

Walchand College of Engineering

Vishrambag, SANGLI-416415

(Government Aided Autonomous Institute)



Syllabus

M. Tech. Civil (Environmental Engineering)

With Effect From

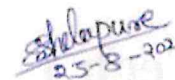
Academic Year

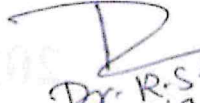
2023-24 (F. Y. M. Tech.)


B. R. Kavathekar

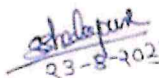


Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)					
AY 2023-24					
Course Information					
Program		M. Tech. All Branches			
Class, Semester		First Year M. Tech., Semester I			
Course Code		7IC501			
Course Name		Research Methodology and IPR			
Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs/week	MSE	ISE	ESE	Total
Tutorial	---	30	20	50	100
Credits: 3					
Course Objectives					
1	To prepare students for undergoing research, identify and formulate the research problems, state the hypothesis, design a research layout, set a research process and methodology.				
2	To enable student interpret the results, propose theories, suggest possible/alternative solutions, solve, and prove the solution adapted-logically and analytically, conclude the research findings.				
3	To impart knowledge to analyze critically the literature and publish research in conferences, journals and to expose students to research ethics, IPR and Patents				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	Demonstrate a research solution in respective engineering domain using appropriate Engineering research process and research methodology.				Apply
CO2	Devise feasible solution to a research problem in respective engineering domain based on economic, social and legal aspects using appropriate research procedures and practices.				Analyze
CO3	Write research publication, Dissertation, IPR and patent document.				Create
Module	Module Contents				Hours
I	Engineering Research Process Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Definition, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.				6
II	Research Methodology Problem statement formulation, resources identification for solution, Experimental and Analytical modelling, Simulations, Numerical and Statistical methods in engineering research. Hypothesis and its testing by different techniques: Z-test etc.,				6
III	Research Methods Uni and Multivariate Analysis: ANOVA, Design of Experiments/Taguchi Method, Regression Analysis. Software tools like spreadsheets. Processing and Analysis of Data: Processing Operations, Types of Analysis-Presentation and Interpretation of Data Editing, Classification and Tabulation-				7


 25-8-2023
 Dr. S.S. Solapur
 Associate Professor (IT)


 Dr. R.S. Desai
 23/8/2023
 Applied Mechanics Dept
 Dr. R. K. Kulkarni

	Interpretation. Analyse your results and draw conclusions.	
IV	Research Practices Effective literature studies approaches, critical analysis, Plagiarism, Research ethics, Mendeley - Reference Management Software. Research communication- Effective Technical Writing, Writing a research article for Journal/conference paper, Technical report, Dissertation/ Thesis report writing, Software used for report writing such as WORD, Latex etc. Presentation techniques for paper/report/seminar. Publishing article in Scopus/SCI/Web of science indexed journal or conference.	7
V	Intellectual Property Rights (IPR) Nature of Intellectual Property: Patents, Designs, Trade and Copyright, Ownership of copyright, Term of copyright, Technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. New developments in IPR, Traditional knowledge ,Various Case Studies.	7
VI	Patents Patent Rights: Scope of Patent Rights. Various Patent databases. Geographical Indications. Procedure for grants of patents, Patenting under PCT. Licensing and transfer of technology. Administration of Patent System. Introduction to International Scenario: WIPO, TRIPs, Patenting under PCT	6
Textbooks		
1	Kothari C. R, "Research Methodology", 2nd Edition, New Age International, 2004	
2	Melville Stuart and Goddard Wayne, "Research Methodology: An Introduction for Science & Engineering Students" Juta and Company Ltd, 2000.	
3	Kumar Ranjit, "Research Methodology: A Step-by-Step Guide for beginners", SAGE Publications, 4 th Ed.-2014.	
References		
1	Merges Robert, Menell Peter, Lemley Mark, "Intellectual Property in New Technological Age", ASPEN Publishers, 2016.	
2	Ramappa T., "Intellectual Property Rights Under WTO", S. Chand, 2008	
3	Mayall, "Industrial Design", McGraw Hill, 1992.	
4	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007	
5	Deepak Chopra and Neena Sondhi, Research Methodology : Concepts and cases, Vikas Publishing House, New Delhi	
Useful Links		
1	NPTEL :: General - NOC: Introduction to Research	
2	Introduction to Research - Course (nptel.ac.in)	
3	Qualitative Research Methods And Research Writing - Course (nptel.ac.in)	
4	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing	
5	https://www.scopus.com/search/form.uri?display=basic#basic	
6	https://onlinecourses.nptel.ac.in/noc21_ge12/preview - Qualitative Research Methods And Research Writing	
7	https://onlinecourses.nptel.ac.in/noc21_hs44/preview - Effective Writing	
8	https://webofscienceacademy.clarivate.com/learn	


 23-8-2023
 D. S. S. Solapure
 Associate professor (IT)

9	https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing
10	https://nptel.ac.in/courses/121/106/121106007/
11	https://www.wipo.int/about-wipo/en/

CO-PO Mapping						
Programme Outcomes (PO)						
	1	2	3	4	5	6
CO1	3		1			
CO2			2	3	2	
CO3		3		2		2

The strength of mapping is to be written as 1: Low, 2: Medium, 3: High
Each CO of the course must map to at least one PO.

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>

Solapur
28-8-2023
Dr. S. S. Solapur
Associate Professor (IT)
Dept.

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester I
Course Code	7EV501
Course Name	Physico-Chemical Methods for Water and Wastewater Treatment
Desired Requisites:	Water and Wastewater Treatment

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					

Course Objectives

1	To provide in-depth knowledge of unit operations and processes for the treatment of water and wastewater.
2	To impart technical competency for analysis, evaluation and design of physical and chemical treatment systems for water and wastewater.
3	To inculcate aptitude for research, and consultancy.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to

CO1	<i>Explain</i> and <i>apply</i> the concepts of unit operations and processes for physical and chemical treatment of water and wastewater.	Understanding Applying
CO2	<i>Analyze</i> and <i>evaluate</i> the physical and chemical treatment systems used in water and wastewater.	Analyzing Evaluating
CO3	<i>Design</i> physical and chemical treatment systems for water and wastewater.	Creating

Module	Module Contents	Hours
I	Transport phenomena and Reaction kinetics Review of conventional unit operations and processes in water and wastewater treatment, Transport processes, Kinetics and Reaction rates, System material balance, Hydraulic transport flow regimes, Reactor Engineering (CMBR, CMFR, CMFRS, PFR, PFRD), Processes and rates of gas transfer	7
II	Aeration, mixing and Settling Types of aerators, Design of gravity aerators Coagulation and flocculation, Stability and destabilization of colloids, Transport of colloidal particles, Design of rapid and slow mix units Types of settling, Design of sedimentation tanks, Tube settler, Grit chamber (horizontal flow and aerated)	8
III	Filtration Gravity and pressure filtration, filter hydraulics, Analysis of filtration process, Backwash hydraulics, Rate control patterns and methods, Design of dual media and pressure filter	5
IV	Adsorption and Ion exchange Causes and Types of adsorption, Adsorption equilibria and adsorption isotherm, Process, Analysis and design of batch and continuous flow activated carbon adsorber Ion Exchange process, Exchange materials and capacity, Exchange reactions, Design and operation of softener for hardness and TDS removal	8

V	Membrane filtration Membrane separation processes, Design and operation of Reverse osmosis, Ultrafiltration, and Electrodialysis. Membrane fouling: Causes, and Control.	7
VI	Disinfection Kinetics of disinfection Ozone disinfection: Chemistry, System components, Modeling. UV disinfection: Source, System components, Estimation of UV dose. Principles and theories of Chemical oxidation.	5
Textbooks		
1	Peavy H, S, Rowe D, R, and Tchobanoglous G, " <i>Environmental Engineering</i> ", McGraw-Hill Book Company, Indian edition 2017.	
2	Metcalf and Eddy " <i>Wastewater Engineering Treatment and Reuse</i> ", Tata McGraw Hill Publication, Indian Edition 2017.	
3	Davis, M, L, and Cornwell, D, A, " <i>Introduction to Environmental Engineering</i> ", Tata McGraw Hill Publishing Company, Special Indian Edition, 2010.	
4	Unit Operations and Processes in Environmental Engineering, 2nd Edition, by Tom D. Reynolds and Paul A. Richards, PWS Publishing Company, 1995.	
References		
1	Droste, Ronald L " <i>Theory and Practice of Water and Wastewater Treatment</i> ", Wiley student Edition, 2009.	
2	Weber W, J, " <i>Physico-Chemical Processes of Water quality control</i> ", Wiley-Interscience, 1994.	
3	Sincero A, P and Sincero G, A, " <i>Environmental Engineering A Design approach</i> ", PHI learning private limited, 2004.	
4	Quasim, S. R., Motley E, M, and Zhu G, " <i>Water works engineering</i> ", PHI learning private limited, 2000.	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2				3		
CO3						3

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>

Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)					
AY 2023-24					
Course Information					
Programme	M. Tech. Civil (Environmental Engineering)				
Class, Semester	First Year M. Tech., Semester I				
Course Code	7EV502				
Course Name	Municipal Solid Waste Management				
Desired Requisites	A graduate level course in Environmental Engineering				
Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					
Course Objectives					
1	Provide knowledge on functional elements of MSWM.				
2	Impart basic skills for design and operation of MSWM systems.				
3	Have overview of MSW rules and Government initiatives.				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	<i>Recognize</i> fundamental elements of MSW and <i>summarize</i> practices for effective MSW management.				Remember Understand
CO2	<i>Apply</i> the fundamental elements of MSWM to <i>analyze</i> collection, transportation, and processing of MSW.				Apply Analyze
CO3	<i>Evaluate</i> processing and disposal system; and to <i>devise</i> suitable plans for rehabilitation of existing MSWM				Evaluate
Module	Module Contents				Hours
I	Municipal Solid Waste Sources and Characterization Sources, Types, Composition, Physical, Chemical and Biological properties. Solid Waste Management: Objectives, Functional elements, Environmental impact of mismanagement, Present scenario of municipal solid waste management in India				7
II	Solid Waste Generation Rate & Transfer Station Solid Waste Generation Rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Collection components, Types of collection systems and its design, Transportation of solid waste: Means and methods, Routing of vehicles. Transfer station: Need, Types, factors affecting Capacity, Location and economic Viability.				6
III	Waste Processing Techniques & Material Recovery and Recycling Waste Processing Techniques: Purpose, Mechanical volume and size reduction, component separation techniques. Material Recovery and Recycling: Objectives, Recycling program elements, Commonly recycled materials and processes. Energy recovery from solid waste: Parameters affecting, Fundamentals of thermal processing, Pyrolysis, Incineration, Refuse derived fuels, Energy recovery, case studies under Indian conditions.				7
IV	Recovery of Biological Conversion Products: Compost and Biogas				6

