



Course Name: **Bachelor of Vocational (B.Voc.)**
 Discipline: **Environmental Assessment and Remediation**
 (For Those Who Join In 2022 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.

II -Year Syllabus

COURSE SCHME:

Semester	Part	Subject	Hours/ Week	Credits			Int + Ext =Total	Subject Code	Focus on Employability / Entrepreneurship/ Skill Development	Revised / New/ No change/ Interchanged & Percentage of revision
				Theory	Skill	Total				
III		Soft Skills Development	4	2	1	3	25+75=100	EV16T31/ EV22T31	Skill Development	No change
	Core-5	Human impact on the Environment	4	2	1	3	25+75=100	EV22T32	Skill Development	Revised – 30%
	Core-6	Environmental Pollution- II	4	2	1	3	25+75=100	EV22T33	Skill Development	Revised – 20%
	Core-7	Air Quality Assessment & Remediation	5	3	1	4	25+75=100	EV22T34	Skill Development	Revised – 50%
	Core-8	Climate change and Carbon Sequestration	5	3	1	4	25+75=100	EV22T35	Skill Development	Revised – 30%
	Core-3 Lab	LAB: III Air Quality	10	0	5	5	40+60=100	EV16P31/ EV22P31	Skill Development	No change



VIRUDHUNAGAR HINDU NADARS' SENTHIKUMARA NADAR COLLEGE
 (An Autonomous Institution Affiliated to Madurai Kamaraj University)
 [Re-accredited with 'A' Grade by NAAC]
 Virudhunagar – 626 001.



	Assessment I								
	Internship	8	0	4	4	50(Internal)	EV16ISP3 / EV22ISP3 1	Skill Development	No change
	Industrial Visit	2	0	1	1	20(Internal)		Entrepreneurship	No change
	Project Work	6	0	3	3	30(Internal)		Skill Development	No change
	Total	48	12	18	30				

Semester	Part	Subject	Hours/ Week	Credits			Int + Ext =Total	Subject Code	Focus on Employability / Entrepreneurship/ Skill Development	Revised / New/ No change/ Interchanged & Percentage of revision
				Theory	Skill	Total				
IV	Core-9	Remote sensing and GIS	4	2	1	3	25+75=100	EV22T41	Skill Development	Revised – 10%
	Core-10	Air Pollution Control Technologies	4	2	1	3	25+75=100	EV22T42	Skill Development	Interchanged – 10%
	Core-11	Hazardous Waste Management	4	2	1	3	25+75=100	EV22T43	Skill Development	Revised – 10%
	Core-12	Bioremediation – I	5	3	1	4	25+75=100	EV22T44	Skill Development	Revised – 10%
	Core-13	Indoor Environment Monitoring	5	3	1	4	25+75=100	EV16T45/ EV22T45	Skill Development	No change
	Core-4 Lab	LAB IV : Air Quality Assessment II	10	0	5	5	40+60=100	EV16P41/ EV22P41	Skill Development	No change
		Internship	8	0	4	4	50(Internal)	EV16ISP4 / EV22ISP4 1	Skill Development	No change
		Industrial Visit	2	0	1	1	20(Internal)		Entrepreneurship	No change
		Project Work	6	0	3	3	30(Internal)		Skill Development	No change
	Total	48	12	18	30					



Semester – 3
Soft Skills Development

Contact Hours per week : 4 **Subject Code:** EV16T31/ EV22T31
Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits:**3 (2 Theory +1 Skill)

Section- A: Theory (2 credits)

Contact Hours: 30

Course outcomes:

Students, after successful completion of the course, will be able to

CO1 : develop effective communication skills, presentation skills.

CO2 : focus on developing effective communication skills, presentation skills.

CO3 :improve team management skills, and leadership skills.

Unit I Introduction

6 Hours

Meaning of soft skills – Soft skills versus hard skills – The importance of soft skills in the competitive job market today – Selling your soft skills – Attributes regarded as soft skills – Identifying your soft skills – Enhancement of your soft skills through training.

Unit II Resume preparation

6 Hours

What is resuming? – The importance of a resume in an interview – Details to be included in a resume – Do's for resume preparation – Don't' for resume preparation – Resume preparation for freshers – Resume preparation for candidates with experience.

