



Course Name: **Bachelor of Vocational (B.Voc)**
Discipline: **Environmental Assessment and Remediation**
(For Those Who Join In 2016 and After)

Duration of the Course: Three Years

1. Course Objectives

The objective is to recognize that curriculum, course content and assessment of academic achievement play complementary roles in shaping education. The course has been designed to improve the understanding of the students about different pollution control strategies and the skills of application of remediation techniques to combat pollution in three environmental compartments i.e. water, air and soil. The course will also be dealing with the sources of pollution in water, air, soil, solid-waste, thermal and noise and the impacts these sources on the environment and health. In addition, the students will be given the training to develop the particular skills required in pollution related structured study and conservation methods.

- To study sources and classification of water pollutants.
- To study air pollution: sources and effects.
- To study sources of soil contamination and management of solid waste.
- To develop skill in practical work, experiments, equipment's and laboratory use along with collection of sample and interpretation of data for environmental Assessment.
- Make aware of natural resources and environment and the importance of conservation.

2. Eligibility for admission:

A pass in the Higher Secondary with Biology background / other streams also and its equivalent as per Madurai Kamaraj University rules.

III-Year Syllabus

COURSE SCHME:

Sem	Subject	Hours/ Week	Credits			Int + Ext =Total	Subject Code
			Theory	Skill	Total		
V	Solid Waste Recycling and Processing	5	3	1	4	25+75=100	EV16T51
	Bioremediation-II	5	3	1	4	25+75=100	EV16T52
	Ecotoxicology and Human Health	4	2	1	3	25+75=100	EV16T53
	Circular Economy	4	2	1	3	25+75=100	EV16T54
	Workplace Hazardous and Occupational Health	4	2	1	3	25+75=100	EV16T55
	LAB: V Solid Waste Assessment and Remediation-I	10	0	5	5	40+60=100	EV16P51
	Internship	8	0	4	4	50(Internal)	EV16ISP5
	Industrial Visit	2	0	1	1	20(Internal)	
	Project Work	6	0	3	3	30(Internal)	
	Total		48	12	18	30	



Sem	Subject	Hours/ Week	Credits			Int+Ext =Total	Subject Code
			Theory	Skill	Total		
VI	Applied Pyrolysis and Gasification	5	3	1	4	25+75=100	EV16T61
	Waste to product Conversion Techniques	5	3	1	4	25+75=100	EV16T62
	Hazardous Waste Management	4	2	1	3	25+75=100	EV16T63
	Natural Resources and Conservation	4	2	1	3	25+75=100	EV16T64
	Environmental Nanotechnology	4	2	1	3	25+75=100	EV16T65
	LAB: VI Solid Waste Assessment and Remediation-II	10	0	5	5	40+60=100	EV16P6
	Internship	8	0	4	4	50(Internal)	EV16ISP6
	Industrial Visit	2	0	1	1	20(Internal)	
	Project Work	6	0	3	3	30(Internal)	
	Total		48	12	18	30	

Semester – V

Solid Waste Recycling and Processing

Contact Hours per week : 5

Subject Code: EV16T51

Contact Hours per semester : 75 (Theory 45 + Skill 30) Credits: 4 (3 Theory + 1 Skill)

Section- A: Theory (3 credits)

Contact Hours:45

Objectives:

- To study the various waste management and reduction, waste recycling, and discuss the recycling processing

Unit I Municipal solid waste

9 Hours

Definition - Sources and types of solid waste- composition and its determinants of Solid waste-factors influencing generation-quantity assessment of solid wastes-methods of sampling and characterization.

Unit II Collection and Transfer:

9 Hours

Collection of Solid waste – collection services – collection system, equipments – time and frequency of collection – labour requirement – factors affecting collection – analysis of collection system – collection routes – preparation of master schedules

Unit III Processing techniques and Recovery of Energy

9 Hours

purposes mechanical volume reduction – necessary equipments – chemical volume reduction – incinerators – mechanical size reduction selection of equipments – components separation – methods – drying and dewatering. Recovery of Resources, conversion products and energy recovery – recoverable materials – processing and recovery systems – incineration with heat recovery.