	Composting: Benefits, Processes, Stages, Technologies, Factors affecting properties of compost. Vermicomposting, Mechanical composting, In-vessel composting and Bio-methanation.	
V	Landfills Dumpsites: Problems associated with dumpsites, Management, Dumpsite rehabilitation, Bio-mining of dumpsites. Sanitary Landfills: Site selection, Types, Principle, Processes, Land filling methods, Design of a landfill facility, Landfill Liners, Leachate and landfill gas management, closure, post-closure plans.	7
VI	Overview of Municipal Solid Waste Rules and Government Initiatives Waste Management legislation in India, MSWM Rules 2016, Role of CPCB and SPCB in management of solid waste. Biomedical and Construction and Demolition Waste Management: Generation, Sources, Classification, Management technologies, Legislation.	7

Textbooks

1	Bhide. A. D. and Sundaresan. B. B., "Solid Waste Management", Indian National Scientific Documentation Centre, 1st Edition, 1983.
2	CPHEEO, "Manual on Municipal Solid waste management", Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000
3	Tchobanoglous G., "Integrated Solid Waste Management", Tata McGraw-Hill Publishing Company Limited, 1st Edition, 1993.

References

1	Vesilind, Worrell and Reinhart, "Solid Waste Engineering", Cengage Learning India Pvt. Ltd.,
2	Masters G., "Introduction to Environmental Engineering and Science", Pearson Education, 2004
3	Peavy, Rowe and Tchobanoglous, "Environmental Engineering", Tata McGraw-Hill Publishing Company Limited, 1st Edition, 1985.
4	"MSW Rules 2016", Swachh Bharat Mission and Smart Cities Program of India.

Programme Outcomes (PO)						
	1	2	3	4	5	6
CO1			3			
CO2				3		3
CO3				3		

Assessment

The assessment is based on MSE, ISE and ESE.
MSE shall be typically on modules 1 to 3.
ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.
ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester I
Course Code	7EV503
Course Name	Hydraulics of Transport Systems in Environmental Engineering
Desired Requisites:	Basic courses on hydraulics, water supply and sewerage

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					

Course Objectives

1	Provide in-depth knowledge of hydraulics for analysis and evaluation of transport systems in Environmental Engineering
2	Enhance the technical competency and apply the acquired knowledge for research and development, industry, and consultancy activities.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	<i>Explain</i> and <i>apply</i> hydraulics of environmental facilities	Understand Apply
CO2	<i>Analyze</i> the distribution and collection systems	Analyze
CO3	<i>Design</i> the distribution, collection and treatment facilities in environmental systems	Create

Module	Module Contents	Hours
I	<p>Pumped and Gravity Water Mains and Service Reservoirs <i>Review of closed conduit hydraulics:</i> Continuity and Energy equation, Head loss calculations. <i>Sizing water mains:</i> Classification of problems, Design flow, Design of pumped and gravity system of water mains, Concept of Optimal design, Economic design of pumped and gravity water mains. <i>Pumping system:</i> Design of water pumping system.</p>	7
II	<p>Water Distribution System (WDS): Analysis and Design <i>Water Distribution System (WDS):</i> Types of networks, Water demand allocation, Types of problem, Network hydraulics, Types of simulation, Flow, node and loop equations <i>Analysis and Design of WDS:</i> Hardy-Cross method, Linear theory, and Newton-Raphson methods, <i>Hydraulic design of Service Reservoirs:</i> Necessity, Components, Location, Capacity requirements</p>	8
III	<p>Testing, Calibration and Leak Detection for Water Distribution System <i>WDS testing:</i> Fundamentals, Pressure and flow measurement. <i>Calibration:</i> Concept, Parameters, Approaches. <i>Pipe breaks and water loss:</i> Causes, Leak detection, Loss of carrying capacity of pipes, Appurtenances in WDS</p>	5
IV	<p>Sanitary Sewerage System <i>Review of sewer hydraulics:</i> Velocity of flow, Hydraulic formulae, Gradient,</p>	7

	types of sewers. <i>Design of sanitary sewerage system:</i> Estimation of design flow, Design considerations, Procedure, Design of sanitary sewer system.	
V	Storm water Drainage System: System Components and Rainfall Modeling Need and design objectives of storm water conveyance system, Hydrologic and Hydraulic Components, Basic Rainfall Characteristics, Obtaining Rainfall Data, Types of Rainfall Data, Rainfall Requirements for Modeling Runoff	5
VI	Storm water Drainage System: Modeling Runoff and Design Rainfall Abstractions, Determination of Effective Precipitation (Runoff), Basin Response Time, Peak flow estimation by rational and SCS method. Storm Sewer Types, Components, and Materials, Alignment of Storm Sewers, Initial and Final Pipe System Design, Outfall Design and Energy Dissipation, Hydraulic analysis of roadway gutter and inlets	8

Textbooks

1	Garg S. K., "Water Supply Engineering", Khanna Publishers, 35 th Edition, 2018.
2	Garg S. K., "Sewage Disposal and Air pollution Engineering", Khanna Publishers, 41 st Edition, 2021.
3	Subramnaya K., "Engineering Hydrology", McGraw Hill Education, 4 th Edition, 2017.

References

1	"Manual on Water Supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2	"Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
3	"Manual on Storm Water Drainage Systems", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2019.
4	Walski, Chase and Savic, "Water Distribution Modeling", Haestad Press, 1 st Edition, 2007.
5	Haestad-Durrans, "Storm Water Conveyance Modeling and Design", Haestad Press, 1 st edition, 2003.

Useful Links

1	https://www.youtube.com/channel/UCbFIgNot42PRCi-05X8aF_A
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CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2				3		
CO3				2		3

Assessment

The assessment is based on MSE, ISE and ESE.

MSE shall be typically on modules 1 to 3.

ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.

ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)					
AY 2023-24					
Course Information					
Programme	M. Tech. Civil (Environmental Engineering)				
Class, Semester	First Year M. Tech., Semester I				
Course Code	7EV551				
Course Name	Environmental Chemistry and Microbiology Laboratory				
Desired Requisites:	-				
Teaching Scheme		Examination Scheme (Marks)			
Practical	2 Hrs./ Week	LA1	LA2	Lab ESE	Total
Interaction	-	30	30	40	100
Credits: 1					
Course Objectives					
1	To provide basic knowledge of environmental chemistry and microbiology for the treatment of water, wastewater and solid waste.				
2	To provide hands-on practice for analyzing the water and wastewater by physical, chemical and instrumental methods.				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	<i>Apply</i> physical, bio-chemical and advanced instrumental methods for water and wastewater analysis.				Apply
CO2	<i>Analyze</i> data acquired from the experiments.				Analyze
List of Experiments / Lab Activities/Topics					
List of Lab Experiments:					
I. Physical and bio-chemical analysis of water:					
a. Review of basic experiments: pH, Acidity and Alkalinity, Electrical conductivity, Hardness, Chlorides					
b. Solids					
c. Dissolved organic matter by BOD and COD					
d. Total Kjeldahl Nitrogen (TKN)					
e. Nitrate and Sulphate					
f. Fluoride					
g. Iron and Manganese (Spectrophotometer)					
h. Most Probable Number (MPN)					
II. Instrumental Methods:					
Study and use of					
i. Atomic Absorption Spectrophotometer					
j. Flame photometer					
k. Spectrophotometer					
Demonstration of					
a. TOC Analyzer					
b. Gas Chromatograph					
c. Zeta meter					
d. CHNS Analyzer					
Textbooks					
1	Sawyer C.N. and McCarty P.L., "Chemistry for Environmental Engineers", Tata McGraw-Hill				

	Publishing Company Limited, 5 th Edition, 2003.
2	Mohapatra P. K., "Textbook of Environmental Microbiology", I. K. International Publishing House Pvt. Ltd., Reprint 2013.
3	Peavy H. S., Rowe D. R. and Tchobanoglous G, "Environmental Engineering", McGraw-Hill book company, 1 st Edition, 2013.
References	
1	VanLoon G. W. and Duffy S. J., "Environmental Chemistry: A Global Perspective", Oxford University Press, Indian Edition, Reprint 2011.
2	Pelczar Jr., M. J. E. C. S. Krieg, R. Noel., and Pelczar M. F., "Microbiology", Tata McGraw Hill Publishing Company Limited, Reprint 2012.
3	American Public Health Association (APHA), "Standard Methods for the Examination of Water and Wastewater", 23 rd Edition, 2017.
4	Metcalf and Eddy "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, 6 th Reprint. 2003.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2			2	3		
CO3			2	2		

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE.				
IMP: Lab ESE is a separate head of passing. (min 40 %), LA1+LA2 should be min 40%				
Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

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Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)					
AY 2023-24					
Course Information					
Programme	M. Tech. Civil (Environmental Engineering)				
Class, Semester	First Year M. Tech., Semester I				
Course Code	7EV552				
Course Name	Water Treatability Studies Laboratory				
Desired Requisites:	Physico-Chemical Methods for Water and Wastewater Treatment				
Teaching Scheme		Examination Scheme (Marks)			
Practical	2 Hrs./ Week	LA1	LA2	Lab ESE	Total
Interaction	-	30	30	40	100
Credits: 1					
Course Objectives					
1	To provide exposure to the techniques and tools for the design and conduct of the experiments.				
2	To provide an opportunity to contribute individually/ in groups to the development of experimental set ups by applying the acquired technological knowledge.				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	<i>Design</i> experiments by applying the acquired knowledge on techniques and tools.				Create
CO2	<i>Carry out</i> experimental studies for characterization, parameter estimation, and performance evaluation independently and in teams.				Apply
CO3	<i>Analyze, critique,</i> and <i>interpret</i> experimental results through application of modern engineering tools and <i>conclude</i> based on the results.				Analyze Evaluate
List of Experiments / Lab Activities/Topics					
List of Lab Experiments:					
1. Determination of order and rate of reaction/mass transfer parameter using CMBR					
2. Flow measurement by ultrasonic flow meter					
3. Use of natural and chemical coagulant/s for the turbidity, and colour removal					
4. Settling column studies for discrete and flocculent dilute suspensions					
5. Physical and chemical characteristics of sand as filter media					
6. Determination of head loss in depth filter					
7. Development of adsorption isotherm with activated carbon					
8. Determination of exchange capacity of resin					
9. Use of resin for hardness removal					
10. Chlorination study on raw, filtered and distributed water					
Textbooks					
1	Peavy H, S, Rowe D, R, and Tchobanoglous G, "Environmental Engineering", McGraw-Hill Book Company, International edition, 1985.				
2	Metcalf and Eddy "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, 6 th Reprint, 2003.				