Unit III Career Goal

6 Hours

Meaning of career goal – The importance of “Know Thyself” or self-assessment – What is SWOT analysis – Long term goal and short term goal – Career opportunities today – Source of career information – Importance of career guidance.

Unit IV Group Discussion

6 Hours

What is GD? – Necessity of GD in an interview – Characters tested in a GD – Skills required in a GD – Types of GD – Body language in a GD – Movements and gestures to be avoided in GD – Topics for GD – GD etiquette.

Unit V Personal interview

6 Hours

Why an interview – Types of interview – Anticipated interview questions – Body language in an interview dress code in an interview – Do's in interview – Don'ts in an interview – Post interview etiquette – Salary negotiation in an interview.

Text Book:

SOFT SKILLS, 2015, Career Development Centre, Green Pearl Publications.



Section –B Skill component (1 credit)

Soft Skills Development

Contact Hours: 30

Credit:1

Unit I Introduction

6 Hours

1. Make the students give “self – introduction” in front of others in order to eradicate their stage fear.
2. Make the students identify their strength and weaknesses and give a summary of them.

Unit II Resume preparation

6 Hours

3. Ask them to prepare a resume and let it be corrected.
4. Conduct Aptitude Test periodically and correct it
5. Ask them to gather information about career opportunities from various sources.

Unit III Career Goal

6 Hours

6. Conduct GD very often and evaluate the students. Presentation skill, communication skill, body language etc.
7. Conduct Mock- interviews very often and assess the students.

Unit IV Group Discussion

6 Hours

8. Organize events very often to assess their team spirit and leadership quality. Discuss the contemporary issues.

Unit V Personal interview

6 Hours

9. Ask them to prepare speeches in English on environmental relative topics and deliver them in front of others.
10. Ask them to organize events in order to assess their organization skill.
11. Assign them many works and ask them to finish it within a particulate time to assess their time management skill and priority management skill.

Human impact on the Environment

Contact Hours per week : 4

Subject Code: EV22T32

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

Section- A: Theory (2 Credits)

Contact Hours:30

Course outcomes:

Students, after successful completion of the course, will be able to

- CO1 : provide plenty of knowledge about Human impacts.
- CO2 : understand the various pollutants of environment.
- CO3 : know the effect of urbanization and industrialization



CO4 :understand the importance of water conservation

Unit – I

6Hours

Environment: basic concepts and types, causes of population explosion, degradation of natural resources, pollution of air, water and soil. Public health: food security, safety, and sustainability.

Unit – II

6 Hours

Environmental Degradation: Man and Environment – Man made Degradation: Deforestation– Urbanization – Industrialization – Mining – Dam building and other activities.

Unit – III

6 Hours

Mining and Eco restoration. Mineral Resources- Types, effects on environment, Conservation of Mineral Resources and Restoration of Mining Sites. Energy resources: Introduction, Types (Conventional, Non-Conventional), Energy crisis on the environment.

Unit – IV

6 Hours

Urbanization: Definition, causes, effects on environment, Strategies to improve urban energy efficiency. Industrialization: Definition, advantages and disadvantages of industrialization. Impacts of industrialization on the environment.

Unit – V

6 Hours

Water conservation: Goals, importance, advantages. Methods of water conversion: rain water harvesting- watershed management.

Text Books

1. Ravikrishnan, A. 2017. *Environment Science and Engineering*. Sri Krishna Hitech Publishing Company Pvt. Ltd., Chennai.
2. Benny Joseph, 2006. *Environment science and engineering*, Tata McGraw-Hill Publishing Company limited, New Delhi.

Reference Books

1. Masters,G.M. and Ela, W.P. 2015. *Introduction to Environmental Engineering and Science*, 3rd Edition, Pearson Education, India.

Section –B Skill component (1 credit)

Contact Hours:30

(1 credit)

1. To study the urbanization any nearest one city.
 2. To study the impact of Industrialization and Urbanization on Environment from Sivakasi.
 3. The effect of mining process and health hazards to workers
 4. Any one place study about the impact of mining induced urbanization.
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Environmental Pollution- II

Contact Hours per week : 4 **Subject Code: EV22T33**
Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits:3 (2 Theory +1 Skill)**

Course outcomes:

Students, after successful completion of the course, will be able to

CO1 : provide plenty of knowledge on various types of pollution.

