VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(VJTI)

MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

Multi-Disciplinary Minor

in

Sustainable Environment

Implemented for the batch admitted in Academic Year 2023-24

V J T I Veermata Jijabai Technological Institute
(Central Technological Institute, Maharashtra State, INDIA)
H. R. Mahajani Marg, Matunga, Mumbai 400019
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www.vjti.ac.in

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Credit Framework for

Multi-Disciplinary Minor

in

Sustainable Environment

Sr.	Semester	Course Code	Course Name	L	T	P	Hr	Cr	Examination Weightage in %		
									TA	MST	ESE
1	III	R5CE2203T	Principles of Sustainability	2	0	0	2	2	20	30	50
2	IV	R5CE2206T	Water and Wastewater Management	2	0	0	2	2	20	30	50
3	V	R5CE3203T	Environmental Economics	3	0	0	3	3	20	30	50
4	VI	R5CE3206T	Air and Noise pollution control engineering	3	0	0	3	3	20	30	50
5	VII	R5CE4203T	Climate Change and Adaptation	3	1	0	4	4	20	30	50
			Total					**14**			

Abbreviations: **L** Lecture, **T** Tutorial, **P** Practical, **TA** Teacher Assessment / Term work Assessment, **MST** Mid Semester Test, **ESE** End Semester Written Examination,

Programme Name	*Bachelor of Technology in Civil Engineering*	*Semester – III*

Semester – III		**Multidiscplinary Minor (Sustainable Environment)**						
SN	**Course Code**	**Course Title**	**L-T-P (Hours/Week)**	**Credit**	**TA**	**MST**	**ESE**	**ESE hours**
1	R5CE2203T	Principles of Sustainability	2-0-0 = 2	2	20	30	50	3
	Course Outcome: **1.** Describe sustainable environment, sustainability processes and relate impact of various levels **2.** Formulate the methodology for assessment of sustainability of project using various indicators **3.** Apply environmental legislations to various development processes and projects.							

Module	**Course Content:**
1	**Concept of sustainability:** Definition of sustainability, three pillars of sustainable development, environmental, social, and economic aspects of development, interconnectivity of people, planet, and prosperity aspects.
2	**Sustainable Development Goals:** Millenium development goals, formulation of sustainable development goals, indicators for various sustainability goals, sustainability index and associated targets.
3	**Ecosystem services:** Understanding various ecosystem services, effect of industrialization on ecosystem services, impact of climate change.
4	**Sustainability in supply chain:** Understanding sustainable supply chain management, sustainability reporting and associated standards, national and global legislations associated to sustainable reporting.
5	**Principles of green chemistry:**

	Definition of green chemistry, 12 principles of green chemistry, resource recovery, environmentally sound reject management practices.
6	**Engineering applications of sustainability principles:** Applications of sustainability principles to engineering projects, sustainable product design, innovative thinking and optimum resource management.
	Recommended Reading: 1) P Tatyana, P. Soubbotina, Beyond Economic Growth: An Introduction to Sustainable Development, World Bank Institute Learning Resources Series, 2nd edition, 2004. (ISBN: 0-8213-5933-99) 2) P. P. Roger, F. J. Jalal and J. A. Boyd, An Introduction to Sustainable Development, Earthscan Publications, 2nd edition, 2008. (ISBN: 9781844075201/1844075206) 3) T. Strange and A. Bayley, Sustainable Development: Linking Economy, Society, Environment, 2008. (ISBN: 9789264047785) 4) H. G. Brauch, Sustainable Development and Sustainability Transition Studies, Series: Springer Briefs in Environment, Security, Development and Peace, Series Ed.

Programme Name	*Bachelor of Technology in Civil Engineering*	*Semester – IV*

Semester – IV		**Multidiscplinary Minor (Sustainable Environment)**						
SN	**Course Code**	**Course Title**	**L-T-P (Hours/Week)**	**Credit**	**TA**	**MST**	**ESE**	**ESE hours**
2	R5CE2206T	Water and Wastewater Management	2-0-0 = 2	2	20	30	50	3
	Course Outcome: **1.** Understand the physical, chemical, and biological characteristics of water and wastewater **2.** Design treatment schemes for various drinking water and wastewater sources **3.** Study industrial effluent treatment and residual management systems							