3	"Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, GoI, New Delhi, 1999.
References	
1	Sincero A, P and Sincero G, A, "Environmental Engineering A Design approach", PHI learning private limited, 2004.
2	Sawyer and McCarty, "Chemistry for Environmental Engineers", Tata McGraw Hill, 5 th Edition, 2003.
3	Clesceri, L. S., Greenberg, A. E. and Eaton, A. D. (Eds), Standard Methods for the Examination of Water and Wastewater, Washington, D.C., 21 st Ed., 2001.
4	Quasim, S. R., "Water treatment plants planning, design and operation", CRC Press, 2 nd Edition, 2010
Useful Links	
1	https://www.youtube.com/watch?v=tA2nbDeueng
2	https://cwaterservices.com/treatment-plant-design-construction/water-treatability-studies/
3	http://www.environmentclearance.nic.in/writereaddata/online/EC/01042017OGDANQ0QTreatabiltyReport.pdf

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2			3			
CO3				3		

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE. IMP: Lab ESE is a separate head of passing. (min 40 %), LA1+LA2 should be min 40%				
Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

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Walchand College of Engineering, Sangli

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AY 2023-24

Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester I
Course Code	7EV553
Course Name	Modeling and Simulation Laboratory
Desired Requisites:	Hydraulics of Transport Systems in Environmental Engineering

Teaching Scheme		Examination Scheme (Marks)			
Practical	2 Hrs./ Week	LA1	LA2	Lab ESE	Total
Interaction	-	30	30	40	100
Credits: 1					

Course Objectives

- 1 Simulate/analyze/ Model complex environmental systems using Modern tools.
- 2 Design water and wastewater treatment, water distribution, drainage, storm water drainage systems using modern tools/software

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	<i>Analyze</i> environmental engineering related problems/systems by using Software and spreadsheets.	Analyze
CO2	<i>Design</i> water and wastewater treatment, water distribution, drainage, storm water drainage systems using modern tools and software	Create

List of Experiments / Lab Activities/Topics

List of Lab Activities:

1. Study and application of at least two software for simple case studies
 - a. Q-GIS
 - b. EPANET/WaterGEMS
 - c. SewerGEMS
 - d. HEC-RAS, HEC-HMS
 - e. AERMOD/HYSPLIT/UrbAirIndia
 - f. iNODE WTP
2. Development of simulation/analysis/design modules for at least one of following using spread sheet/C programming/MATLAB/VB
 - a. Water and wastewater treatment systems
 - b. Solid waste processing units
 - c. Air quality modeling, Emission inventory
 - d. Energy Efficient Buildings

Textbooks

1	Walski, Chase and Savic, "Water Distribution Modeling", Haestad Press, First edition, 2007.
2	Haestad-Durrans, "Storm water conveyance modeling and design", Haestad Press, 1st edition, 2003.
3	Peavy H, S, Rowe D, R, and Tchobanoglous G, "Environmental Engineering", McGraw-Hill Book Company, Indian edition 2017.

References

1	User manuals of EPANET/WaterGEMS and SewerGEMS
2	User manuals of HEC-RAS, HEC-HMS
3	User manuals of AERMOD/HYSPLIT/UrbAirIndia
4	User manual of iNODE WTP
Useful Links	
1	https://www.youtube.com/@HalHartQGIS
2	https://www.youtube.com/@bentleysystems
3	https://www.youtube.com/@HEC-RAS
4	https://www.youtube.com/@AERMODTraining

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1				2		2
CO2				2		2

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE.				
IMP: Lab ESE is a separate head of passing. (min 40 %), LA1+LA2 should be min 40%				
Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

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Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester I
Course Code	7EV511
Course Name	Professional Elective 1: Environmental Chemistry and Microbiology
Desired Requisites:	A course on chemistry at graduate level

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					

Course Objectives

- | | |
|----------|---|
| 1 | To provide in-depth knowledge of environmental chemistry and microbiology for the treatment of water, wastewater and solid waste. |
|----------|---|

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	<i>Explain</i> the basic concepts of environmental chemistry and microbiology of water and wastewater.	Understand
CO2	<i>Summarize</i> environmental significance of organic compounds and microorganisms.	Understand
CO3	<i>Apply</i> instrumental and microbiological methods for water and wastewater analysis.	Apply

Module	Module Contents	Hours
I	Introduction to General Chemistry and Physical Chemistry General chemistry: Nomenclature, Valency, Oxidation-reduction equations, Ionization, Solubility Product, Common ion effect. Physical chemistry: Enthalpy, Entropy, Vapour pressure	6
II	Introduction to Organic Chemistry and Biochemistry Organic chemistry: Environmental significance of different organic compounds viz. Aliphatic Compounds: Alcohols, Aldehydes and Ketones, Acids, Esters, Ethers, Halogenated aliphatic compounds, Compounds containing nitrogen. Aromatic Compounds: Hydrocarbons, Phenols, Alcohols, Aldehydes, Ketones and Acids, Compounds containing nitrogen, Heterocyclic compounds, Dyes, Detergents and Pesticides.	4
III	Instrumental Methods UV- visible, atomic absorption spectroscopy, flame photometry with reference to principle, instrumentation, calibration, working and applications in environmental analysis. Chromatography and its types. Mass spectroscopy and Gas chromatography with reference to principle, instrumentation, calibration, working and applications in environmental analysis.	10
IV	Introduction to Biochemistry Biochemistry of carbohydrates and Proteins, General biochemical pathways.	4
V	Introduction to Environmental Microbiology Groups of microorganisms, Major characteristics of microorganisms, Microbial classification, nomenclature and identification, Cell elements and composition, Cell	8

	and its composition, Cytoplasmic membrane, Prokaryotic cell division, Growth curve of bacteria, Enzymes and their regulation, Control of microorganisms by physical and chemical agents.	
VI	Water, Wastewater and Solid Waste Treatment using Microbiome Drinking water microbiology, Drinking water microbiome and treatment Bioremediation and wastewater microbiology, Bioremediation examples, Enhanced metal recovery. Solid waste microbiology, Landfills, Leachate anaerobic degradation phases.	8
Textbooks		
1	Sawyer C.N. and McCarty P.L., "Chemistry for Environmental Engineers", Tata McGraw-Hill Publishing Company Limited, 5 th Edition, 2003.	
2	Holler F. J. and Crouch S. R., "Skoog and West's Fundamentals of analytical Chemistry", Cengage Learning, 9 th Edition, 2012.	
3	Mohapatra P. K., "Textbook of Environmental Microbiology", I. K. International Publishing House Pvt. Ltd., Reprint 2013.	
References		
1	VanLoon G. W. and Duffy S. J., "Environmental Chemistry: A Global Perspective", Oxford University Press, Indian Edition, Reprint 2011.	
2	Pelczar Jr., M. J. E. C. S. Krieg, R. Noel., and Pelczar M. F., "Microbiology", Tata McGraw Hill Publishing Company Limited, Reprint 2012.	
3	Madigan, M., Bender K. S., Buckley D.H., Sattley W. M., and Stahl D.A., "Brock Biology of Microorganisms", 15 th Edition New York: Pearson, 2017.	
Useful Links		
1		

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2			2			
CO3			3	1		1

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>




Walchand College of Engineering, Sangli

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Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester I
Course Code	7EV512
Course Name	Professional Elective 1: Environmental Policies and Law
Desired Requisites:	-

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100

Credits: 2

Course Objectives

1	To acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective
2	To acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	<i>Interpret</i> laws, policies and judicial decisions in a general perspective	Applying
CO2	<i>Appraise</i> the role of law and policy in conservation and management of natural resources and prevention of pollution	Evaluating

Module	Module Contents	Hours
I	Environmental policies, organisational Structure and functions of department of environment and forest, Pollution control boards in centre and states	8
II	EPA Act 1986: Preliminary definitions, general powers of the central government, prevention, control, and abatement of environmental pollution	7
III	Water (prevention and control of pollution) act 1974, The environmental act 1986 and its amendments, Forest act 2006, Noise pollution rules 2022	7
IV	Air pollution act 1987, Indian forest act 1950 and other amendments, Major legislations – USEPA 1969 to clean water act 2022	8
V	Municipal wastes (management and handling) rules 2016, Hazardous Wastes (Management and Handling) Rules 1989, Biomedical waste (management and handling) rules 2016.	5
VI	Case studies of landmark judgments, Critical evaluation of current environmental risk management policy	5

Textbooks

1	Kamala S. and Singh U.K. (eds.) (2008) Towards Legal Literacy: An Introduction to Law in India, Oxford, New Delhi.
2	Desai A. (2002) Environmental Jurisprudence, 2nd ed., Modern Law House, Allahabad.
3	Shyam Diwan and Armin Rosencranz, <i>Environmental Law and Policy in India– Cases, Materials and Statutes</i> (2nd ed., 2001)

References	
1	Upadhyay S. and Upadhyay V. (2002) Hand Book on Environmental Law- Forest Laws, Wildlife Laws and the Environment; Vols. I, II and III, Lexis Nexis- Butterworths-India, New Delhi.
2	Sands P. (2002) Principles of International Environmental Law, 2nd edition, Cambridge.
3	Philippe Sands and Jacqueline Peel, <i>Principles of International Environmental Law</i> (4th ed., 2018).
Useful Links	
1	https://www.indiacode.nic.in/bitstream/123456789/4316/1/ep_act_1986.pdf
2	https://www.youtube.com/watch?v=aBkeecCKV64
3	https://www.youtube.com/watch?v=aekqi7dmJwQ
4	https://www.youtube.com/watch?v=0i848T0EdYk

