E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

NAGAPATTINAM - 611 002.

(Affiliated to Anna University, Chennai |Accredited by NAAC with 'A++'Grade Accredited by NBA | Approved by AICTE, New Delhi)

REGULATIONS-R2024

M.E. ENVIRONMENTAL ENGINEERING

First Year – Second Semester Curriculum

COURSE CODE	COURSE NAME	CATEGORY	L	T	P	C	MAX.MARKS		
							CA	ES	TOTAL
Theory Courses									
2402EV201	Biological Treatment System for Wastewater	PCC	3	2	0	4	40	60	100
2402EV202	Solid Waste Management	PCC	3	0	0	3	40	60	100
2402EV203	Environmental Impact and Risk Assessment	PCC	3	0	0	3	40	60	100
2403EV003	Circular Economy (Professional Elective I)	PEC	3	0	0	3	40	60	100
2403EV008	Environmental Legislation and Management Systems (Professional Elective II)	PEC	3	0	0	3	40	60	100
2401AU002	Disaster Management (Audit Course II)	AUC	2	0	0	0	100	0	100
Laboratory Courses									
2402EV204	Module Operations & Process Laboratory	PCC	0	0	4	2	60	40	100
2402EV205	Mini Project with Seminar	EEC	0	0	2	1	100	00	100
TOTAL			**17**	**2**	**6**	**19**	**460**	**340**	**800**

2402EV201	BIOLOGICAL TREATMENT SYSTEM FOR WASTEWATER	L	T	P	C
		4	0	0	4

PREREQUISITE:

	Microbiology

COURSE OBJECTIVES:

	To provide students with a comprehensive understanding of biological treatment processes for wastewater, enabling them to design, operate, and maintain efficient and sustainable wastewater treatment systems.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1:	Apply reaction engineering principles to biochemical processes
CO2:	Design and size the different components of conventional aerobic treatment systems.
CO3:	Design and size the different components of advanced aerobic treatment systems.
CO4:	Design the anaerobic treatment units of wastewater which include the attached and suspended growth processes.
CO5:	Design the different elements of nutrient removal systems

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2			3	3					
CO2	3	3	2			3	3					
CO3	3	3	2			3	3					
CO4	3	3	2			3	3					
CO5	3	3	2			3	3					

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	3	-
CO2	3	3	-
CO3	3	3	-
CO4	3	3	-
CO5	3	3	-

COURSE CONTENTS:

MODULE I	REACTION KINETICS AND BIO REACTORS	12 Hours

Objectives of biological treatment–significance–principles of aerobic and anaerobic treatment-kinetics of biological growth–factors affecting growth–attached and suspended growth-determination of kinetic coefficients for organic removal- enzyme kinetics biodegradability assessment - selection of process reactors-

biokinetics - batch reactor - continuous flow stirred tank reactor-plug flow reactor - flowcharts, layout, PID, hydraulic profile		
MODULE II	**CONVENTIONAL AEROBIC TREATMENT PROCESSES**	**12 Hours**
Design of sewage treatment plant units –activated sludge process and variations-trickling filters- bio tower-BC- fluidized bed reactors, aerated lagoons, waste stabilization ponds– natural treatment systems, constructed wetland - disposal options – reclamation and reuse – recent trends.		
MODULE III	**ADVANCED AEROBIC TREATMENT PROCESSES OF WASTEWATER**	**12 Hours**
Sequencing batch reactors- moving bed biofilm reactors- membrane bioreactor- reclamation and reuse of wastewater-design of tertiary treatment units-application of membrane separation technologies in reuse of sewage -case studies		
MODULE IV	**ANAEROBIC TREATMENT OF WASTEWATER**	**12 Hours**
Attached and suspended growth process -design of units–UASB – post treatment systems for UASB reactor-anaerobic filters – expanded bed and fluidized bed anaerobic systems -septic tank and soil disposal system - anaerobic baffled reactor–anaerobic sludge digestion process -types of anaerobic sludge digesters – design of low rate and high rate anaerobic digestors- recent trends.		
MODULE V	**NUTRIENT REMOVAL SYSTEMS**	**12 Hours**
Nutrients in wastewater –significance - nitrification and denitrification-nitrogen removal systems – anaerobic ammonium oxidation (ANAMMOX) - Reactors for ANAMMOX process development - Polyphosphate-accumulating organisms (PAOs)–anaerobic and aerobic metabolism of phosphorus in phosphate accumulating bacteria -enhanced biological phosphorus removal (EBPR) –recent trends – case studies.		
TOTAL: 60 Hours		