Module	**Course Content:**
1	**Characteristics of water and wastewater:** Physical, chemical, and biological characteristics of water and wastewater, drinking water standards in India (IS10500-2012), treated wastewater discharge standards, water quality index.
2	**Water treatment processes:** Design of unit processes used for water treatment such as aeration, sedimentation, filtration, and chlorination, developing water treatment scheme for ground water and surface water.
3	**Wastewater treatment processes:** Design of unit processes used for wastewater treatment such as screening, coagulation and flocculation, biological treatment, filtration, and adsorption, developing wastewater treatment scheme for domestic wastewater.
4	**Resource recovery:** Understanding efficient water and wastewater management, resource recovery from waste streams, concepts of reuse and recycle.
5	**Industrial effluent treatment:** Effluent characteristics for ‘red category’ industries, treatment units used for industrial effluent treatment, effluent management for major polluting industries.
6	**Zero Liquid Discharge:**

	Definition of Zero Liquid Discharge (ZLD) systems, tertiary treatment units and reject management systems, advantages and disadvantages of ZLDs, case studies on sectors implementing ZLD regulations.
	Recommended Reading: 1) Metcalf, Leonard, Harrison P. Eddy, and Georg Tchobanoglous. *Wastewater engineering: treatment, disposal, and reuse*. Vol. 4. New York: McGraw-Hill, 1991. 2) Peavy, Howard S., D. R. Rowe, and G. Tchobanoglous. "Wastewater treatment and disposal." *Environmental Engineering. McGraw Hill Education Pvt. Ltd* (1985). 3) Bui, Xuan-Thanh, Chart Chiemchaisri, Takahiro Fujioka, and Sunita Varjani, eds. *Water and wastewater treatment technologies*. Singapore: Springer, 2019.

Programme Name	***Bachelor of Technology in Civil Engineering***	***Semester – V***

Semester - V		**Multidisciplinary Minor**	**Sustainable Environment**					
SN	**Course Code**	**Course Title**	**L-T-P (Hours/Week)**	**Credit**	**TA**	**MST**	**ESE**	**ESE hours**
3	R5CE3203T	Environmental Economics	3-0-0=3	3	20	30	50	3
	Course Outcome: After completion of course students will be able to 1. Understand the Economic Principles Underlying Environmental Issues. 2. Evaluate Economic Practices for Sustainable Development. 3. Evaluate Environmental Policies and Regulations Based on Economics.							

Module	**Course Contents**
1	**Introduction to Environmental Economics:** Meaning, Definition, and Relevance of Environmental Economics; Basic Concepts and Tools from Microeconomics and Welfare Economics; Comparison with Other Sub-disciplines like Ecological, Economics, and Natural Resource Economics; Major Problems and Key Concerns of Environmental Economics. Commons and Collective Actions Problem: Seminal Theories; Mancur Olson's Theory of Collective Action; Collective Action and Prisoner's Dilemma Game.
2	**Environment and Economic Growth:** Poverty, Environment and Economic Growth Linkages-Environmental Kuznets Curve, Environmental Sustainability; Environmental Performance Index; Benefit-cost Analysis.
3	**Consumer Demand for Environmental Goods:** Consumer Demand for Environmental Goods and Welfare Effects of Price Change; Values, Environmental Values, and Non-market Valuations: Revealed Preference Methods, Stated Preference Methods. Market-efficiency, Optimality, Consumers and Producers Surplus.
4	**Public Market and Environment:** Optimal Provision of Public Goods and Bads; Externality and Market Failure; Pigouvian Fee, Property Rights and Coase Theorem.
5	**Environmental Acts and Regulations:**

	Environmental Regulations and Basic Regulatory Instruments-Market-based Instruments/ Approaches; Environmental Regulation and Basic Regulatory Instruments-Market Trading Systems.
	Textbooks **1.** Hanley, Nick, Jason F Shogren& Ben White, (2008). Environmental Economics, Macmillan. **2.** Folmer, Henk, Hlandis Gabel and Hans Opschoor (1997). Principles of Environmental and Resource Economics, Edward Elgar Pub. **Recommended Reading** **1.** Brady, John (2006). Environmental Management in organizations, Earthscan Pub. **2.** Bromely, Daniel E The Handbook of Environmental Economics **3.** Connor, Robin and Stephen, Dovers (2004). Edward Institutional Change for Sustainable Development, Edward Elgar Publishing. **4.** Waheed Uddin, Ronald Hudson, and Ralph Haas, Public Infrastructure Asset Management, McGraw-Hill Professional **5.** Hart, Staurt L (1997). Strategies for Sustainable World, Harvard Business Review.