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2					2	

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>





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Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester I
Course Code	7EV513
Course Name	Professional Elective 1: Advanced Numerical Methods
Desired Requisites:	All Courses in Mathematics for UG

Teaching Scheme

Examination Scheme (Marks)

Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100

Credits: 2

Course Objectives

This course intends to introduce various theoretical and practical aspects associated with numerical methods for environmental applications. It would help students to provide solutions to generic versions of equations that arise in the Environmental Engineering discipline.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Solve problems numerically related to non-linear equation, polynomials.	Applying
CO2	Solve problems numerically related to linear and nonlinear algebraic equations.	Applying
CO3	Solve problems related to numerical differentiation and integration.	Applying

Module	Module Contents	Hours
I	Introduction, roots of a non-linear equation and roots of a polynomial of n^{th} degree [incremental search method, method of successive approximations, Newton's method, bisection method, secant method, Müller's method, synthetic division, Bairstow's method and convergence study]	6
II	Solution of (non-homogeneous) linear algebraic equations, review of matrix algebra, Gauss elimination method, Cholesky's decomposition method, householder method, Gauss-Siedal iterative method	8
III	Solution of non-linear algebraic equations, method of successive approximation, Newton's method, modified Newton – Raphson method, secant method	6
IV	Eigen values and Eigen vectors, reduction of generalized Eigen value problem to the standard Eigen value problem, methods for obtaining Eigen values and Eigen vectors [polynomial method, vector iteration method, Mises power method, Jacobi method]	8
V	Time marching schemes for solution of problems in time domain, numerical integration (2 – D) [Newton – Cotes method, Gauss – Legendre method]	6
VI	Solution of ordinary and partial differential equations, Euler's method, Runge – Kutta method, finite difference method.	6

Textbooks

1	Chapra, S. C. and Canale R. P. (2003) , “ <i>Numerical Methods for Engineers</i> ”, Tata McGraw hill
2	Douglas Faires, J. and Richard Burden (2003), “ <i>Numerical Methods</i> ”, Thomson
	Charles Prochaska, Louis Theodore (2018), “ <i>Introduction to Mathematical Methods for Environmental Engineers and Scientists</i> ” Wiley

3	Rajasekaran, S. (1999) , “ <i>Numerical Methods in Science and Engineering</i> ”, S. Chand
References	
1	George F. Pinder (2018), “ <i>Numerical Methods for Solving Partial Differential Equations: A Comprehensive Introduction for Scientists and Engineers</i> ”, Wiley
2	E. Joseph Billo (2007),” <i>Excel for Scientists and Engineers - Numerical Methods</i> ”, Wiley-Interscience
Useful Links	
1	https://nptel.ac.in/courses/111106101

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1				3		1
CO2				3		1
CO3				3		1

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher’s assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>

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Walchand College of Engineering, Sangli					
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AY 2023-24					
Course Information					
Programme	M. Tech. Civil (Environmental Engineering)				
Class, Semester	First Year M. Tech., Semester I				
Course Code	7EV514				
Course Name	Professional Elective 2: Water Quality Modeling				
Desired Requisites:	Basics of hydraulics and water quality				
Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					
Course Objectives					
1	Impart in-depth knowledge of modelling /simulation of water quality in surface, and sub-surface sources.				
2	Enhance technical competency to deal with water quality issues in real life cases through modeling.				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	<i>Explain</i> and <i>apply</i> concepts of simulation/modeling for pollutant transport in surface and sub-surface sources of water.				Understand Apply
CO2	<i>Analyze</i> the processes contributing to water quality variations.				Analyze
CO3	<i>Apply</i> the knowledge of water quality for rejuvenation of lakes and streams				Apply
Module	Module Contents				Hours
I	Fundamentals of Water Quality Modeling Fundamentals: Concept of modeling, Model development, Types of models, Model sensitivity, Assessment of model performance, Movement of the contaminants in the environment Water quality in distribution system, Causes of variation, transport of constituents in pipe, chemical reactions, water quality simulations for source trace and water age.				6
II	Streams/Rivers and Estuaries Streams/Rivers and Estuaries: Dispersion and Mixing of pollutants, Estuary transport, Point and non-point/distributed sources of pollution, Application plug and mixed flow reactors (MFR) to streams with point and distributed sources, Spill models for plug and mixed flow system, Application of MFR model to estuaries.				6
III	Process of Water Quality Modeling Water quality modeling process, Modeling of organic pollution of stream, Streeter-Phelps equation for point, multiple point and distributed sources, Calibration, Modified/Total Streeter-Phelps equation, Anaerobic condition, Estuary Streeter-Phelps equation.				8
IV	Groundwater Pollution and Control Sources of groundwater pollution, Groundwater movement, Cone of Depression, Capture zone curve, Immiscible compounds, Processes in solute migration through porous media, Solute transport equation, Chemical reaction during transport, Sorption and retardation, Dupuit - Forchheimer theory of free surface flow, Control measures for contaminant plume, Hydrodynamic, physical, conventional pump and				8

	treat system, Soil vapour extraction with and without air sparging, In-situ bioremediation.	
V	Lakes Eutrophication problem in lakes and flowing water, Role of Carbon, Nitrogen and phosphorous, Phosphorus loading concept, Thermal stratification, Stratification and dissolved oxygen, Hydraulic behaviour of lakes, Effects of physical processes on water quality.	7
VI	Rejuvenation of Lakes and Streams Water Balance Study, Control of pollution in lakes, Methods of weed control, Bathymetry studies, Lake water quality monitoring. Methods of stream rejuvenation	5
Textbooks		
1	Tchobanoglous G. and Schroeder E. D., "Water Quality: Characteristics, Modeling and Modifications", Addison-Wesley publishing company, Reprint 1987.	
2	Chapra S., "Surface Water Quality Modeling", Tata Mc-Graw Hill, 1997.	
3	Walski, Chase and Savic, "Water Distribution Modeling", Haestad Press, First edition, 2007.	
References		
1	Lee C. C and Lin S. D., "Handbook of environmental engineering calculations", McGraw Hill Publication, 2 nd Edition 2007.	
2	Todd D. K., "Groundwater Hydrology", John Wiley & Sons, Second Edition, 2007.	
3	Metcalf and Eddy, "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, 6 th Reprint. 2003.	
Useful Links		
1	https://youtu.be/vvgqcDYLHUo	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2						3
CO3			3			

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>

Signature

Signature

Walchand College of Engineering, Sangli

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AY 2023-24

Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester I
Course Code	7EV515
Course Name	Professional Elective 2: Energy Efficient Buildings
Desired Requisites:	Nil

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					

Course Objectives

1	To introduce the scientific and engineering principles of energy.
2	To impart the integration of new materials and traditional techniques to bring about energy efficiency, cost effectiveness and environmental friendly technologies in construction industry.
3	Imparting the objective of environmental friendly, active and passive concepts during the construction and operational phases of building life cycle.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Grasp the language of energy in context to energy policies and interpret the relevance of environment and energy efficiency in context to non-renewable and renewable energy resources.	Applying
CO2	examine the energy contribution of various materials and components in buildings and develop an ability to justify appropriate/environmental friendly/energy efficient building systems	Analyzing
CO3	apply the concept of heat exchange in buildings and adopt passive and active design strategies to maximize human comfort in buildings for tropical regions	Applying

Module	Module Contents	Hours
I	Introduction to Energy Global warming, causes, energy considerations, energy conservation and energy efficiency, energy systems and spatial structures, Classification of energy, primary and secondary energy, commercial and non-commercial energy, renewable and nonrenewable energy, Global primary energy reserves and consumption, energy distribution, Units of Energy with examples	7
II	Conventional Materials and Techniques in Buildings Constraints in Choice of building systems, Pre & post construction performance, Properties of materials, Types of Physical, Mechanical, Chemical and Thermal characteristics, Introduction to structural and physical aspects of buildings, Conventional materials used in construction, Case studies of various building materials, Energy consumption in various building materials, Sustainability considerations	6
III	Energy and Environmental issues in Buildings General facts, energy resources and their impacts on environment, energy in context to built-environment, Sustainable buildings, sustainability and objectives of green buildings, Rating of Buildings- LEED & Griha, planning aspects of sustainable buildings, energy consumption and efficiency in buildings, Design	6

	strategies, Material strategies, Parametric assessment, Env. Issues related to buildings materials.	
IV	Sustainable Materials and Techniques for Masonry Felt requirements and real objectives of green towns, Energy scenario in pre and post independent India, Need and approach to sustainability, Green building materials, Design constraints. Appropriate materials and techniques in construction: Relevance of building blocks, mortars. Stabilized mud blocks, FAL-G blocks, Hollow concrete blocks, Calcium silicate bricks for masonry, Energy consumption and comparison in building blocks, energy estimates in masonry components.	7
V	Roofing Alternatives in Green Buildings Structural inefficiencies in Conventional roofing systems, Concepts in roofing alternatives, Thatch roofs, Filler slab roofs, Filler materials, Composite beam-panel roofs / floors, hollow hourdi/concrete block roofs / floors, Ferrocement roofing systems, Masonry Domes and Vaults, Rain water harvesting, Energy consumption in different roofing systems. Overall embodied energy comparisons in buildings.	7
VI	Energy systems in Building Maintenance Elements of climate, Factors influencing climate, Climate and human comfort, Orientation of buildings, Comfort criteria, Heat exchange in buildings, Concepts of Active and Passive Energy systems in Buildings, Use of modern gadgets leading to energy efficiency.	7

Textbooks

1	Alternative Building materials and Technologies by K.S. Jagadish, B.V.Venkatarama Reddy, K. S. Nanjunda Rao.
2	Sustainable Building Technologies, Editor :K S. Jagadish, Published by BMTPC, I.K. International Publishing House Pvt. Ltd.
3	Manual of tropical Housing and Building- Climatic Design by Koenigsberger, Ingersoll, Mayhew, Szokolay.

References

1	Renewable Energy: Power for Sustainable Future, Ed. By Godfrey Boyle, Oxford Univ. Press, Third Edition.
2	World Energy Investment Outlook- Special Report, International Energy Agency, London, 2014.

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2	2			2		
CO3	2					

Assessment

The assessment is based on MSE, ISE and ESE.