Unit IV Disposal of Solid Wastes

9 Hours

Refuse disposal – various methods – incinerations – principle features of an incinerator – site selection and plant layout of an incinerator - sanitary landfill- methods of operation – advantages and disadvantages of sanitary land fill - site selection – reactions accruing in completed landfills.

Unit V Management of hazardous wastes

9 Hours

Identifying a hazardous waste – methods – Quantities of hazardous waste generated – Components of a hazardous waste management plan – Hazardous waste minimization – Disposal practices in Indian Industries – Future challenges.

References Book:

1. George Tchobanoglous et al, Integrated Solid Waste Management” McGraw - Hill, 1993.
- 2) Tchobanoglous Thiesen Ellasen; Solid Waste Engineering Principles and Management, McGraw - Hill 1997.

**Section –B Skill component (1 credit)
Solid Waste Recycling and Processing**

Contact Hours:30

Credit:1

1. To prepare the list of Kitchen waste including food waste of all kinds, cooked and uncooked, including eggshells and bones from your locality
2. To study the Waste from tea stalls/shops etc. from your regions
3. Study the Flower and fruit waste including juice peels and vegetable market waste from your cities
4. To study the Solid Waste Reduction techniques
5. To study the Solid waste processing methods (storage, conveying, compacting, shredding, pulping, granulating, etc.).
6. Arrange site visits to show different activities related with solid waste recycling management

Bioremediation-II

Contact Hours per week : 5

Subject Code: EV16T52

Contact Hours per semester: 75 (Theory 45 + Skill 30)

Credits: 4 (3 Theory + 1 Skill)

Section- A: Theory (3 credits)

Contact Hours:45

Objectives:

- To provide plenty knowledge about Bioremediation
- To understand the various pollutants of environment.

Unit – I

9Hours

Bioremediation: Advantages of Bioremediation, types of bioremediation. Monitoring the efficacy of Bioremediation. Bioventing Bioremediation for controlling oil spills. Biosorption: Use of bacteria and fungi, Bio reaction for biosorption

Unit – II

9 Hours

Problems associated with disposal of xenobiotic compounds, Hazardous wastes. Biodegradation of xenobiotics: Persistent compounds, Degradation mechanisms, naphthalene, benzene, phenol, PCB's, propanil (Herbicide), urea. Biodegradation of petrochemical effluents.

Unit – III

9 Hours

Bioremediation: Microbes in mining, ore leaching, oil recovery, waste water treatment, biodegradation of non cellulose and cellulosic wastes for environmental conservation.



Unit – IV

9 Hours

Detoxification of Hazardous chemicals: Factors causing molecular recalcitrance – Biodegradations of problem environmental contaminants – Bioremediation of problem environmental contaminants – Bioremediation: Engineering strategies for Evaluating bioremediation.

Unit – V

9 Hours

Define: Industrialization, advantage and disadvantage of industrialization. Impact of Industrialization on the Environment

Suggested Books for study

1. El-mans, E.M.T., and Bryce, C.F.A 2002. Fermentation microbiology and Biotechnology. Taylor and Francis group.
2. Martin Alexander. Biodegradation and Bioremediation. Academic Press; 2nd edition (April 15, 1999) ISBN: 0120498618.
3. George Tchobanoglous et al, "Integrated Solid Waste Management" McGraw - Hill, 1993.
4. Tchobanoglous Thiesen Ellasen; Solid Waste Engineering Principles and Management, McGraw - Hill 1997.