CO2 : understand the impact of hazardous pollution.

CO3 : know the rules and regulations of environmental protection

Section- A: Theory (2 Credits)

Contact Hours:30

Unit: 1.

6 Hours

Photo pollution: Definition, causes, Impact of energy usages, Effect on human and environment. Control measures of light pollution.

Unit: II

6 Hours

E-Waste:Definition –components – sources - environmental impact –awareness - recycling process. E-Waste management and handling Rules.

Unit: III

6 Hours

Radioactive pollution: Definition – types – sources – Effects - control measures. Cell Tower Radiation: Introduction – range – hazardous effects – radiation limits and regulations - suggested solutions.

Unit: IV

6 Hours

Hazardous wastes: health care waste and diseases - Infectious waste - genotoxic waste, Biomedical wastes: Objectives, categorization - composition – treatment and disposal. Safety precaution and prevention of diseases.

Unit: V

6 Hours

Environmental rules in India: Environmental Protection Act (1986), Hazardous Waste Rules, 1989; Rules framed under industrial waste; Biomedical Waste Management Rules; noise and Environmental Pollution under Motor vehicles Rules, 1989, Coastal Zone Regulation, 1991.

Section –B Skill component (1 credit)

Environmental Pollution- II

Contact Hours:30

Credit: 1

1. To study the various symbol of biohazards waste and radiation waste.
2. To study the nearest biomedical waste deposit area.
3. To demonstrate the e-waste in to useful products.
4. To study cell phone tower effect and nearest environment.



5. To study the nearest coastal pollution area.

Text Books

1. Peirce, J.J., Vesilind, P.A. and Weiner, R.F. 1997. *Environmental Pollution and Control*. 4th Edition, Elsevier Science & Technology Books.
2. Murali Krishna, K.V.S.G. 2016. *Air Pollution and Control*. Laxmi Publication Pvt. Ltd.

Reference Books

1. Philp, R.B. 2013. *Ecosystems and Human Health: Toxicology and Environmental Hazards*. CRC Press, Taylor & Francis Group, London.

Air Quality Assessment & Remediation

Contact Hours per week : 5

Subject Code: EV22T34

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

Section- A: Theory (3 credits)

Contact Hours: 45

Course outcomes:

Students, after successful completion of the course, will be able to

CO1 : provide plenty knowledge on different emission inventories.

CO2 : get the knowledge on monitoring air pollution.

CO3 : understand the various air quality and measurement and remediation

CO4 : understand the impact of carbon on environment

Unit I

9 Hours

Emission Inventories: Introduction – importance – sources – issues. Industrial emissions - Domestic emissions - Agricultural emissions - Motor vehicle emissions - Aircraft emissions. National Emissions Inventory.

Unit II

9 Hours

Air pollution monitoring: Principle - site selection - monitoring standards and accreditation- Methods and techniques of monitoring – applications – advantages – preventing measures. Carbon monoxide - Sulphur dioxide - Oxides of nitrogen- Ozone - Volatile organic compounds - National and municipal air quality monitoring networks.

Unit III

9 Hours

Air Quality Index: Definition – major pollutants - Air Quality Index India - Calculation of AQI - Particulate Matter – categories - control measures. National Ambient Air Quality Standards (NAAQS).

UNIT: IV

9 Hours

Carbon capture and sequestration: types – impact on soil and crop productivity - advantages and disadvantages. Carbon dioxide capture for biofuel production. Renewable energy and CO2 emission.



Unit V

9 Hours

Air pollution indices: Impact significance - Indoor air pollution - Air pollution legislation - National air pollution control regimes - pollution control regime.

TEXT BOOKS:

1. Noel de Nevers. 2000. *Air Pollution Control Engineering*. Mcgrew Hill.
2. Brauer, H. and Varma, Y.B.G. 1981. *Air Pollution Control Equipment*. Springer-Verlag, Berlin Heidelberg, New York.
3. Theodore, L. 2008. *Air Pollution Control Equipment Calculations*. John Wiley & Sons Inc., Hoboken.