MSE shall be typically on modules 1 to 3.

ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.

ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)					
AY 2023-24					
Course Information					
Programme	M. Tech. Civil (Environmental Engineering)				
Class, Semester	First Year M. Tech., Semester I				
Course Code	7EV516				
Course Name	Professional Elective 2: Hazardous Waste Management				
Desired Requisites:	Wastewater and Industrial Waste treatment				
Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					
Course Objectives					
1	Provide in-depth knowledge of hazardous waste management.				
2	To enhance the technical competency and apply the acquired knowledge for research and development, industry, and consultancy activities.				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	<i>Explain</i> characterization, waste minimization, transportation, site remediation, and risk associated with hazardous waste.				Understand
CO2	<i>Explain</i> and <i>apply</i> the physical, chemical, and biological methods of treating hazardous waste.				Understand Apply
CO3	<i>Design</i> treatment and disposal facilities for hazardous waste.				Create
Module	Module Contents				Hours
I	Introduction to hazardous Waste Management Hazardous waste: Definition, Sources, Characterization, Classification, Magnitude of problem, Concept of toxicity, Assessment of sites.				6
II	Waste minimization and Treatment Waste minimization: Benefits, Approaches, Priorities in hazardous waste management, Resources recovery, Case studies. Treatment: Physical, Chemical and Biological treatment systems applicable for hazardous waste, Hazard in processing, Case studies of treatment.				7
III	Transportation of Hazardous Waste Transportation: Storage of hazardous waste, Regulations governing transporters, Containers, Bulk transport, Non-bulk transport, Hazardous substances emergency response.				7
IV	Disposal of Hazardous Waste Land fill disposal: Land fill as disposal sites, Siting, Designing, Closure, Case studies Injection well disposal: Classifications, Deep well injection, Case studies.				7
V	Site Remediation Site remediation: Site assessment and inspection, Hazard ranking system, Containment and treatment technologies, financial considerations, Case studies.				7
VI	Risk Assessment Risk Assessment: Process, Risk management, Hazardous waste management rules.				6

Textbooks	
1	LaGrega, M. D., Buckingham, P. L. and Evans, J. C., Hazardous Waste Management, 2nd Edition, McGraw Hill, 2001.
2	Metcalf and Eddy "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, 6th Reprint, 2003.
3	LaGrega, M. D., Buckingham, P. L. and Evans, J. C., Hazardous Waste Management, 2nd Edition, McGraw Hill, 2001.
References	
1	Sincero A, P and Sincero G, A, "Environmental Engineering A Design approach", PHI learning private limited, 2004.
2	Wentz, C. A., Hazardous Waste Management, 2nd Ed., McGraw Hill, 1995.
3	Lewandowski G.A. and DeFilippi L.J., Biological Treatment of Hazardous Wastes, John Wiley & Sons, 1998.
Useful Links	
1	https://www.youtube.com/watch?v=x8ViYojEhc&t=4s
2	https://www.youtube.com/watch?v=prsVIHDDCyM
3	https://www.youtube.com/watch?v=Awiq0JLfmMA

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2				3		
CO3						3

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>

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Walchand College of Engineering, Sangli					
(Government Aided Autonomous Institute)					
AY 2023-24					
Course Information					
Programme	M. Tech. Civil (Environmental Engineering)				
Class, Semester	First Year M. Tech., Semester II				
Course Code	7EV521				
Course Name	Biological Methods for Wastewater Treatment				
Desired Requisites:	Wastewater Treatment				
Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					
Course Objectives					
1	To provide conceptual and field knowledge for the analysis, design and evaluation of biological processes of wastewater treatment.				
2	To enhance the technical competency to conduct research and address the problems of industry/society related to wastewater treatment.				
3	To inculcate aptitude for research, and consultancy.				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to					
CO1	<i>Explain</i> and <i>apply</i> the acquired knowledge on biological wastewater treatment.				Understanding Applying
CO2	<i>Analyze</i> and <i>evaluate</i> the suspended and attached growth, aerobic and anaerobic biological wastewater treatment systems at secondary and tertiary levels.				Analyzing Evaluating
CO3	<i>Design</i> wastewater treatment and sludge processing facilities.				Creating
Module	Module Contents				Hours
I	Fundamentals of Biological Treatment Fundamentals: Measurement of organic pollutant, Biochemical transformation, Bioreactor configuration, Aerobic, Anoxic and Anaerobic Biochemical operations Kinetics of Bio-chemical operations: Biomass growth, Substrate utilization, Yield Kinetics of (Aerobic/Anoxic, Anaerobic) biomass growth				6
II	Aerobic Suspended and Attached Growth Processes Review of conventional activated sludge process (ASP), aerated lagoon and waste stabilization ponds Modelling aerobic suspended growth in complete-mix and plug flow reactor with and without recycle Design and operation of sequential batch/cyclic ASP and membrane bioreactor Biological filtration, Eckenfelder model for performance of packed tower with and without recirculation Design and operation of rotating biological contactor				9
III	Biological Nitrification and Denitrification Biological nitrogen and phosphorous removal, Kinetics of nitrification and denitrification Process design of ASP, SBR and RBC for carbon oxidation – nitrification and denitrification				5
IV	Sludge Processing				9

	Design and operation of Upflow Anaerobic Sludge Blanket system Sludge processing: Sludge mass-volume relationship, Process fundamentals of Thickening, Stabilization, Conditioning, and Dewatering Design and operation of gravity thickener, dissolved air flotation tank, anaerobic digester, belt press and sludge drying bed	
V	Decentralized Wastewater Treatment Design and operation of decentralized wastewater treatment systems Moving Bed Bio-reactor, Anaerobic filter, Modified septic tank Constructed Wetland (CW): Classification and application, Design and operation of horizontal flow subsurface, Vertical flow systems Emerging concepts in CW, Sludge treatment constructed wetland Design and operation of Water hyacinth system	7
VI	Land application and Treatment Land application treatment systems: Processes, Removal mechanisms, Design and operation of slow rate, rapid infiltration and overland flow systems	4

Textbooks

1	Peavy H, S, Rowe D, R, and Tchobanoglous G, " <i>Environmental Engineering</i> ", McGraw-Hill Book Company, Indian edition 2017.
2	Metcalf and Eddy " <i>Wastewater Engineering Treatment and Reuse</i> ", Tata McGraw Hill Publication, Indian Edition 2017.
3	Karia, G, L, and Christian R, A, " <i>Wastewater treatment</i> ", PHI learning private limited, 2008.
4	Tom D. Reynolds and Paul A. Richards, " <i>Unit Operations and Processes in Environmental Engineering</i> ", 2 nd Edition, PWS Publishing Company, 1995.

References

1	Droste, Ronald L " <i>Theory and Practice of Water and Wastewater Treatment</i> ", Wiley student Edition, 2009.
2	Crites Ron and Tchobanoglous George, " <i>Small and Decentralized Wastewater Management Systems</i> ", McGraw-Hill Book Company, International edition, 1998.
3	Sincero A, P and Sincero G, A, " <i>Environmental Engineering A Design approach</i> ", PHI learning private limited, 2004.
4	Quasim, S. R., " <i>Wastewater treatment plants planning, design and operation</i> ", CRC Press, 2 nd Edition, 2010.

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2				3		
CO3						3

Assessment

The assessment is based on MSE, ISE and ESE.

MSE shall be typically on modules 1 to 3.

ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.

ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	7EV522
Course Name	Air Pollution and Control
Desired Requisites	A graduate level course in Environmental Engineering

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					

Course Objectives

1	To provide knowledge on physics of atmosphere, meteorology and its relation to air pollution, different types of air pollution control equipment.
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Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	<i>Recognize</i> and <i>summarize</i> scientific and engineering principles for air pollution studies	Remember Understand
CO2	<i>Apply</i> appropriate dispersion models <i>estimate</i> air pollutant concentrations	Apply Evaluate
CO3	<i>Analyze</i> situations leading to air pollution and <i>design</i> air pollution control strategies with due consideration to technical, environmental, health, safety and social considerations	Analyze Evaluate

Module	Module Contents	Hours
I	Air pollution: A retrospective Air pollution: sources and types and effects on biosphere, National and international air emission standards; air pollution emission inventory; emission factor; air quality index; Strategy for effective control of air pollution in India, Introduction to air pollution control act, and international agreements for mitigating global air pollution effects.	7
II	Meteorology Physics of atmosphere, Solar radiation, Wind circulation, Lapse rate, Inversion, Stability conditions, Pasquill stability model, Maximum mixing depth, Wind rose, Plume behaviour, Global effects of air pollution: Greenhouse effects, acid rain and ozone layer depletion, Heat island effect, Visibility, Photochemical reaction	7
III	Dispersion of pollutants in the atmosphere Eddy diffusion model, the Gaussian dispersion model, Point source, Line source, Maximum ground level concentration, Determination of stack height, Sampling time corrections, Effects of inversion trap Definition, Distribution and source of different particulate matter, Terminal settling velocity, Basics of hood and duct design for particulate collection	7
IV	Control of Air Pollution	7

	Control Equipment for Particulate Matter: Operation design and component detailing of Settling chamber, Cyclone, Wet collectors, Fabric filter, and Electrostatic precipitator	
V	General control of Gaseous pollutants Principles of absorption, Adsorption, Basic design of absorption and adsorption units, Incineration and after burner, Control of SO ₂ , NO _x , SPM, RSPM, Biological Matter	6
VI	Motor Vehicle Emissions Automobile Source Emission of pollutants from automobiles, Photochemical smog, Reduction of emissions by different methods, Alternative fuels and their utilizations	6

Textbooks

1	Wark and Warner, "Air Pollution", C.F., H.R. Publication, 1 st Edition, 1978.
2	Nevers N., "Air Pollution Control Engineering" McGraw-Hill, New York, 2 nd edition, 1995.
3	Martin Crawford, "Air Pollution and Control", Tata McGraw Hill Publication, 1 st Edition, 1976.

References

1	Richard W. Boubel and Bruce Turner, "Fundamentals of Air Pollution", Academic Press, New York, Third edition, 1994.
2	Stern A. C., "Air Pollution Vol. I and II", Allied Publishers Limited, 1 st Edition, 1994.
3	Rao H.V.N. and Rao M. N., "Air Pollution", Tata McGraw Hill, 1 st Edition, 1989.