Bioremediation - II

Section –B Skill component (1 credit)

Contact Hours:30

(1 credit)

1. To study the bioremediation by using plants.
2. To study the bioremediation by using Microbes.
3. To Develop environmentally friendly processes such as integrated waste management
4. Any one place study the need for management of resources.
5. To study the Biogas and biofuel production from natural resources

Ecotoxicology and Human Health

Contact Hours per week : 4

Subject Code: EV16T53

Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits:3 (2 Theory +1 Skill)**

Section- A: Theory(2 Credit)

Contact Hours:30

Objectives: To provide knowledge about Ecotoxicology and Human Health

To study the various toxic substances and effect on Human health

Unit: 1.

6 Hours

Introduction to Toxicology: Concepts of toxins, toxicity and toxicology, sub disciplines of toxicology- Environmental toxicology, aquatic toxicology, forensic toxicology, chemical toxicology, Toxicogenomics; Types of toxicants, classification of toxicants - factors that affect environmental concentration of toxicants.

Unit: II

6 Hours

Toxic chemicals in the Environment: a) Air Pollutants; SO₂,NO_x,H₂S, particulate matter, ozone, Hydrocarbons, Industrial chemicals, agro chemical and fertilizers- Ammonium Sulphate, Potash, urea, pesticides-organ chlorines (DDT, BHC, and Endosulphan), organic phosphates (Malathion, Parathion) and carbamates.



Unit : III

6 Hours

Pesticides – microcosms - compartment models. Absorption – Translocation and Excretion of chemicals (xenobiotics) – membranes permeability and mechanisms of chemical transfer Bio-transformation of xenobiotics – Selective toxicity. Biomonitoring of Toxic chemicals – Monitoring Program Parameters of biomonitoring .

Unit : IV

6 Hours

Individual health parameters Determinants of Health, Importance and Source of Public-health Standards, Relevance to social aspects Future challenges in public health

Unit : V

6 Hours

Determinative factors: Family health history, Physique, Environment, Life-style and Social cultural aspects Overview of Healthcare Systems in India. Primary healthcare hand-washing, immunization, Drugs, Tobacco and Alcohol: Chemical agents, Effects and Side effects.

References Book:

1. George Tchobanoglous et al, Integrated Solid Waste Management” McGraw - Hill, 1993.
- 2) Tchobanoglous Thiesen Ellasen; Solid Waste Engineering Principles and Management, McGraw - Hill 1997.

Section –B Skill component (1 credit)

Ecotoxicology and Human Health

Contact Hours:30

Credit:1

1. To study the various Ecotoxicology substances.
2. To study the nearest ecotoxicology affected area.
3. To demonstrate the Health hygienic by using organic products.
4. To study ecotoxicology effect nearest pond
5. To visit the nearest Hospital and study the health aspects.

Circular Economy

Contact Hours per week : 4

Subject Code: EV16T54

Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits:3 (2 Theory +1 Skill)**

Section- A: Theory (2 Credit)

Contact Hours:30

Objective:

- To provide knowledge on linear and circular economic practices
- To understand the impact of circular economic practices in environment, economic and employment.
- To understand the various emerging business sectors based on Circular Economy

Unit I-

6Hours

Linear Economy and its Limits: The success and limits of linear consumptions- Linearity of consumer goods industry- Facts of linear model that causes economic losses- Agricultural supply chain

Unit II-

6 Hours

Linear to Circular transformation: The goals of circular economy policy- The circular economy is based on a few simple principles- Making the shift to a circular economy- The Ellen MacArthur Foundation's perspective on the circular economy.



Unit III-

6 Hours

Environmental perspectives of the circular economy: Reduction of waste generation- Managing and recovering the waste- Utilization of greener feedstocks

UNIT: IV

6 Hours

Circularity of Materials: Sources of value creation in a circular economy- Long-term effects of circularity on material stocks and mix - Case examples of circular products

Unit V-

6 Hours

Life and the Circular Economy: Circularity in production- consumption - secondary raw materials- Priority sectors

References

1. LIFE and the circular economy, EUROPEAN COMMISSION ENVIRONMENT DIRECTORATE-GENERAL, ISBN 978-92-79-64147-3, ISSN 2314-9329, (doi:10.2779/29436), © European Union, 2017
2. "Towards the circular economy", Volume 1 & 2, Ellen MacArthur Foundation, 2013.