Suggested Books for Study

1. Harrop, O. 2002. Air quality assessment and management: A practical guide. CRC Press, London.
2. Cooper, C.D. and Alley, F.C. 2002. *Air Pollution Control*. 3rd Edition, Waveland Press Inc. Long Grove.

Section –B Skill component (1 credit)

Air Quality Assessment & Remediation

Contact Hours:30

Credit: 1

1. To study the microorganism's from polluted area
2. To determination of particulate matter from the industrial area by High Volume Sampler/ Settling method.
3. List out the effects air pollution to human beings and environment.
4. To study the power plant gas used as a Carbon sequestration
5. A review of vehicular pollution in urban areas and its effects on human health

Climate change and Carbon Sequestration

Contact Hours per week : 5

Subject Code: EV22T35

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

Section- A: Theory (3 credits)

Contact Hours:45

Course outcomes:

Students, after successful completion of the course, will be able to

- CO1 : provide knowledge about Climate and carbon sequestration.
- CO2 : know the effect of global warming.
- CO3 : understand the ozone depletion and its consequences.
- CO4 : get the knowledge on climate change agreement.

Unit – I

9 Hours

Climate: Definition – causes – effects – facts – control strategies. Greenhouse effect: Greenhouse gases – mechanisms - control of Greenhouse effects - anthropogenic sources – Regional climate change in Indian context.



Unit – II

9 Hours

Global warming: Health impacts – causes – effects. Sea level change – crop yield – water balance. Solutions to Global Warming in Asia.

Unit – III

9 Hours

Ozone: Ozone in the atmosphere - Ozone hole forming sequences. Ozone depletion process – Ozone hole – Worldwide ozone trends. Consequences of Ozone depletion: Human health - Terrestrial plants – Aquatic ecosystems – climate. Intergovernmental Panel for Climate Change (IPCC) emission scenarios.

Unit – IV

9 Hours

Climate change: climate change agreement - Kyoto protocol – UN Framework Convention on Climate Change (UNFCCC) - importance of CoP8 conference, New Delhi.

Unit – V

9 Hours

Carbon Sequestration: Definition – types – sources - impacts on environment. Control methods of carbon sources. Carbon sinks.

Text Books

1. Ravikrishnan, A. 2017. *Environment science and engineering*. Sri Krishna Hitech Publishing Company

Reference Books

1. Joseph, B. 2006. *Environment science and engineering*, Tata McGraw-Hill Publishing Company limited, New Delhi.

Section –B Skill component (1 credit)

Climate change and Carbon Sequestration

Contact Hours: 30

Credit: 1

1. To study the climate change in Virudhunagar and surrounding cities.
 2. To demonstrate that through the burning of fossil fuels (fields as well as forests) humans release additional CO₂ into the atmosphere.
 3. Case studies on effects of climate change: crop productivity, human diseases.
 4. Case studies on effects of climate change: greenhouse gas emissions, sea level rise.
 5. Case studies on successful green energy initiatives: Hybrid vehicles.
 6. A review of El Niño and La Niña events are a natural part of the global climate system.
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Lab: III – LAB: Air Quality Assessment I

Contact Hours: 150

Credits: 5

Subject Code: EV16P31/ EV22P31

- 1) Methods of air sampling.
- 2) Determination of bacteria in air by open plate method.
- 3) Determination of fungi in air by open plate method.
- 4) Assessment of indoor micro flora by open plate method.
- 5) Determination of particulate matter from the industrial area by High Volume Sampler/ Settling method.
- 6) Assessment of outdoor bacteria by air sampling device.
- 7) Enumeration of fungi in outdoor/indoor air by air sampling device.

SEMESTER- IV
Remote Sensing and GIS

Contact Hours per week : 4

Subject Code: EV22T41

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

Section- A: Theory (2 credits)

Contact Hours:30

Course outcomes:

Students, after successful completion of the course, will be able to

CO1 : explain the remote sensing and Geographic Information Systems.

CO2 : know image processing system.