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2			3			3
CO3				3		3

Assessment

The assessment is based on MSE, ISE and ESE.

MSE shall be typically on modules 1 to 3.

ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.

ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.

For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)

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Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	7EV523
Course Name	Industrial Wastewater Pollution and Control
Desired Requisites:	A course on Wastewater Treatment at graduate level and Physico-Chemical Methods for Water and Wastewater Treatment

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					

Course Objectives

1	To provide conceptual and field knowledge for the analysis, design and evaluation of biological processes of wastewater treatment.
2	To enhance the technical competency to conduct research and address the problems of industry/society related to wastewater treatment.
3	To inculcate the qualities of critical thinking.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Explain and apply concepts of industrial wastewater treatment.	Understanding Applying
CO2	Analyze and evaluate the physical and chemical treatment systems used in water and wastewater.	Analyzing Evaluating
CO3	Design physical and chemical treatment systems for water and wastewater.	Creating

Module	Module Contents	Hours
I	Classification of Industries and Cooling Tower Classification of Industries, General water requirements in industry, Industrial water reuse, Cooling tower make up water, Water and salt balances in cooling tower, Common water quality problems in cooling water tower systems, Estimation of blow-down water composition, Analysis of scaling potential by Langlier and Ryzner indices.	4
II	Waste Minimization Techniques Waste audit, Concept of waste minimization and Techniques of volume and strength reduction. Equalization: Process, Flow and quality, Location, Volume requirement and Design considerations. Reuse and recycling concepts, Process description, Objectives and Methods of Neutralization and Proportioning	5

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III	Agro Based Industries Manufacturing processes, Water usage, Sources, Quantities and characteristics of effluents (process stream and combined), Pollution effects, Waste Reduction/Reclamation/Byproduct recovery, Utilization, Alternative methods of treatment and disposal for Agro-based industries: Sugar, Distillery, Dairy, Pulp and paper mill and Textile	12
IV	Chemical and Engineering Industries Manufacturing processes, Water usage, Sources, Quantities and characteristics of effluents (process stream and combined), Pollution effects, Waste Reduction /Reclamation/Byproduct recovery, Utilization, Alternative methods of treatment and disposal for a. Chemical industries: Pharmaceutical, Petroleum and refineries, Fertilizer and Tannery b. Engineering industries: Steel, Electroplating and Battery Manufacturing c. Thermal power plants.	12
V	Common Effluent Treatment Plant Concept, Objectives, Methodology, Cost benefit analysis, Design, Operation and maintenance	4
VI	Detailed Project Report for Waste Treatment Facilities Project report preparation for waste treatment and disposal system of industries, Pre-feasibility, feasibility and detailed project reports, Project financial appraisal.	3
Textbooks		
1	Peavy H, S, Rowe D, R, and Tchobanoglous G, "Environmental Engineering", McGraw-Hill Book Company, Indian edition 2017.	
2	Metcalf and Eddy "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, Indian Edition 2017.	
3	Unit Operations and Processes in Environmental Engineering, 2nd Edition, by Tom D. Reynolds and Paul A. Richards, PWS Publishing Company, 1995.	
References		
1	Droste, Ronald L "Theory and Practice of Water and Wastewater Treatment", Wiley student Edition, 2009.	
2	Crites Ron and Tchobanoglous George, " <i>Small and Decentralized Wastewater Management Systems</i> ", McGraw-Hill Book Company, International edition, 1998.	
3	Quasim, S. R., "Wastewater treatment plants planning, design and operation", CRC Press, 2 nd Edition, 2010.	
Useful Links		
1	https://www.youtube.com/watch?v=fHRxhuMQQnE&list=PLbRMhDVUMngdeOSgQOe399aBKqdxkxNCp	
2	https://pubs.rsc.org/en/content/chapterhtml/2021/bk9781839162794-00001?isbn=978-1-83916-279-4&sercode=bk	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2				3		
CO3				2		3

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>

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Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	7EV571
Course Name	MSW Characterization and Air Quality Monitoring Laboratory
Desired Requisites:	Solid Waste Management & Air Pollution and Control

Teaching Scheme		Examination Scheme (Marks)			
Practical	2 Hrs./ Week	LA1	LA2	Lab ESE	Total
Interaction	-	30	30	40	100
Credits: 1					

Course Objectives

1	To provide hands-on practice to analyze the quality of ambient air, noise levels, stack emissions and MSW.
2	To provide knowledge to analyze environmental condition.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Recognize and explain use of instrumentation for air, and noise monitoring and MSW Characterization.	Remembering Understanding
CO2	Use instrumentation for air, and noise monitoring and MSW Characterization.	Applying
CO3	Assess environmental conditions by using results obtained through experimentation.	Evaluating

List of Experiments / Lab Activities/Topics

List of Topics (Applicable for Interaction mode):

1. Sampling of Municipal Solid Waste (MSW)
2. Proximate analysis of Municipal Solid Waste (MSW).
3. Ultimate analysis of Municipal Solid Waste (MSW).
4. Study of air samplers for ambient air quality monitoring.
5. Study of air samplers for indoor air quality monitoring.
6. Study of stack monitoring kit.
7. Study of automobile exhaust analyzer.
8. Study of weather monitoring station.
9. Study of noise level meter and ambient noise level measurements.

List of Lab Activities:

1. Mini Project 1: Municipal Solid Waste Management for small locality/society/colony/village.
2. Mini Project 2: Indoor/Outdoor air quality monitoring of enclosed/open area.

Textbooks

1	Wayne T. D., Air Pollution Engineering Manual, John Wiley & Sons, 2000.
2	Rao C. S., Environmental Pollution Control Engineering, New Age Int. Pubs, 2005.
3	"Manual for wet and dry depositing", CPCB Methods, Central Lab test methods, 2001.

References

1	Sincero A. P. and Sincero G, A, "Environmental Engineering A Design approach", PHI learning
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	Private limited, 2004.
2	Nathanson J. A. "Basic Environmental technology for water supply, waste management and Pollution control", PHI Publishing Company, 5th Edition, 2009.
3	Wark K. and Warner C.F., "Air Pollution", C.F., H.R. Publication, 1st Edition, 1978.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2	3		
CO2				3		2
CO3				3		2

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE.				
IMP: Lab ESE is a separate head of passing. (min 40 %), LA1+LA2 should be min 40%				
Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

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Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	7EV572
Course Name	Wastewater Treatability Studies Laboratory
Desired Requisites:	Physico-Chemical Methods for Water and Wastewater Treatment and Biological Methods for Wastewater Treatment.

Teaching Scheme		Examination Scheme (Marks)			
Practical	2 Hrs./ Week	LA1	LA2	Lab ESE	Total
Interaction	-	30	30	40	100
Credits: 1					

Course Objectives

- 1** To provide hands-on practice to plan, design and conduct experiments.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	<i>Design</i> and <i>conduct</i> experiments using appropriate techniques and tools to demonstrate research skill individually/groups.	Creating
CO2	<i>Analyze, critique,</i> and <i>interpret</i> results of experimental studies on performance evaluation and characterization studies.	Analyzing Evaluating

List of Experiments / Lab Activities/Topics

List of Experiments:

- Determination of BOD rate constant for domestic and industrial wastewater
- Development of laboratory scale Activated Sludge Process (ASP) and Determination of MLSS, MLVSS, sludge volume index and sludge density index
- Evaluation of bio-kinetic parameters for aerobic treatment
- Performance evaluation of aerobic sequential batch reactor for treating domestic wastewater
- Study on characterization of raw and processed (thickened/stabilized/dewatered) sludge
- Development and operation of anaerobic reactor for wastewater/sludge treatment
- Evaluation of effluent quality for land application
- Evaluation of impact of effluent disposal on soil
- Study of Activated Sludge Models (ASM)

Textbooks

1	Metcalf and Eddy, "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, 6th Reprint 2003.
2	Lee C. C. and Lin S. D., "Hand book of environmental engineering calculations", McGraw Hill Publication, 2nd Edition, 2007.
3	Hammer M, J and Hammer M, J, "Water and Wastewater Technology", PHI learning private limited, 6 th Edition, 2008.

References

1	Quasim, S. R., "Wastewater treatment plants planning, design and operation", CRC Press, 2 nd Edition, 2010.
2	Sawyer and McCarty, "Chemistry for Environmental Engineers", Tata McGraw Hill, Edition 5,

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	2003.
3	Clesceri, L. S., Greenberg, A. E. and Eaton, A. D. (Eds), Standard Methods for the Examination of Water and Wastewater, Washington, D.C., 21 st Ed., 2001.

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2				3		

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE.				
IMP: Lab ESE is a separate head of passing. (min 40 %), LA1+LA2 should be min 40%				
Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

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Walchand College of Engineering, Sangli (Government Aided Autonomous Institute)					
AY 2023-24					
Course Information					
Programme	M. Tech. Civil (Environmental Engineering)				
Class, Semester	First Year M. Tech., Semester II				
Course Code	7EV545				
Course Name	Seminar				
Desired Requisites:	-				
Teaching Scheme		Examination Scheme (Marks)			
Practical	2 Hrs./ Week	LA1	LA2	Lab ESE	Total
Interaction	-	30	30	40	100
Credits: 1					
Course Objectives					
1	Encourage students to explore new research from a range of academic disciplines which shed light on environmental issues.				
2	Create awareness amongst students about the cutting edge technical/industrial research projects that can be undertaken for their dissertation works.				
3	Develop the attribute of effective communication (written and oral) through effective presentations				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	<i>Examine</i> the confirming and opposing evidence from research papers in order to draw conclusions consistent with the topic.				Analyzing
CO2	<i>Summarize</i> gaps in the research areas related to environmental engineering based on a thorough literature review of research papers from recognized authors/journals and prepare project proposals.				Understanding
CO3	<i>Demonstrate</i> effective written and oral communication, giving appropriate consideration to audience, context, format and textual evidence.				Applying
List of Experiments / Lab Activities/Topics					
Part A: List of Topics (Applicable for Interaction mode):					
The students shall collect information on the probable topic of his/her dissertation by referring to research articles from journals and conferences.					
Students should deliver minimum of three presentations on chosen topic with a view of enhancing their presentation skills on technical presentation.					
A detailed report based on three presentations is to be prepared and submitted.					
Textbooks					
1	Metcalf and Eddy, "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, 6th Reprint 2003.				
2	Lee C. C. and Lin S. D., "Hand book of environmental engineering calculations", McGraw Hill Publication, 2nd Edition, 2007.				
References					
1	Quasim, S. R., "Wastewater treatment plants planning, design and operation", CRC Press, 2nd				

