sources in India, classification of energy resources-conventional and non conventional, renewable and non- renewable, environmental implications of energy resources.

UNIT-II (7 Hrs)

Conventional energy

Fossil fuels (Coal, petroleum, LPG and natural gas) – origin, composition and physico chemical characteristics and energy content, sources properties and production process; nuclear energy– fission and fusion, technologies – nuclear enrichment, nuclear reactors, nuclear waste disposal, policies and regulations.

UNIT- III (10 Hrs)

Non Conventional energy

Prospects of renewable non-conventional energy, Types-solar energy, wind energy, hydel, tidal and geothermal energy, OTEC: introduction, principle, generation. Solar collectors, applications of solar energy: Solar water heating, solar heating and cooling of buildings, solar photo-voltaics, solar distillation, solar cooking and solar ponds. Basic components of wind energy conversion system, types and applications of wind energy.

UNIT-IV (13 Hrs)

Waste to Energy and Energy Conservation

Bio energy - Biomass energy as an energy source, characteristics of biomass, Energy plantations, Biomass conversion technologies. Types of bio fuels - Biodiesel, bio ethanol, biogas, bio hydrogen - importance, production, technologies and applications.

Waste to resource recovery and recycling for energy, conversion technologies. Feed stocks, factors affecting biogas generation, Biogas plants: Classification of biogas plants, advantages and disadvantages of biogas plants, community biogas plants. Microbial fuel cell – principle, types and challenges. Environmental impacts of over exploitation of solar, wind and ocean energy. Energy conservation – principles and approach, energy conservation in buildings, green buildings, solar passive architecture, eco-housing, energy audit, national and international norms**.**

Recommended Books:

1. S. Gupta, Harsh and Roy, ‘ Geothermal energy: An alternative resource for the 21st century,’ Elsevier Science Ltd, **2006**.
2. Lal, Banwari and P.M Sarma, ‘ Wealth from waste: Trends and technologies’, TERI**, 2011.**
3. MNRE, Griha manual vol-3 ,Technical manual for trainers on building and system design optimization renewable energy application, Ministry of new and renewable energy,2**011**.

NATURAL RESOURCE MANAGEMENT

Subject Code –MESE2-158 **LTPC** **Duration:45 Hrs**

3 1 0 4

UNIT-I (10 Hrs)

Forest resources

Natural resources: Definition, classification of natural resources, natural resource degradation and conservation, Environmental impacts of resource depletion.

Forest Resources: Forest cover of India and world, forest types, functions of forest – production and protection, Conservation of forests, forestry programmes – social forestry, farm forestry, urban forestry, community forestry, deforestation, Exploitation of forest resources, Afforestation, Desertification, Forest policy.

UNIT-II (13 Hrs)

Water and Marine resources

Water Resources: Surface, ground water, marine and brackish water resources **-** assessment and utilization, Rivers and Lakes in India, hydrological cycle, Ground water depletion, Water logging

and salinity, Water Conservation and management techniques, Rain water harvesting, Watershed management, Eutrophication, Restoration of Lakes, River cleaning, River action plans - Ganga and Yamuna action plan, Interlinking of rivers, conflicts over water.

Marine resources: Introduction to marine resources, Factors controlling abiotic resources and their distribution - polymetallic manganese nodules, phosphorites, hydrocarbons, beach placers evaporates, rare metals, corals, pearls and shells. Prospecting and mining of the ocean floor, Management of marine resources, demand, supply and production of marine resources. Policies and acts related to ocean and land.

UNIT-III (12 Hrs)

Land and mineral resources

Land resources: Land degradation due to mining, exploration, industrialization, irrigation and natural disasters; Soil Erosion, Loss of soil fertility, Restoration of soil Fertility, Soil Conservation Methods, restoration of degraded land, Wasteland reclamation, Organic farming, green manuring, Wetland – definition, classification, functions, ecological importance and conservation.

Mineral resources: Mineral resources of India – Use and exploitation; mineral exploration, extraction; environmental impacts of extraction; Restoration of mining lands.

UNIT-IV (10 Hrs)

Bioresources

Evolution strategies, adaptation, Vegetation, flora and fauna of India; Aquatic bioresource;Definition, Types and significanceof biodiversity, values and threats, biodiversity conservation strategies; Bioprospecting. Biopiracy, REDD+; Conventions and protocols. Wild life resources and conservation measures

Human resources – population explosion, urbanization, industrialization, slums, poverty.