REFERENCES:

1. *ArceivalaS.J., and Asolekar S.R" Wastewater Treatment for Pollution Control and reuse" McGraw Hill, third Edition, New Delhi, 2007.*
2. *Manual for "Sewerage and Sewage Treatment Systems", PART- A, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.*
3. *Metcalf & Eddy, Inc., George Tchobanoglous, Franklin L. Burton and H. David Stensel, Wastewater engineering, treatment and reuse, Fourth Edition, McGraw-Hill, 2017*
4. *Qasim, S. R. and Guang Zhu "Wastewater Treatment and Reuse. Theory and Design Examples", CRC Press, New York, 2018.*
5. *F.R. Spellman, "Handbook of Water and Wastewater Treatment Plant operations", CRC Press, New York2020.*

2402EV202	SOLID WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

PREREQUISITE:

Chemistry, Biology, Environmental Science

COURSE OBJECTIVES:

The objective of the course is to prepare students to contribute to the development and implementation of sustainable solid waste management strategies, addressing the environmental and public health challenges posed by waste.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1:	Identify and discuss solid and hazardous waste management, including legal, health, safety, cultural, and stakeholder responsibilities.
CO2:	Analyze solid and hazardous waste kinds, evaluate causes driving variance, and evaluate waste treatment and disposal systems.
CO3:	Design the system and process for waste minimization, storage, collection, transport, recycling, processing, and disposal.
CO4:	Choose sustainable techniques for processing and disposing of solid and hazardous waste, considering their impact on sustainability.
CO5:	Conduct solid and hazardous waste management research, interact effectively with stakeholders, and learn independently throughout life.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2			3	3					
CO2	3	3	2			3	3					
CO3	3	3	2			3	3					
CO4	3	3	2			3	3					
CO5	3	3	2			3	3					

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	3	2	-
CO3	3	2	-
CO4	3	2	-
CO5	3	2	-

COURSE CONTENTS:

MODULE I	WASTE CLASSIFICATION AND REGULATORY REQUIREMENTS	9 Hours

Sources and types of solid and hazardous waste - need for solid and hazardous waste management – salient features of latest Indian legislations on management and handling of solid wastes, hazardous wastes, Plastic