**Section –B Skill Component (1 credit)
Circular Economy**

Contact Hours:30

Credit:1

1. Investigate the various circular economic components/ practices.
2. Analysis of market and profit strategy involved in plastic waste collection and recycling.
3. Analyses the circular practices of nearby food industry.
4. Study on the circular practices in plastic industry
5. Recycling process in post consumed batteries.
6. Study of circular economic practices towards electronic waste managements

Workplace Hazardous and Occupational Health

Contact Hours per week : 4

Subject Code: EV16T55

Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits:3 (2 Theory +1 Skill)**

Section- A: Theory (2 Credit)

Contact Hours:30

Objectives: To know the workplace hazarders and occupational Health on various occasion

Unit – I

6 Hours

Key elements of a safety and Health Management System- Policy & commitment, Safety and health Management System model, safety and Health policy- Developing a workplace Safety and Health Policy, Planning – safety and Health objectives and Targets, performance standards, Safety Consultation

Unit – II

6 Hours

Definition : Incident, accident, injury, dangerous occurrences, unsafe acts, unsafe conditions, hazards, error, oversight, mistakes, etc. Accident Prevention: Principles of accident prevention, Accident and Financial implications, Hazard identification and analysis, fault tree analysis. Job safety analysis with examples.



Unit – III

6 Hours

Body structure and Functions, Position of causality, the unconscious casualty, fracture and dislocation, Injuries in muscles and joints, Bleeding, Burns, Scalds and accidents caused by electricity, Respiratory problems, Rescue and Transport of Casualty. Cardiac massage, poisoning, wounds. Personal Protective Equipments: Need, selection, supply, use, care and maintenance.

Unit – IV

6 Hours

Design and location ,distance between hazardous units, color coding, Lighting, ventilation, Flow charts, pilot plant applications and machine guarding and it's types, Housekeeping. Work permits systems - Significance of documentation.

Unit – V

6 Hours

Bureau of Indian standards on safety and health 14489 - 1998 and 15001 - 2000 OSHA, Process Safety Management (PSM) as per OSHA, PSM principles, OHSAS – 18001, EPA Standards, Performance measurements to determine effectiveness of PSM

References:

1. George Techobanoglous et al, Integrated Solid Waste Management” McGraw - Hill, 1993.
- 2) Techobanoglous Thiesen Ellasen; Solid Waste Engineering Principles and Management, McGraw - Hill 1997.

**Section –B Skill component (1 credit)
Workplace Hazardous and Occupational Health**

Contact Hours: 30

Credit:1

1. To study the laboratory work hazardous and risks
2. To study and demonstrate the first aid steps on various occasions
3. To study hazards that may be associated with these jobs (Welder, Textile worker, Agricultural worker, Construction worker etc.)
4. To study the general health issues of various workers
5. To study the work hazardous magazines, reports and videos

LAB: V Solid Waste Assessment and Remediation-I

Contact Hours: 150

Credits: 5

Subject Code: EV16P51

- 1) Determination of total dissolved solids
- 2) Determination of pH of the solid waste
- 3) Determination of optimum coagulant dosage
- 4) Determination of chlorine from the solid waste
- 5) To study the Clariflocculator and Trickling filter systems
- 6) Determination of Chromium, Lead and Zinc from any one Solid waste
- 7) Determination of Solid waste from any one school or college campus
- 8) Estimation of E-waste and Hazardous waste



Semester- VI

Applied Pyrolysis and Gasification

Contact Hours per week : 5

Subject Code: EV16T61

Contact Hours per semester : 75 (Theory 45 + Skill 30) **Credits: 4 (3 Theory + 1 Skill)**

Section- A: Theory (3 credits)

Contact Hours:45

Objectives To Know the pyrolysis and gasification process, biochemical and high energy producing biomass etc.