Recommended Books:

1. Anderson, A.David., 'Environmental economics and natural resource management, Taylor and Francis 4th Edn. ,**2013.**
2. Gurdev Singh, ' Land resource management', Oxford publishers, **2007.**
3. Kathy Wilson Peacock, ' Natural Resources and Sustainable Developments,'Viva books ,**2010.**
4. Lynch,R.Daniel, 'Sustainable Natural Resource Management for Scientists and Engineers,' Cambridge University Press ,**2009.**
5. Somesh Jaidev, 'Natural resources in 21st century,' Oxford Publishers, **2010.**
6. S.P Mishra, ' Essential Environmental Studies,' Ane Books, **2010.**
7. Kudrow, J. Nikolas , 'Conservation of Natural Resources,' Nora Science, New York, **2009.**
8. H.D.Kumar, 'Forest resources: Conservation and Management,' Affiliated East-West Press, **2001.**
9. Neil S.Grigg, 'Water resources Management: Principles, regulations and cases', McGraw Hill Professional, **2009.**
10. Beckman, W.Daniel, 'Marine Environmental Biology and Conservation. Jones and Barlett learning , **2013.**
11. R.B Primak , ' Essentials of Conservation Biology,' 6th Edn, Sinauer Publishers,

ENVIRONMENTAL NANO TECHNOLOGY

Subject Code –MESE2-159 **LTPC** **Duration:45 Hrs**

3 1 0 4

UNIT-I (10 Hrs)

Synthesis and Advanced Characterization of Nanomaterials

Physical and chemical method of synthesis for SWCNT, MWCNT, Metal nanoparticles and Metal oxide and Chalcogenide nanoparticles. Biologically Synthesized Nanoparticles,

Nanostructures and Synthetic Nanocomposites - Protein-Based Nanostructure Formation - DNA-Templated Nanostructure Formation - Protein Assembly - Biologically Inspired Nanocomposites

UNIT-II (12 Hrs)

Properties of Nanomaterial

Carbon nanotubes: electrical properties, vibrational properties, mechanical properties and applications of carbon nanotubes: field emission and shielding, computers, fuel cells, chemical sensors, catalysis – mechanical reinforcement. Semiconductor nanostructures – electronic properties, optical behavior and quantum confinement, characterization of semiconductor nanostructures.

UNIT-III (13 Hrs)

Nanomaterials in Environment

DNA, protein, molecular motors, aerosols, self-assembly and natural surfactants, Identification and characterization of Hazardous waste, Nano Pollution, Air, Water and Soil Contaminants.

Environmental Nano Remediation Technology - Nanotechnology for water remediation and purification: nZVI, Ag, Photofenton process, TiO2 and its modification for efficient photodegradation, Nano Filtration for treatment of waste – removal of organics & inorganics and pathogens, Nanomembranes in Drinking water treatment, Nanomembranes in Sea desalination. Application of Nanomaterial in microfuelcell, fuel Cell, hydrogen storage.

Unit-IV(10 Hrs)

Environmental Nanotoxicology

Fate of nanomaterials in environment, environmental life cycle of nano materials, environmental and health impacts of nano materials, toxicological threats, eco-toxicology, exposure to nano particles – biological damage, threat posed by nano materials to humans, environmental reconnaissance and surveillance.

Recommended Books:

1. S.Balaji., 'Nanobiotechnology', MJP Publishers,Chennai **2010**.
2. C. P. Jr Poole, and F. J Owens, ' Introduction to nanotechnology', Wiley India, New Delhi. **2009**.

ECOLOGY, ENVIRONMENTAL CHEMISTRY AND INSTRUMENTAL ANALYSIS LAB

Subject Code –MESE2-104 **LTPC**
0 0 4 2

List of Experiments

1. To determine minimum quadrat size for studying vegetation in a grassland.
2. To study the community by quadrat method by determining frequency, density and abundance of different plant species present in a grassland.
3. To determine basal area and dominance of species.
4. To calculate Importance value index (IVI) of species.
5. To calculate index of diversity, richness, evenness and dominance of species.
6. To study ecology of some more exotic invasive weeds.
7. To study and enlist various biotic and abiotic components of pond and forest ecosystem.
8. To estimate chlorophyll content of plant leaves.
9. To study percent cellular respiration.
10. To estimate carbohydrate content in given plant sample.
11. To estimate protein content in the given sample.
12. Neutralization titration
    (a) Determination of Acidity.
    (b) Determination of free carbon dioxide.

(c) Determination of alkalinity.

13. Complexometric titration
    (a) Determination of temporary and permanent hardness.
    (b) Determination of total, calcium and magnesium hardness.
14. Precipitation titration
    (a) Determination of chloride.
15. Gravimetric method: TSS and TDS.
16 Sulphate determination by gravimetry.
17 Spectrophotometric/ Colorimetric determination
    (a) Determination of nickel.
    (b) Determination of hexavalent chromium.
18 To calculate the lambda max of the given compound by UV-Vis spectrophotometer.
19 Conductometric determination
    (c) Determination of strength of acid against standard alkali.
    (d) Find out the strength of mixture of acids in an unknown mixture.
20 pH metric determination
    (e) Determination of strength of acid against standard alkali.
    (f) Find out the strength of mixture of acids in an unknown mixture.