CO3 : understand the mapping concept.

CO4 : get the knowledge on Web GIS.

Unit – I

6 hours

Remote Sensing: Introduction, Basic concepts - Electromagnetic radiation - Characteristics of real remote sensing systems – Platforms – Satellite - Indian remote sensing satellite - Sensors - Satellite Retrievals - Advantages and limitations of Remote Sensing.

Unit –II

6 hours

Image processing - Elements of image interpretation - Digital image processing: Definition, Concepts, Basic features, sources of data, Categorization, Image processing system

Unit –III

6 hours

GIS: Basic concepts - Introduction - History of development – Elements. Computer software's: ArcGIS (Esri), QGIS (Quantum GIS), GRASS GIS, Global Mapp.



Unit – IV

6 hours

Map overlay - Vector and raster data model - Mapping concept - Data storage and databasemanagement Development of map overlay - Overlay operation. Applications of GIS and remote sensing in Energy and Environmental Engineering.

Unit – V

6 hours

Web GIS: Definition, concept, History, components, internet GIS, web GIS v/s Internet GIS, Applications of web GIS, users and stake holders of web GIS, advantages and limitations of web GIS,

Text Books

1. Patel,A.N. and Singh,S.1999.*Remote Sensing Principles and Applications*,Scientific Publisher, Jodpur.

Reference Books

1. Burrough,P.A. 2000.*Principle of Geographical Information Systems for LandResources Assessment*. Clarendon Press, Oxford.

Section –B Skill component (1 credit)
Remote sensing and GIS

Contact Hours: 30

Credit: 1

1. Study of topographic maps – identification of scale, latitude and longitude in any one of city.
2. Study of various geomorphic and environmental features in the maps.
3. Case study about GIS and uses in current applications
4. To study the Remote Sensing Applications in Hydrology & Water Resources Management.
5. To study Land use/ Land Cover Mapping using any one GIS tools in Virudhunagar area.
6. To study the fundamentals of aerial photos and satellite images at Madurai city.
7. To study the future applications of remote sensing and GIS.
8. Demonstration and use of GPS

Core10 - Air Pollution Control Technologies

Contact Hours per week : 4 **Subject Code: EV22T42**
Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits: 3 (2 Theory + 1 Skill)**

Section- A: Theory (2 credits)

Contact Hours:30

Course outcomes:

Students, after successful completion of the course, will be able to
CO1 : understand various components of air pollution.



CO2 : study various techniques for controlling air pollution.

CO3 :get the knowledge on various air handling devices.

CO4 : know about the volatile organic compounds

Content

Unit-I

(6 Hours)

Gaseous pollutants: Introduction –sources (stationary and mobile sources) – formation - control -Engineering control concepts- Concentrations and deposition - harmful impacts on environment. Mitigation of air pollution: the role of vegetation.

Unit-II

(6 Hours)

Introduction to NO_x, SO_x, NH₄ and H₂S control- techniques for NO_x control- techniques for SO_x control- techniques for HCl, NH₄ and H₂S control.

Unit-III

(6 Hours)

Volatile organic compounds (VOC): Absorption and Thermal Oxidation - Design Techniques for Countercurrent Absorption Columns- Countercurrent Flow Packed Absorption Tower Design.

Unit-IV

(6 Hours)

Control of VOC and Hazardous Air Pollutants (HAP) by Condensation- VOC and HAP by Biofiltration- Design Parameters and Conditions- Performance evaluation of Biofilter technologies.

Unit-V

(6 Hours)

Air handling devices and types, Fundamentals of Particulate Control- Hood, Ductwork and Cyclone Design- Wet Scrubbers- Filtration and Baghouses- Electrostatic Precipitators.

Text Books

1. Boubel, R.W., Fox,D.L., Turner,D.B., Stern,A.C. 2008. *Fundamentals of Air Pollution*. Academic Press, An imprint of Elsevier, Burlington, USA.