Unit - I

6 hours

Biomass – types – fuels from biomass. Terms and units used in biomass production. Biomass fuel characterization – physical, chemical and thermal – energy release. Supply chain – harvesting / collection – transportation and processing. Briquetting – types – pelletizing

Unit -II

6 hours

Energy sources, Introduction, Classification, Energy from Biomass, Types of biogas plants, constructional details, Biogas production and its utilization, Agricultural wastes, Principles of combustion, pyrolysis and gasification, Types of gasifiers, Producer gas and its utilization.

Unit -III

6 hours

Biochemical degradation – factors affecting biogas production - types of biogas plants – construction details – operation and maintenance – utilization of biogas - slurry handling, utilization and enrichment – high rate biomethanation process – landfills – bioethanol – feedstock – process – utilization - composting - methods – machinery.

Unit - IV

6 hours

Biomass gasification – chemistry of gasification – types of gasifier – Gas cleaning & conditioning - utilization of producer gas - emissions – commercial gasifiers plants. Pyrolysis – product recovery – types - biochar – bio oil – operation – recovery

Unit - V

6 hours

Energy sources (renewable and non-renewable). Classification of fuels and their calorific value. Coal: Uses of coal (fuel and nonfuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Coal gasification (Hydro gasification and Catalytic gasification).

References

1. Song, Y. L.; Tsai, W.; Yao, Y. D. (2004). "Ultrasonic Spray Pyrolysis for Synthesis of Spherical Zirconia Particles" (PDF). *Journal of the American Ceramic Society*. **87** (10): 1864–1871. doi:10.1111/j.1151-2916.2004.tb06332.x. Archived (PDF) from the original on 2014-04-08.
2. Heffungs, Udo (June 2010). "Effective Spinneret Cleaning". *Fiber Journal*. Archived from the original on 30 June 2016. Retrieved 19 April 2016.
3. Ringer, M.; Putsche, V.; Scahill, J. (2006) Large-Scale Pyrolysis Oil Production: A Technology Assessment and Economic Analysis Archived 2016-12-30 at the Way back Machine.; NREL/TP-510-37779; National Renewable Energy Laboratory (NREL), Golden, CO.



Section –B Skill component (1 credit)
Applied Pyrolysis and Gasification

Contact Hours:30

Credit:1

1. To study the type biogas plants; Field visit to biogas plants;
2. To study the different types of gasifiers Testing of gasifiers;
3. To study the Briquette preparation from biomass
4. To study and find the efficiency of solar cooker;
5. To study the performance of different types of wind mills.
6. To study the Bio-diesel production from Algae

Waste to product Conversion Techniques

Contact Hours per week : 5

Subject Code: EV16T62

Contact Hours per semester : 75 (Theory 45 + Skill 30) **Credits: 4 (3 Theory + 1 Skill)**

Section- A: Theory (3 credits)

Contact Hours:45

Objectives: To Know the waste products and Waste Processing Techniques in the form useful products

Unit-I

(6 Hours)

Waste as a Renewable Energy Source, Waste-to-Energy Conversion: Thermochemical Conversion, Biochemical Conversion, Physico-chemical Conversion, Factors affecting Energy Recovery from waste, Agricultural Residues, Animal Waste, Industrial Wastes, Forestry Residues, Municipal Solid Waste (MSW), Converting Waste Heat to Electricity

Unit-II

(6 Hours)

Bio energy as by product of waste processing, Environmental significance, Introduction to anaerobic digestion, Process fundamentals and design considerations, Process analysis and reactor configurations, Methane production, Energy assessment, Bio-methanation from sludge digestion, Types of reactors

Unit-III

(6 Hours)

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

Unit-IV

(6 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 – - treatment of biomedical wastes

Unit-V

(6 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 — landfill remediation



References:

1. "Costs compared for waste treatment options". letsrecycle.com. 15 August 2008.
2. Wrap.org.uk
3. Ryan, Michael (2008). "Maximum and minimum Infant Mortality Rates 2003–06 in Coventry's electoral wards (ONS data)" (PDF). UK Health Research.
4. "Hazardous Waste: Treatment and Landfill" (PDF). Grondon. 2004. Archived from the original (PDF) on 2 March 2013.