wastes, biomedical wastes, electronic wastes, construction and demolition wastes, plastics and discarded lead acid batteries – elements of integrated waste management and roles of stakeholders - seven elements and seven step approach to integrated solid waste management planning.		
MODULE II	**WASTE CHARACTERIZATION, SOURCE REDUCTION AND RECYCLING**	**9 Hours**
Waste sampling and characterization plan - waste generation rates and variation – physical composition, chemical and biological properties – hazardous characteristics – ignitability, corrosivity and TCLP tests – source reduction, segregation and onsite storage of wastes – waste exchange - extended producer responsibility - recycling of plastics, Micro plastics, C&D wastes and E wastes.		
MODULE III	**WASTE COLLECTION, TRANSPORT AND MATERIAL RECOVERY**	**9 Hours**
Door to door collection of segregated solid wastes -analysis of hauled container and stationery container collection systems - compatibility, storage, labeling and handling of hazardous wastes – principles and design of transfer and transport facilities - hazardous waste transport and manifests - mechanical processing and material separation technologies – Size reduction – size separation - density separation - magnetic separation – compaction – principles and design of material recovery facilities – physico chemical treatment of hazardous wastes - solidification and stabilization – E-waste kiosks - case studies on waste collection and material recovery.		
MODULE IV	**BIOLOGICAL AND THERMAL PROCESSING OF WASTES**	**9 Hours**
Biological and thermo chemical conversion technologies – composting – bio methanation – incineration – pyrolysis- plasma arc gasification –principles and design of biological and thermal treatment facilities - MSW processes to energy with high-value products and specialty BY-Products - operation of facilities and environmental controls - treatment of biomedical wastes – case studies and emerging waste processing technologies.		
MODULE V	**WASTE DISPOSAL**	**9 Hours**
Sanitary and secure landfills - components and configuration– site selection - liner and cover systems - geo synthetic clay liners and geo membranes - design of sanitary landfills and secure landfill leachate collection, treatment and landfill gas management – landfill construction and operational controls - landfill closure and environmental monitoring – landfill bioreactors – rehabilitation of open dumps and biomining of dumpsites-remediation of contaminated sites- Case studies.		
		TOTAL: 45 HOURS

REFERENCES:

1. *George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill India, First edition, 2015*
2. *William A. Worrell, P. Aarne Vesilind, Christian Ludwig, Solid Waste Engineering - A Global Perspective, 3rd Edition, Cengage Learning, 2017.*
3. *Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York,2010*
4. *John Pitchtel, Waste Management Practices, CRC Press, Taylor and Francis Group,2014*
5. *CPHEEO, "Manual on Municipal Solid waste management, Vol I, II and III, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2016.*

2402EV203	ENVIRONMENTAL IMPACT AND RISK ASSESSMENT	L	T	P	C
		3	0	0	3

PREREQUISITE:

	Environmental Science & Statistics

COURSE OBJECTIVES:

	To equip students with the knowledge and skills necessary to assess the potential environmental impacts and risks associated with proposed projects and activities, enabling them to make informed decisions and contribute to sustainable development.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1:	Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles
CO2:	Understand various impact identification methodologies, prediction techniques and model of impacts on various environments
CO3:	Understand relationship between social impacts and change in community due to development activities and rehabilitation methods
CO4:	Document the EIA findings and prepare environmental management and monitoring plan
CO5:	Identify, predict and assess impacts of similar projects based on case studies

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2			3	3					
CO2	3	3	2			3	3					
CO3	3	3	2			3	3					
CO4	3	3	2			3	3					
CO5	3	3	2			3	3					

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	3	-
CO2	3	3	-
CO3	3	3	-
CO4	3	3	-
CO5	3	3	-

COURSE CONTENTS:

MODULE I	INTRODUCTION	9 Hours

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance-EIA in project cycle. legal and regulatory aspects in India – types and limitations of EIA –EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

MODULE II	**IMPACT INDENTIFICATION AND PREDICTION**	**9 Hours**
Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment		
MODULE III	**SOCIO-ECONOMIC IMPACT ASSESSMENT**	**9 Hours**
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation.		
MODULE IV	**EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN**	**9 Hours**
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment and Case Studies.		
MODULE V	**ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT**	**9 Hours**
Environmental risk assessment framework-Hazard identification -Dose Response Evaluation - Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs		
		TOTAL: 45 HOURS

REFERENCES:

1. *BEIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India.*
2. *Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India.*
3. *Canter, L.W., Environmental Impact Assessment, McGraw Hill, New York. 1996.*
4. *Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, Wiley-Interscience, New Jersey. 2003.*
5. *Lee N. and George C. 2000. Environmental Assessment in Developing and Transitional Countries. Chichester: Willey.*

2403EV003	CIRCULAR ECONOMY	L	T	P	C
		3	0	0	3

PREREQUISITE:

	Environmental Science

COURSE OBJECTIVES:

	Identify and critically discuss the connection between linear/circular economies and environmental sustainability generally and between circular economies and SDG 12 specifically.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1:	Compare linear and circular economic models. Core circular economic principles and their relationship to sustainability and the SDGs will also be understood.
CO2:	Develop and evaluate diverse circular business models, applying them to real-world scenarios to create economically viable and environmentally sustainable solutions.
CO3:	Make use of the right measurements and methods to quantify circularity, analyze the environmental and economic implications of circular economy plans, and critically evaluate measurement frameworks.
CO4:	Analyze and evaluate diverse business models that implement circular economy principles and develop strategies for businesses to effectively transition towards circular practices.
CO5:	Examine circular economy concepts' ability to address global concerns and improve economic, social, and environmental well-being in varied development situations.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1			3	3					
CO2	3	2	1			3	3					
CO3	3	2	1			3	3					
CO4	3	2	1			3	3					
CO5	3	2	1			3	3					

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	3	2	-
CO3	3	2	-
CO4	3	2	-
CO5	3	2	-

COURSE CONTENTS:

MODULE I	INTRODUCTION	9 Hours

Linear economy- General principles of sustainability and the SDGs- Principles of Circular Economies – Life Cycle Analysis- Biomimicry, the sharing economy, cradle-tocradle, and the roots/genealogies - conceptual frameworks of circular economies.

MODULE II	**BUSINESS MODELS FOR CIRCULAR ECONOMY**	**9 Hours**
Create value by reusing/recycling - Industrial designs provide smarter solutions- Offering products as "service" rather than selling products - Transferring ownership to consumers - Business model for Circular Economy.		
MODULE III	**MEASUREMENTS AND METRICS**	**9 Hours**
Carbon footprint of any given product or service- Review Life Cycle Assessments - Review the case for proximity and appropriate scale in the design of production-trade consumption networks- Case studies include biofuels from the production of palm oil and the manufacture of mobile phones.		
MODULE IV	**BUSINESSES ADOPTING CIRCULAR ECONOMY MODELS**	**9 Hours**
Businesses adopt circular economy models for specific sectors - food & agriculture, mining & minerals, transport & cycling, fashion & textiles, consumer electricals & electronics and industrial manufacturing (furniture).		
MODULE V	**CIRCULAR ECONOMIES AND DEVELOPMENT**	**9 Hours**
Current Global scenario of adoption of circular economies in development economies - Transitions to Circular Economies - Economic anthropology on exchange, circulation and flows of materials in specific societies- circular economies in space and time.		
		TOTAL: 45 HOURS

REFERENCES:

1. *Angelis, Roberta De (2018) Business Models in the Circular Economy: Concepts, Examples and Theory (Palgrave)*
2. *Weetman, Catherine (2016) A Circular Economy Handbook for Business and Supply Chains (Kogan Page)*
3. *United Nations Sustainable Development Goals (2015)*
4. *The Age of Sustainable Development, Sach,2015*

2403EV008	ENVIRONMENTAL LEGISLATION AND MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

PREREQUISITE:

	Environmental Science

COURSE OBJECTIVES:

	To impart knowledge on policies, legislation, institutional framework and enforcement mechanisms for environmental management in India.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1:	Explain the constitutional and legal framework for environmental protection in India, including key national policies and principles.
CO2:	Discuss the Water (Prevention and Control of Pollution) Act, 1974, encompassing regulatory agency jurisdictions, obligations of occupiers, consent protocols, legal sample methodologies, and enforcement mechanisms.
CO3:	Elucidate the Air (Prevention and Control of Pollution) Act, 1981, detailing the authorities of regulatory agencies, obligations of occupiers, permission protocols, legal sampling methodologies, and enforcement mechanisms for air pollution control.
CO4:	Describe the Environment (Protection) Act 1986, EIA, waste management, pollution control, and stakeholder responsibilities.
CO5:	Exhibit comprehension of pertinent Indian legal statutes and judicial mechanisms of environmental preservation, encompassing forest legislation, liability insurance, criminal proceedings, and significant Supreme Court rulings.