	Edition, 2010.
2	National and International journals in Environmental Engineering [A. Journal of Indian water works association, b. Journal of environmental science and engineering (NEERI), c. Journal of environmental engineering (ASCE), d. Water research, e. Water science and technology, f. Journal of Water supply: Research and technology-AQUA, g. Journal of environmental management, h. Journal of waste management, i. Water science and technology –Water supply, j. Journal of Water Reuse and Desalination, k. Journal of American water works association. L. Building and Energy (Elsevier)]

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1	2			2	1	
CO2	2			2	2	
CO3		3			2	

Assessment				
There are three components of lab assessment, LA1, LA2 and Lab ESE.				
IMP: Lab ESE is a separate head of passing. (min. 40 %), LA1+LA2 should be min 40%				
Assessment	Based on	Conducted by	Typical Schedule	Marks
LA1	Lab activities, attendance, journal	Lab Course Faculty	During Week 1 to Week 8 Marks Submission at the end of Week 8	30
LA2	Lab activities, attendance, journal	Lab Course Faculty	During Week 9 to Week 16 Marks Submission at the end of Week 16	30
Lab ESE	Lab activities, journal/ performance	Lab Course Faculty and External Examiner as applicable	During Week 18 to Week 19 Marks Submission at the end of Week 19	40

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Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	7EV531
Course Name	Professional Elective 3: Project Management
Desired Requisites:	Nil

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					

Course Objectives

1	To develop a holistic, integrated approach to manage projects, exploring both technical and managerial challenges in civil engineering projects.
2	To inculcate leadership and ethical qualities in dealing with real life project environment and develop positive attitude towards individual responsibility in project execution.
3	To induce the art of documentation and oral communication in research and industry.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	Explain critically the project characteristics, project management principles and to apply them within the context of practical projects.	Understanding
CO2	Construct and solve projects in context of scheduling and controlling with time and cost as constraints using knowledge of network scheduling techniques and applications.	Applying
CO3	Engage in effective oral/written communication and apply leadership skills to successfully manage in a project environment and ethically accomplish project objectives.	Applying

Module	Module Contents	Hours
I	Project Management Concepts Factors Governing Modern Business, Effective Project Management, definition of project, Attributes of Project, Strategic Planning, Project Life Cycle, considerations for RFP, Project Process, Project Balancing, Project Environment, Programme and Portfolio, Reasons for project failures	6
II	Project Planning and Schedule Work Breakdown Structure, Responsibility matrix, Development of non-network and network schedules, Deterministic and Stochastic models and Problem solving in scheduling, Activity duration estimates, Schedule calculations, Probability considerations.	7
III	Schedule Control Project control process Updating schedule, Approaches to schedule control, Resource considerations Resource smoothening, Resource limited scheduling, Problem solving on Resource constrained planning.	7
IV	Project Cost: Planning and Performance Project cost estimation, budgeting, Techniques for cost estimation, Direct and Indirect	8

	costs, Fixed variable costs, Least-cost schedules, Problem solving on Schedule compression, Project Cost Management, Earned Value Management system, Planned Value, Earned Value, Actual Cost, Schedule variance, Cost Variance, Schedule performance index, Cost performance index, Limitations of EVM.	
V	Leadership, Project Manager and Project Team Understanding Leadership, Responsibilities and skills, Delegation, Managing Change, Development and effectiveness of project team, Ethics, Conflicts on Projects, Time Management, SWOT Analysis	7
VI	Communication and Documentation Types of Project organizations- their merits and demerits, Personal communication, Effective listening, Meeting, Presentations and Report preparation.	5
Textbooks		
1	A Guide to Project Management Body of Knowledge, 7 th edition, 2021, Project Management Institute. (Free download)	
2	Jack Gido, James P Clements, Project Management, Cengage Learning India Pvt. Ltd., 2 nd Reprint 2011, ©2007	
3	B.C. Punmia and Khandelwal, Project Planning and Control with PERT and CPM, Lakshmi Publications Pvt. Ltd., 4 th Edition, 2008	
References		
1	John Adair, Strategic Leadership, Kogan Page Ltd., 1st ed. 2010.	
2	Project Management, Achieving Competitive Advantage, Jeffrey K. Pinto, Dorling Kindersley India Pvt. Ltd. Ed. 2009.	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1					2	
CO2				2	2	
CO3		2				

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>




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AY 2023-24					
Course Information					
Programme	M. Tech. Civil (Environmental Engineering)				
Class, Semester	First Year M. Tech., Semester II				
Course Code	7EV532				
Course Name	Professional Elective 3: Operation and Maintenance of Environmental Facilities				
Desired Requisites:	Courses on Water and Wastewater Treatment, Air pollution, Solid Waste Management				
Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					
Course Objectives					
1	Provide in-depth knowledge of operation and maintenance of infrastructural facilities in environmental engineering.				
2	To enhance the technical competency and apply the acquired knowledge for research and development, industry, and consultancy activities.				
Course Outcomes (CO) with Bloom's Taxonomy Level					
At the end of the course, the students will be able to,					
CO1	<i>Explain</i> concepts of operation and maintenance for environmental facilities.				Understand
CO2	<i>Apply</i> the imparted knowledge to effectively operate the system.				Apply
CO3	<i>Assess</i> operation and maintenance problems associated with real life environmental facility.				Evaluate
Module	Module Contents				Hours
I	Introduction Need of Operation and Maintenance (O & M), Basic principles, corrective and preventive maintenance, Detailed plans, drawings, operation manuals, computer usage in O and M.				7
II	Water Supply System Intakes, pumps, transmission pipes, water treatment process control, Quantity and quality monitoring.				6
III	Water Distribution and Sewerage System <i>Water distribution system:</i> Loss of carrying capacity of pipes, pipe breaks and leakages, leak detection, record keeping, O and M of Appurtenances, Use of network models in O and M, Corrosion control. <i>Sewerage system:</i> Maintenance, Inspection methods, Manual and television, Cleaning and rehabilitation, Safety in sewer inspection.				7
IV	Wastewater Treatment Plant Wastewater treatment plant: O and M of wastewater treatment plant, Monitoring and operational problems, Corrective measures. Performance: Plant performance, Need for up gradation, Process reliability, Odour management.				7
V	Air Pollution Control Facilities Air pollution control facilities: Regular inspection of devices, SPM control equipment, Gravity settlers, Cyclone separators, Bag filters, Scrubbers, Electrostatic precipitator, Gaseous control devices, incinerators and their troubleshooting.				7

VI	Planning and Management Organizational structure, work planning, preparation and scheduling, Cost estimates.	6
Textbooks		
1	Quasim S. R., Motley E. M. and Zhu G., "Water works engineering", PHI learning private limited, 2000.	
2	Wark K. And Warner C.F., "Air Pollution", H.R. Publication, 1st Edition, 1978.	
References		
1	"Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Govt. of India, New Delhi, 1999.	
2	"Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Govt. of India, New Delhi, 1993.	
Useful Links		
1	https://www.youtube.com/watch?v=Kc9u3I0tyeg	
2	https://www.suezwaterhandbook.com/processes-and-technologies/instrumentation-control-regulation/deferred-plant-control-system/water-treatment-plant-maintenance	
3	https://www.epa.gov/sites/production/files/2018-07/documents/uss-midwest-revised-om-pmpp-manual-submitted-20180626-184pp.pdf	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2			3			
CO3						2

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher's assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>

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Walchand College of Engineering, Sangli

(Government Aided Autonomous Institute)

AY 2023-24

Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	7EV533
Course Name	Professional Elective 4: Environmental Management Systems
Desired Requisites:	Environmental Engineering Course at Graduate Level

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100

Credits: 3

Course Objectives

1	To provide knowledge of ecological aspects.
2	To provide knowledge of Environmental Ethics and Environmental Legislation.
3	To provide necessary knowledge of managerial tools required for assessing, analyzing and solving problems in the field of environmental management.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	<i>Explain</i> ecological imbalance due to various types of pollution and perceive environmental ethics and legislation.	Understand
CO2	<i>Choose</i> appropriate methodology for EIA and auditing and assess the impacts.	Apply
CO3	<i>Justify</i> EMS and Environmental Management Plan for infrastructural facilities.	Evaluate

Module	Module Contents	Hours
I	Ecological Aspects and Noise Pollution Ecological aspects: Salient features of major Eco Systems, Energy Transfer, Population Dynamics, Ecological imbalance, Preservation of Biodiversity. Land Pollution, Water Pollution due to sewage, industrial effluents and leachate, Pollution due to Nuclear Power Plants, Radioactive Waste, Thermal pollution, causes and control. Noise Pollution: Decibel Levels, Monitoring, Hazards, Control measures.	6
II	Environmental Ethics and Legislation Environmental Ethics: Ethics in society, Environmental consequences, Responsibility for environmental degradation, Ethical theories and codes of Ethics, Changing attitudes, Sustainable development. Environmental Legislation: Water (prevention and control of pollution) act 1974, The environmental act 1986, The Noise Pollution (Regulation and Control) Rules, 2000. Environmental economics.	7
III	Environmental Impact Assessment (EIA) Definitions and Concept, Scope, Objectives, Types of impacts, Elements of EIA, Baseline studies. Methodologies of EIA, Prediction of impacts and its methodology, Uncertainties in EIA, Status of EIAs in India.	7
IV	Environmental Auditing Definitions and concepts, Scope and Objectives, Types of audit, Accounts audit, Environmental audit statement, Qualities of environment auditor. Environmental	7