Section –B Skill component (1 credit)
Waste to product Conversion Techniques

Contact Hours:30

Credit: 1

- 1) To study the waste generation and sources
 - 2) To Study on classification all types of wastes
 - 3) Study of hazardous waste producing industry with details of points of generation in various forms.
 - 4) To study waste product from convert to useful products
 - 5) To study local availability source convert to vermicomposting farming
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Hazardous Waste Management

Contact Hours per week : 4 **Subject Code: EV16T63**
Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits:3 (2 Theory +1 Skill)**

Section- A: Theory (2 Credit)

Contact Hours:30

Objectives:

- To understand waste generation and their health and environmental impact.
- To study the various disposal and processing technology of waste.
- To understand the various other Hazardous materials and their management techniques.

Unit-I- Hazardous Materials (6 Hours)

Definition: Hazardous Waste, classification waste, sources Hazardous Waste-Waste-Toxicology and the Standard-Setting Processes-Hazardous Waste Sources/Generators.

Unit-II Medical Waste an Introduction (6 Hours)

Introduction- medical waste classification- nature of medical waste- potential impacts (risks) associated with medical waste- environmental hazards related to medical waste- consequences of improper disposal or non-disposal of medical waste.

Unit-III Toxicity evaluation of Hospital waste (6 Hours)

Introduction- Healthcare waste generation- Segregation at source- Collection- Transport- Storage- Recycling – reuse- Treatment – disposal- Measurements- BOD/COD



Unit-IV Medical Waste Treatment and Disposal Methods (6 Hours)

Medical Waste Disposal- Medical Waste Treatment and Disposal Methods- Hydrothermal techniques- radiation methods- fast pyrolysis and gasification techniques for medical waste conversion in to carbon and energy.

Unit-V: Hazardous waste management (6 Hours)

Define Atomic waste, sources and types, Transportation of Hazardous Wastes- Modes and Scope of Hazardous Waste Transportation- Regulation and Disposal Methods, Waste Minimization, Reuse, and Recycling-Resource Conservation and Recovery Act (RCRA)- Assessment Techniques for Site Remediation.

Suggested Books for study

1. Benny Joseph, Environment science and engineering, Tata McGraw-Hill publishing Company limited, New Delhi, 2006.
2. Environmental science, S.C.Santra New Central Book Agency (P) LTD London.
3. P. Leelakrishnan, Environmental and the last (Bullorthworths, Latold, edn.).

Suggested Books for Reference and Further Readings

1. Jerry; A. Nathanson Basic environmental technology.

Section –B Skill component (1 credit)

Hazardous Waste Management

Contact Hours: 30

Credit:1

1. A Visit to the Hazardous waste Generation or disposal site.
2. Visit to Industrial area, especially the handling of Hazardous materials
3. Ecology baseline and impact of waste – disposal on vegetation
4. Preparation of report based on a case study of one hospital hazardous solid waste
5. Practical knowledge and uses of incinerators
6. Case study about pyrolysis unit uses

Natural Resources and Conservation

Contact Hours per week : 4

Subject Code: EV16T64

Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits:3 (2 Theory +1 Skill)**

Section- A: Theory (2 Credit)

Contact Hours:30

Objectives: To study the Natural resources and different conservation process

Unit-I (9 Hours)

Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Inter relationships among different types of natural resources. Ecological, social and economic dimension of resource management Natural resources and development.

Unit-II (9 Hours)

Forest resources: Forest vegetation, status and distribution, contribution as resource .Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people, Forest products. Developing and developed world strategies for forestry.