COs Vs POs MAPPING:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1			3	3					
CO2	3	2	1			3	3					
CO3	3	2	1			3	3					
CO4	3	2	1			3	3					
CO5	3	2	1			3	3					

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	2	-
CO2	3	2	-
CO3	3	2	-
CO4	3	2	-
CO5	3	2	-

COURSE CONTENTS:

MODULE I	INTRODUCTION	9 Hours

Indian Constitution and Environmental Protection – National Environmental policies – Precautionary

Principle and Polluter Pays Principle – Concept of absolute liability – multilateral environmental agreements and Protocols – Montreal Protocol, Kyoto agreement, Rio declaration– Environmental Protection Act, Water (P&CP) Act, Air (P&CP) Act – Institutional framework (SPCB/CPCB/MoEF).		
MODULE II	**WATER (P&CP) ACT, 1974**	**9 Hours**
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.		
MODULE III	**AIR (P&CP) ACT, 1981**	**9 Hours**
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation		
MODULE IV	**ENVIRONMENT (PROTECTION) ACT 1986**	**9 Hours**
Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorization – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards		
MODULE V	**OTHER ACTS**	**9 Hours**
Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation – Writ petitions - Supreme Court Judgments in Landmark cases.		
		TOTAL: 45 HOURS

REFERENCES:

1. *CPCB "Pollution Control acts, Rules and Notifications issued there under "Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.*
2. *Greger I.Megregor "Environmental law and enforcement", Lewis Publishers, London. 1994.*
3. *Shyam Divan and Armin Roseneranz "Environmental law and policy in India "Oxford University Press, New Delhi, 2001.*

2402EV204	MODULE OPERATIONS & PROCESS LABORATORY	L	T	P	C
		0	0	4	2

PREREQUISITE:

	Basic Chemistry Laboratory

COURSE OBJECTIVES:

	To provide students with a comprehensive understanding of water and wastewater treatment processes, enabling them to design, operate, and maintain efficient and sustainable water and wastewater treatment systems.
	Students will gain knowledge of fundamental principles, practical skills, and the ability to apply advanced technologies to address water quality challenges and ensure public health.

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1:	Apply the principles of coagulation and flocculation to improve water quality parameters such as turbidity, color, and organic matter.
CO2:	Design and operate sedimentation tanks to effectively remove suspended solids from water.
CO3:	Select appropriate filter media and design filtration units to remove suspended solids, turbidity, and other contaminants from water.
CO4:	Design and operate reverse osmosis systems to produce high-quality drinking water and industrial process water.
CO5:	Apply advanced oxidation processes such as ozonation and photocatalysis to remove refractory organic pollutants and disinfection by-products from water.

COs Vs POs MAPPING:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	3	2	1	3	3					
CO2	3	3	3	2	1	3	3					
CO3	3	3	3	2	1	3	3					
CO4	3	3	3	2	1	3	3					

COs Vs PSOs MAPPING:

COs	PSO1	PSO2	PSO3
CO1	3	3	-
CO2	3	3	-
CO3	3	3	-
CO4	3	3	-

LIST OF EXPERIMENTS:

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

10. Disinfection for Drinking water
TOTAL: 60 HOURS
REFERENCES:
1. *Metcalf and Eddy. Inc. „Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.*
2. *Lee, C.C. and Shun dar Lin. Handbook of Environmental Engineering Calculations, McGraw Hill, New York, 1999.*
3. *Casey T.J., Module Treatment Processes in Water and Wastewater Engineering, John Wileys Sons, London, 1993.*
4. *David W.Hendricks, „Water Treatment Module Processes: Physical and Chemical", CRC Press, Boca Raton, 2006.*