Reference Books

1. Schnelle,K.B and Brown, C.A. 2002, *Air pollution Control Technology Handbook*.CRC Press LLC, 2000 N.W. Corporate Blvd., Boca Raton, Florida, USA,

Section –B Skill component (1 credit)

Air Pollution Control Technologies

Contact Hours: 30

Credit: 1

- 1) To study the chimneys types and pollutants.
 - 2) To visit the fire industry to determine the air pollution and content.
 - 3) Comparative analysis of air sampling from clean and polluted area using key parameters.
 - 4) To study the significance of Laminar flow chamber and components.
 - 5) To study various filter system for air pollution control technologies
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Hazardous Waste Management

Contact Hours per week : 4 **Subject Code: EV22T43**
Contact Hours per semester : 60 (Theory 30 + Skill 30) **Credits: 3 (2 Theory + 1 Skill)**

Section- A: Theory (2 credits)

Contact Hours:30

Course outcomes:

Students, after successful completion of the course, will be able to

CO1 : understand medical waste generation and their health and environmental impact.

CO2 : study the various disposal and processing technology of medical waste.

CO3:understand the various other Hazardous materials and their management techniques.

CO4 : know about the atomic wastes and its impacts on the environment

Unit-I (6 Hours)

Hazardous Waste: Definition, Characteristics, classification, sources -Waste-Toxicology and the Standard-Setting Processes-

Unit-II (6 Hours)

Medical waste: Introduction – 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 (6 Hours)

Healthcare waste: Introduction- generation - types - Segregation at source- Collection-Transport- Storage- Recycling – reuse –hazards - treatment - disposal- measurements-BOD/COD

Unit-IV (6 Hours)

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

Unit-V: (6 Hours)

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

Text Books

1. Akter, N. 2000. *Medical Waste Management: A Review*. School of Environment, Resources and Development, Asian Institute of Technology, Thailand.
2. Tsakona, M, Anagnostopoulou, E. and Gidarakos. E. 2007. Hospital waste management and toxicity evaluation: a case study. *Waste management* 27(7): 912-920.



Reference Books

1. Blackman Jr, William C. 2001. Basic Hazardous Waste Management. 3rd Edition, CRC Press, Boca Raton.

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

Bioremediation - I

Contact Hours per week : 5

Subject Code: EV22T44

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

Section- A: Theory (3 credits)

Contact Hours:45

Credits:3

Course outcomes:

Students, after successful completion of the course, will be able to

- CO1 : impart sufficient scientific understanding of the current environmental tribulations and global concern.
- CO2 : focus the process of bioremediation, mechanisms, types, success stories& monitoring strategies.
- CO3 :focus the advance molecular techniques to facilitate bioremediation technology.
- CO4 :apply the concepts of bioremediation technology to the real time problems

Unit-I

(9 Hours)

Bioremediation: Introduction –Types- Factors affecting - Mechanisms – Limitations. Microbes for Bioremediation: Microbes involved - Essential characteristics of microbes, microbial adaptation for adverse conditions. Metabolic process involved in bioremediation. Bioremediation Techniques: *In situ* and *Ex situ* bioremediation techniques.

Unit-II

(9 Hours)

Specific Bioremediation Technologies - Application, specific advantages and disadvantages- land farming, prepared beds, bioaugmentation, bioreactors, biostimulation, biopiles, composting, bioventing, biosparging, pump and treat method, constructed wet lands. Phytoremediation, restoration of coal mines a case study.

Unit-III

(9 Hours)

Bioleaching: Definition – mechanisms - process - factors influencing -advantages and disadvantages. Biomining: Definition - types - factors effecting - process.



Unit-IV (9 Hours)

Nuclear Waste Bioremediation - Spent fuel characterization, storage and disposal- Partitioning, transmutation and conditioning- Measurement of Radioactivity in the environment- Basic actinide research.

Unit-V (9 Hours)

Heavy metal pollution: Definition - sources-Microbial interactions with heavy metals -resistance and tolerance- Microbial transformation- Accumulation and concentration of metals- Biosorption of heavy metals by microbial biomass and secondary metabolites - Biosurfactants-Advantages of biosurfactantsoverchemical surfactants-Biotechnology and oil spills- Improved oil recovery.

Text Books

1. Agarwal S. K., 2000. *Environmental Biotechnology*, APH Publishing, Ladakh.
2. Rajendran P., P. Guansekar, 2011. *Microbial Bioremediation*, 1st Edition, MJ Publishers, Chennai.