Programme Name	*Bachelor of Technology in Civil Engineering*	*Semester – VI*

Semester - VI		**Multidisciplinary Minor**	**Sustainable Environment**					
SN	**Course Code**	**Course Title**	**L-T-P (Hours/Week)**	**Credit**	**TA**	**MST**	**ESE**	**ESE hours**
4	R5CE3206T	Air and Noise pollution control engineering	3-0-0=3	3	20	30	50	3
	Course Outcome: After completion of course students will be able to 1. Analyze air and noise pollution related environmental issues. 2. Formulate economic and technically feasible solutions to air and noise pollution problems. 3. Analyze and develop competency in use of various air modeling software and noise mapping software.							

Module	**Course Contents**
1	**Fundamentals of Air Pollution and Noise Pollution** Composition of dry ambient air, properties of air, Definition of air pollution, Classification of air pollutants, Units for classification of air pollutants, History of air pollution- global and national, Scope of problem-general, urban, rural, and specific. Noise: Basic concept, measurement, various control methods.
2	**Sources of Air Pollution and Its Effects** Sources of air pollution: Natural and man-made, Major pollutants from different sources in Greater Mumbai area and other Indian cities, Emission factors. Effect of air and noise pollution on human health, plants, animals, properties, and visibility, CoH, CoHb
3	**Meteorology and Air Pollution Dispersion** Meteorological aspects of air pollution, large-scale wind circulation including geostrophic wind and gradient wind, influence of cyclones, anticyclones, planetary boundary layers, lapse rate, and stability conditions, wind velocity profile and maximum mixing depth, topographic effects and their role in pollutant dispersion, types of plume patterns and their significance in air quality assessment
4	**Air Quality Monitoring and Standards** Methods and instruments for stack and ambient air monitoring, sampling and analysis techniques for gaseous and particulate pollutants, principles of isokinetic sampling and continuous monitoring, particle size analysis and mass analysis, Government of India's air

	pollution acts and laws, Indian emission and air quality standards, noise standards, amendments in air pollution laws, IS standards for ambient air quality and industrial emissions.
5	**Air Pollution Control Devices – Principles and Design** Design and operation of air pollution control devices, hoods and ducts including hood specifications and design considerations, duct design and ventilation by dilution, settling chambers for dust removal in laminar and turbulent flow, economic sizing and efficiency considerations, inertial devices such as cyclones for particulate collection, factors affecting efficiency, pressure drop and power requirements, economic sizing of cyclones.
6	**Advanced Control Technologies and Filtration Systems** Electrostatic precipitators (ESP) including collection efficiency, electric field principles, particle charging mechanisms, effects of temperature and dust resistivity on collection efficiency, pressure drop, power requirement, sizing, and costing, particulate scrubbers including interception, impaction, collection efficiencies, design criteria for cyclone and Venturi scrubbers, filtration systems such as bag filters and baghouses, fabric filtration theory, collection efficiency, pressure drop, design considerations, sizing, and costing of filtration units**.**
	Recommended Reading: 1. "Air pollution" by Henry C Perkins - McGraw Hill Publications 2. "Air Pollution" by Wark and Warner 3. "Air pollution control Guidebook for Management" Edited by A.T. Rossano 4. Environ-Science Service Dirn. ERA Inc.USA 5. Government of India's publication of laws related to air pollution. Maharashtra Pollution control Board's (MPCB) publication of standards IS relevant to air pollution monitoring definitions, standards etc. 6. “Environmental Engineers” Handbook vol. II ‘Air pollution’ by B.G. Liptak(ed.) Chilton book co. USA 7. Industrial Air Pollution Handbook by A Parker Tata McGraw Hill Publications Handbooks 8. "Environmental Engineers" Handbook Vol. II 'Air Pollution' by B. G. Liptak (ed.) Chilton Book Co.USA 9. Air Pollution Handbook by P.L. Magill and Others. McGraw Hill Publ. New York. 10. Industrial Air Pollution Handbook by A. Parker Tata McGraw Hill Publication Journals