	Impact Statement (EIS).	
V	ISO Standards ISO and ISO 14000 Series: Introduction, Areas covered in the series of standards, Necessity of ISO certification. Environmental management system: Evolution, Need, Elements, Benefits, ISO 14001 requirements, Steps in ISO 14001 certification, ISO 14001 and sustainable development, Integration with other systems (ISO 9000, TQM, Six Sigma), Benefits of integration.	7
VI	Environmental Management Plan Definition, Importance, Development, Structuring, Monitoring, Cost aspects. Strategy for siting of Industries, Environmental Labeling, Life-Cycle Assessment.	6
Textbooks		
1	Canter, L. W., Environmental Impact Assessment, McGraw-Hill, 2nd Edition, 1997.	
2	Agarwal, N. P., Environmental Reporting and Auditing, Raj Pub., 1st Edition, 2002.	
3	Judith, P. and Eduljee, G., Environmental Impact Assessment for Waste Treatment and Disposal Facilities, John Wiley & Sons, 1st Edition, 1994.	
References		
1	“Environmental Auditing”, Published by CPCB, Govt. of India Publication, New Delhi	
2	Mhaskar, A.K., Environmental Audit”, Media Enviro Publications, 2002.	
3	K. Whitelaw and Butterworth, ISO 14001: Environmental System Handbook, 1997.	
Useful Links		
1	https://www.youtube.com/watch?v=wEqrMCdNjX4	
2	https://www.youtube.com/watch?v=hfLGI73N_iA	
3	https://www.youtube.com/watch?v=MpR6YiSiHrs	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2					3	
CO3			3			

Assessment
<p>The assessment is based on MSE, ISE and ESE.</p> <p>MSE shall be typically on modules 1 to 3.</p> <p>ISE shall be taken throughout the semester in the form of teacher’s assessment. Mode of assessment can be field visit, assignments etc. and is expected to map at least one higher order PO.</p> <p>ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.</p> <p>For passing a theory course, Min. 40% marks in (MSE+ISE+ESE) are needed and Min. 40% marks in ESE are needed. (ESE shall be a separate head of passing)</p>

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AY 2023-24

Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	7EV534
Course Name	Professional Elective 4: Geo-Environmental Engineering
Desired Requisites:	Soil Mechanics, Foundation Engineering, Environmental Engineering : UG Level

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs/week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					

Course Objectives

This course is intended to acquaint M. Tech Environmental Engineering students with concepts of Geo-environmental engineering, and planning and design of waste in landfills, ash ponds and tailing ponds.

Course Outcomes (CO) with Bloom's Taxonomy Level

At the end of the course, the students will be able to,

CO1	<i>Describe</i> and <i>differentiate</i> various engineering properties of soils, available geo synthetic materials, their properties and suitability.	Understanding Analyzing
CO2	<i>Calculate</i> area requirement of landfill site and <i>Evaluate</i> compaction quality using field tests.	Analyzing Evaluating
CO3	<i>Analyze</i> stability of landfill embankments, liners and covers.	Analyzing

Module	Module Contents	Hours
I	Introduction to Geo-environmental Engineering Introduction, overview of pollution, control and remediation, Case histories on Geo-environmental Engineering, Soils- Soil as 'Phased System', Soil classification, Various Soil Types with important engineering properties, their suitability for intended purpose, Clay Mineralogy.	7
II	Contaminant Transport in Soil Soil-water-contaminant interaction; Contaminant Transport, Geochemical Attenuation and attenuation capacity of soils. Zones of contaminant plume. Introduction to Detection of polluted zones and Monitoring designed system.	5
III	Introduction to Geo-synthetic Materials Various forms of Geo-synthetic material (GM, GT, GN, GG, GCL, GP, Geo-foam), Their general applications for various engineering functions. Various Geo-synthetic material properties. Use of Geo-synthetic material in waste containment. Concerns about use.	6
IV	Solid Waste Containment Site selection, Typical cross sections of landfills, merits and demerits. Area calculation of landfill site. EPA (MoEF and CPCB) Guidelines. CCL, GCL and composite liners. Compaction quality control for CC liners. Stability analysis of Landfills: Conventional Slope Stability analysis by method of slices, stability number concept. Stability against sliding of geo-membrane over clay (liner stability) and sliding of soil over geo-membrane (Cover stability). Assessment of anchorage requirement of GM.	12

V	Slurry Waste Containment <i>Slurry Waste Containment:</i> Slurry transported wastes, pond layouts, components of pond, embankment construction, staged raising of embankment, Design aspects, environmental impact and control. <i>Vertical Barriers for Containment:</i> Various types of Cutoff Walls, Requirements of good vertical barriers, Slurry trench walls using Bentonite and Cement-bentonite slurry, material and construction aspects.	5
VI	Geotechnical Reuse of Waste Material Waste reduction, use of waste in geotechnical construction, Waste characteristics for soil replacement, Transport considerations, and engineering properties of waste.	5

Textbooks

1	G L Sivakumar Babu, "Soil Reinforcement and Geosynthetics", Universities Press (India) Pvt. Ltd. Hyderabad, 2006.
2	Reddi L.N. and Inyang, H. I., "Geoenvironmental Engineering, Principles and Applications" Marcel Dekker Inc. New York, 2000.
3	Bagchi, A., "Design of landfills and integrated solid waste management" John Wiley & Sons, Inc., USA, 2004.

References

1	Donald Coduto, "Geotechnical Engineering Principles and Practices Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
2	Daniel, D. E, "Geotechnical Practice for Waste Disposal", Chapman and Hall, 1993.
3	Rowe R.K., "Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.

Useful Links

1	https://cpcb.nic.in/rules/
2	https://nptel.ac.in/courses/105103025
3	https://onlinecourses.nptel.ac.in/noc19_ce37/preview

CO-PO Mapping

	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			2			
CO2			3			1
CO3			3	2		2

Assessment

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 ESE shall be on all modules with around 40% weightage on modules 1 to 3 and 60% weightage on modules 4 to 6.
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Walchand College of Engineering, Sangli

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AY 2023-24

Course Information

Programme	M. Tech. Civil (Environmental Engineering)
Class, Semester	First Year M. Tech., Semester II
Course Code	7EV535
Course Name	Professional Elective 4: Emerging Technologies in Water and Wastewater Treatment
Desired Requisites:	A course on Water and Wastewater Treatment at graduate level and Physico-Chemical Methods for Water and Wastewater Treatment

Teaching Scheme		Examination Scheme (Marks)			
Lecture	3 Hrs./week	MSE	ISE	ESE	Total
Tutorial	-	30	20	50	100
Credits: 3					

Course Objectives

1	Provide in-depth knowledge of emergent technologies in water and wastewater engineering.
2	To enhance the technical competency and apply the acquired knowledge for research and development, industry, and consultancy activities.

Course Outcomes (CO) with Bloom's Taxonomy Level


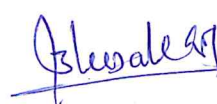
At the end of the course, the students will be able to,

CO1	<i>Explain</i> and <i>apply</i> the concepts of emerging/advanced physical, chemical and biological processes for the treatment of water and wastewater.	Understanding Applying
CO2	<i>Analyze</i> and <i>evaluate</i> the emerging/advanced physical, chemical and biological systems for the treatment of water and wastewater.	Analyzing Evaluating
CO3	<i>Design</i> the emerging/advanced physical, chemical and biological water and wastewater treatment facilities.	Creating

Module	Module Contents	Hours
I	Solids Separation High-rate clarification, Enhanced particle flocculation, Analysis of ballasted flocculation and settling, Dense-sludge process, Swirl and vortex separation, Enhanced coagulation, Applications in water and wastewater treatment	5
II	Organic and Inorganic Matter Removal <i>Organic matter removal:</i> Chemical oxidation for BOD, COD, ammonia and non-biodegradable organic compounds, Advanced oxidation processes. <i>Inorganics removal:</i> Biological removal of phosphorus, heavy metals, toxic and recalcitrant organic compounds, Biological-Chemical Phosphorus and Nitrogen Removal (BCFS) Process Gas Stripping for ammonia and VOC removal, analysis, design of stripping towers	5
III	Hybrid Treatment Biological treatment with membrane separation, Combined aerobic treatment processes, Integrated Fixed-film Activated Sludge (IFAS) Systems, Aerobic granular biomass wastewater treatment, Submerged attached growth processes, Denitrification with attached growth systems, Moving bed bioreactor, Combination natural and mechanized treatment systems, Vertical flow constructed wetland, Aerated constructed wetland	10

IV	<p>Decentralized and Sustainable Wastewater Treatment</p> <p><i>Sustainable wastewater treatment:</i> Limitations of conventional centralized wastewater systems, Concept of sustainability in wastewater treatment.</p> <p><i>Decentralized treatment:</i> Concept, significance, applications and elements of decentralized wastewater treatment, Technologies for Decentralized wastewater treatment, On-site treatment systems, Greywater treatment.</p>	8
V	<p>Vermin Technology</p> <p>Vermin technology: Concept, Worm species, Worm action.</p> <p><i>Applications of vermin technology:</i> Vermifilter and Vegetated vermifilter in biological treatment of wastewater, Vermi-stabilization of sludge, Vermin composting.</p>	6
VI	<p>Introduction to Automation and Nano Technology</p> <p>Introduction to automatic process control, Energy efficiency in wastewater treatment, Upgrading wastewater treatment plant performance.</p> <p><i>Nano technology in treatment:</i> Introduction to Nano technology in water and wastewater treatment, Drinking water decontamination using Nano technology, Application of Nano TiO₂ catalyst in wastewater treatment, Disinfection by Nano particles.</p>	6
Textbooks		
1	Peavy H, S, Rowe D, R, and Tchobanoglous G, "Environmental Engineering", McGraw-Hill Book Company, Indian edition 2017.	
2	Hammer M. J. and Hammer M. J., "Water and Wastewater Technology", PHI learning private limited, 6 th Edition, 2008.	
3	Metcalf and Eddy "Wastewater Engineering Treatment and Reuse", Tata McGraw Hill Publication, 6 th Reprint, 2003.	
References		
1	Sincero A. P. and Sincero G. A., "Environmental Engineering A Design approach", PHI learning private limited, 2004.	
2	Nazaroff W. W. and Alvarwz-Cohen, "Environmental Engineering Science", John Wiley & Sons Publication, 2011.	
3	Ram M. K., Andreescu S. and Ding H., "Nanotechnology for Environmental decontamination", McGraw Hill, 2011.	
Useful Links		
1	https://www.epa.gov/sites/production/files/2019-02/documents/emerging-tech-wastewater-treatment-management.pdf	
2	https://www.intechopen.com/online-first/emerging-trends-in-wastewater-treatment-technologies-the-current-perspective	

CO-PO Mapping						
	Programme Outcomes (PO)					
	1	2	3	4	5	6
CO1			3			
CO2				3		
CO3						3

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