Unit-III

(9 Hours)

Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems,. Fish and other marine resources.

Unit-IV

(9 Hours)

Land resources: Land as a resource. Dry land, land use classification, land use planning and desertification. Land resource management and major issues. Water resources: Use and over-utilization of surface and ground water, drought, conflicts over water, dams-benefits and problems. Water ecology and management.

Unit-V

(9 Hours)

Introduction – Definition : genetic, species and ecosystem diversity. Value of biodiversity consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.

Suggested Books for Study

Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd. 2.Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p

**Section –B Skill component (1 credit)
Natural Resources and Conservation**

Contact Hours: 30

Credit:1

1. To study Measurement of Relative Humidity from throughout the year.
2. To Study the Measurement of rainfall from any one city.
3. To study Plotting line graphs for illustrating climatic factor such as temperature from any one city.
4. To study water conservation from Dam and channels etc.
5. To list out endangered plant species from western Ghats
6. To list out endangered animal species from western Ghats

Environmental Nanotechnology

Contact Hours per week : 4

Subject Code: EV16T65

Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits: 3** (2 Theory +1 Skill)

Section- A: Theory (2 Credit)

Contact Hours:30

Objectives:

To understand the concept of nanoscience, nanotechnology and nanomaterials

To study the various uses of nanostructured materials for environmental applications

To understand the nano enabled devices for environmental monitoring

To understand the nano toxicity and common lab safety practices

Unit : I

(6 Hours)

The over view of nano: Introduction to nanoscience, nanotechnology and nanomaterials,- nanomaterials and their diversity- fabrication and characterization techniques.

Unit-II

(6 Hours)

Nano Catalytic degradation of organic pollutants- Catalytic materials and mechanisms for organic degradation- Photocatalytic degradation of organic pollutants using semiconducting materials- Impact of functional materials in environmental remediation.



Unit: III (6 Hours)

Carbon nanotechnology for absorption techniques- Carbon allotropes- Various carbon nanomaterials- Carbon based absorption for water and air purification.

Unit : IV (6 Hours)

Nano devices for environmental monitoring: basics of sensor- various sensing mechanisms- environmental sensors using nanomaterials- various sensor materials and their applications.

Unit : V (6 Hours)

Nano toxicity and common lab safety practices: Natural versus Engineered nanomaterials- nano toxicity- common lab safety practices for nanomaterials handling, storage and transportation.

References:

1. Environmental, Nanotechnology, Applications and Impacts of Nanomaterials, Editors, M. R. Wiesner and J. Y. Bottero, (2007) The McGraw-Hill Companies, DOI: 10.1036/0071477500.
2. A Laboratory Course in Nanoscience and Nanotechnology, Dr.Gérrard Eddy Jai Poinern (2015) CRC Press, Taylor & Francis Group.

Section –B Skill component (1 credit)

Environmental Nanotechnology

Contact Hours:30

Credit:1

1. Greener synthesis of metal nanoparticles
2. Photocatalytic degradation of organic dyes
3. Activated carbon nanomaterials for dye absorption
4. Biomass in to carbon nanostructures

LAB: VI Solid Waste Assessment and Remediation-II

Contact Hours: 150

Credits: 5

Subject Code: EV16P6

1. Qualitative and Quantitative estimation of solid waste from Household/commercial /Institutional areas.
 2. Estimate energy content of household solid waste.
 3. Cost estimation of recyclable waste generated from households /commercial /Institutional areas.
 4. Making recycled paper/paper items from used newspapers/paper.
 5. Preparation and collection of items from recycled/reused material.
 6. Laboratory demonstration of Vermi –composting
 7. Laboratory demonstration of Aerobic Composting
 8. Field visits to e waste dumping/disposal site
 9. Field visits to Solid Liquid Resource Management(SLRM)
 10. Construction and working of Incinerators/biogas plants
 11. Site selection and siting criteria for sanitary landfills in your area
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