Reference Books

1. LaGrega, M.D., Buckingham,P.L. and Evans,J.C.2010. *Hazardous Waste Management*.Second Edition, Waveland Press Inc., Long Grove, IL.

Section –B Skill component (1 credit)

Bioremediation - I

Contact Hours: 30

Credit:1

- a. To study bioremediation of Polluted sites from Virudhunagar district.
- b. Bioremediation of organic and inorganic pollutants from polluted sites.
- c. To study the Phytoremediation: Mechanisms & techniques of Phytoremediation from one site.
- d. Microbial bioremediation of pesticides and Xenobiotic compounds.
- e. Composting of organic wastes.

Indoor Environment Monitoring

Contact Hours per week : 5

Subject Code: EV16T45/ EV22T45

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

Course outcomes:

Students, after successful completion of the course, will be able to

- CO1 : understand measuring methods and control technologies of air pollution.
- CO2 : focus on indoor air quality and levels of indoor pollutants .
- CO3 :get the knowledge on laboratory safety and standard at indoor conditions.
- CO4 : get the knowledge on industrial and domestic air handling systems

Section- A: Theory (3 credits)

Contact Hours:45

Credits:3

Unit: I

(9 Hours)



Air Pollution: Definition - Indoor and outdoor pollution, sources of indoor air pollution, particulate matter, combustion byproducts; Radon and its decay products. Volatile organic compounds: odors and sick-building syndrome. Humidity Bio-aerosols: infectious disease transmission. Special indoor environments: A/C units in indoor; museum slabs; Measurement methods, Control technologies.

Unit-II (9 Hours)

Indoor activities of inhabitants -residence time.Levels of many pollutants in indoor and outdoor air.Design and operation of buildings for improvements of public health. IAQ policy issues: sustainability; indoor air quality as a basic human right.

Unit: III (9 Hours)

Air pollutants in indoor environments, private residences, offices, schools and public buildings - factors govern indoor pollutant concentrations, ventilation. Characteristics, Consequences.Laboratory safety and standards at indoor condition.

Unit : IV (9 Hours)

Control of several pollutant classes: radon, toxic organic gases, combustion byproducts, and microorganisms (molds and infectious bacteria). Case study by an exploration of public policy related to indoor air.

Unit : V (9 Hours)

Industrial and domestic air handling systems, Design of air pollution control equipment's Principle and design of minimum stack height - Settling chamber - Cyclone collector - Fabric filter and Electrostatic Precipitators (ESP).

Text Books:

1. Godish, T. 2000. *Indoor Air and Environmental Quality*, CRC press, Boca Raton.
2. Nazaroff W.W and Alvarez-Cohen, L.2001. *Environmental Engineering Science*. Wiley &sons, New York.

References

1. Marco, M., Bernd,S. and Thomas, L.1995. *Indoor Air Quality: A Comprehensive Reference Book*.Vol. 3, Elsevier Science, Amsterdam.

Section –B Skill component (1 credit)
Indoor Environment Monitoring

Contact Hours:30

Credit: 1

1. To study of one of closed room and open room air flow condition in our campus.
 2. To study the Indoor air chemicals and Indoor air microbiology, health cause to human beings.
 3. To Review of research on air-conditioning systems and indoor air quality control for human health.
 4. To study the Indoor air quality (IAQ) and green building rating systems.
 5. To study the various types of Heating, ventilation and air conditioning (HVAC) system
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Lab IV: LAB: Air Quality Assessment II

Contact Hours: 150

Credits: 5

Subject Code: EV16P41/ EV22P41

1. Determination of relative humidity from the atmosphere.
 2. Determination of CO₂ in the atmosphere by volumetric method
 3. Determination of NO₂ from the atmosphere by Colorimetric method using high volume sampler.
 4. Determination of SPM in ambient air by high volume sampler and their analysis
 5. Estimation of areal average precipitation/ volume of precipitation
 6. Measurement and analysis of meteorological data
 7. Comparative analysis of air sampling from clean and polluted area using key parameters.
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