Programme Name	*Bachelor of Technology in Civil Engineering*	*Semester – VII*

Semester - VII		**Multi Disciplinary Minor**	**Sustainable Environment**					
SN	**Course Code**	**Course Title**	**L-T-P (Hours/Week)**	**Credit**	**TA**	**MST**	**ESE**	**ESE hours**
5	R5CE4203T	Climate Change and Adaptation.	3-1-0	4	20	30	50	3
	Course Outcome: After completion of the course, students will be able to: 1. Explain the structure and composition of the atmosphere and evaluate air quality using standard indices and emission estimation techniques. 2. Analyze the influence of meteorological parameters on air pollutant dispersion and apply appropriate models to estimate pollutant concentrations. 3. Evaluate climate change using historical data, identify trends, and assess its impacts on environmental and socio-economic systems. 4. Apply carbon footprinting and carbon cycle concepts to quantify emissions and assess mitigation options. 5. Assess climate change mitigation and adaptation strategies using policy frameworks and decision-making tools, and develop practical solutions for real-world problems.							

Module	**Course Contents**
1	**Atmospheric Systems, Air Quality Metrics, and Emission Estimation** Structure and composition of the atmosphere; ambient air quality standards and indices (AQI); Classification of pollutants ($PM_{2.5}$, PM_{10}, NOx, SO_2, O_3); primary vs secondary formation pathways; Emission sources (natural/anthropogenic) and emission factors; Preparation of a basic emission inventory for transport/area/point sources; AQI computation and interpretation using real datasets (e.g., Indian city data); Introduction to source apportionment concepts.
2	**Meteorology and Air Pollution Dispersion Modeling** Atmospheric stability, lapse rate, inversions, mixing height; Wind systems (geostrophic/gradient), wind profiles, and wind rose analysis; Planetary Boundary Layer and implications for pollutant dispersion; Gaussian plume model: assumptions, formulation, and applications; Estimation of ground-level concentrations under varying meteorological conditions; Interpretation of pollution episodes using meteorological data

3	**Climate Change** Climate vs weather; Earth's energy balance and greenhouse effect; Radiative forcing and role of key greenhouse gases; Analysis of long-term datasets (temperature, precipitation, CO_2) for trend detection; Variability vs change; identification of extremes (heatwaves, intense rainfall); Quantification of impacts on health, water resources, agriculture, and infrastructure; Introduction to risk and vulnerability assessment
4	**Carbon Cycle, Footprinting, and Climate Modeling** Global carbon cycle: reservoirs, fluxes, and feedbacks; Estimation of carbon emissions and sinks (forests, oceans); Carbon footprinting methodologies for products, processes, and institutions; Life Cycle Assessment (LCA) fundamentals; Scenario-based analysis using simplified climate projections (IPCC pathways); Evaluation of mitigation options through emission reduction potential.
5	**Climate Policy, Mitigation–Adaptation Strategies, and Decision Analysis** Evolution and structure of international climate frameworks: UNFCCC, Kyoto Protocol, Paris Agreement; National and urban climate action plans (India-focused); Carbon neutrality and net-zero pathways; Scope 1, 2, 3 emissions accounting; Economic and policy tools: carbon pricing, cost–benefit and cost-effectiveness analysis; Design and evaluation of mitigation and adaptation strategies for sectors (urban, water, infrastructure
6	**Mini Project – Climate Change Assessment and Adaptation Planning** Problem definition (campus/city/sector such as transport, buildings, water); Data collection (air quality, emissions, climate variables); Emission inventory and carbon footprint estimation; Trend analysis and identification of climate risks; Scenario development (business-as-usual vs mitigation/adaptation options); Strategy formulation for emission reduction and climate resilience; Preparation of a technical report and presentation
	Text Books: 1. Climate and Eco-systems, David Schimel, Princeton University Press, 2013 2. Climate Crisis: An Introductory Guide to Climate Change; David Archer & Stefan Rahmstorf ; Cambridge University Press; 2001 3. Global Warming and Climate Change; Grover Velma.I; Science Publishers; 2008 4. UNFCCC (2008). Compendium on Methods and Tools to Evaluate Impacts of, and Vulnerability and Adaptation to, Climate Change 5. Atmospheric Chemistry and Physics: from Air Pollution to Climate Change, John Wiley, New York, 1998