

**SU/BOS/Sci & Tech/470**

**Date : 26/06/2023**

**To,**

**1) The Director,**  
Departments of Technology,  
Shivaji University, Kolhapur

**2) The Principal/ Director,**  
All affiliated Engineering Colleges/ Institute,  
Shivaji University, Kolhapur.

**Subject:** Regarding revised syllabus of **Ph. D. Coursework** under the Faculty of Science and Technology.

**Sir/Madam,**

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the syllabus of **Ph. D. Coursework** under the Faculty of Science and Technology.

1.	Civil Engineering & Technology
2.	Mechanical Engineering & Technology
3.	Electrical Engineering & Technology
4.	Electronics Engineering & Technology
5.	Electronics and Telecommunication Engineering & Technology
6.	Textile Engineering & Technology
7.	Computer Science Engineering & Technology
8.	Environmental Engineering & Technology
9.	Pharmacy

This syllabus will be implemented from the academic year 2023-24 i.e. from June 2023 onwards.

You are therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

**Yours faithfully,**

  
**Dr. S. M. Kubal**  
**Dy. Registrar**

**Copy to:**

1	The Dean, Faculty of Science & Technology	7	Computer Centre (IT)
2	The Chairman, Respective Board of Studies	8	Affiliation Section (T.1)
3	Director, Examination and Evaluation	9	Affiliation Section (T.2)
4	Eligibility Section	10	P.G.Admission Section
5	O.E. – 4	11	P.G Seminar Section
6	Appointment Section	12	Meeting Section

**Ph.D. Course work in Environmental Science and Engineering (Paper 3)**

**Index**

<b>Sr. No.</b>	<b>Title of Course</b>
1	Solid Waste Management
2	Air Pollution And Control
3	Environmental Management System
4	Physico-Chemical Methods For Water And Wastewater Treatment
5	Biological Methods For Wastewater Treatment

Solid Waste Management				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100
<b>Textbooks and References:</b>				
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.				
4. Vesilind, Worrell and Reinhart, “Solid Waste Engineering”, Cengage Learning India Pvt. Ltd.,				
5. Masters G., “Introduction to Environmental Engineering and Science”, Pearson Education, 2004				
6. Peavy, Rowe and Tchobanoglous, “Environmental Engineering”, Tata McGraw-Hill Publishing Company Limited, 1st Edition, 1985.				
7. “MSW Rules 2016”, Swachh Bharat Mission and Smart Cities Program of India				
<b>Assessments: As per SUK Guidelines</b>				
• <b>Theory Examination: is to be conducted by the university with duration of 3 hours per paper.</b>				
• <b>Internal Examination is to be conducted by the concerned departments or research centers in the following form:</b>				
1. <b>For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each</b>				
2. <b>For paper – 3 the internal evaluation will be as follows:</b>				
a) <b>Seminars ( Submission and Presentation)- 10 marks</b>				
b) <b>Review s Literature : Submission and Presentation- 10 marks</b>				
<b>(Papers will have separate passing head for theory examination and internal evaluation 32+8=40 )</b>				
Course Contents				
<b>Module 1:</b> Sources, Types, Composition, Physical, Chemical and Biological properties. Solid Waste Management: Objectives, Functional elements, Environmental impact of mismanagement,: Present Indian Scenario and scope to improve system for different functional elements of solid waste management system.				<b>8 Hrs.</b>
<b>Module 2:</b> 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 ofsolid waste: Means and methods, Routing of vehicles.Transfer station: Need, Types, factors affecting Capacity, Location and economicViability.				<b>8 Hrs.</b>

<b>Module 3:</b> 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. .	<b>8 Hrs.</b>
<b>Module 4:</b> Benefits, Processes, Stages, Technologies, Factors affecting, Properties of compost. Vermicomposting, Biomethanation	<b>8 Hrs.</b>
<b>Module 5:</b> Site selection, Types, Principle, Processes, Land filling methods, Leachate and landfill gas management, Design of a landfill facility, closure, post-closure plans, and rehabilitation of dumpsites.	<b>8 Hrs.</b>
<b>Module 6:</b> Waste Management legislation in India, integrated management-Public awareness; Role of NGO's; Introduction to various initiatives of the Govt. of India such as Swachh Bharat Mission, Smart Cities as well as Make in India; Biomedical; C and D waste Generation, identification, storage, collection, transport, treatment, and disposal, occupational hazards and safety measures	<b>8 Hrs.</b>

Air Pollution and Control				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100
<b>Textbooks and References:</b>				
<div>1. Wark and Warner, “Air Pollution”, C.F., H.R. Publication, 1st Edition, 1978.</div> <div>2. Nevers N., "Air Pollution control Engineering" McGraw-Hill, New York, 2nd edition, 1995.</div> <div>3. Martin Crawford, “Air Pollution and Control”, Tata McGraw Hill Publication, 1st Edition, 1976</div> <div>4. Richard W. Boubel and Bruce Turner, "Fundamentals of Air Pollution", Academic Press, New York, Third edition, 1994.</div> <div>5. Stern A. C., “Air Pollution Vol. I and II”, Allied Publishers Limited, 1st Edition, 1994.</div> <div>6. Rao H.V.N. and Rao M. N., "Air Pollution", Tata McGraw Hill, 1st Edition, 1989.</div>				
<b>Assessments: As per SUK Guidelines</b>				
<div>• <b>Theory Examination: is to be conducted by the university with duration of 3 hours per paper.</b></div> <div>• <b>Internal Examination is to be conducted by the concerned departments or research centers in the following form:</b><div><div>1. For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each</div><div>2. For paper – 3 the internal evaluation will be as follows:<div><div>a) Seminars ( Submission and Presentation)- 10 marks</div><div>b) <b>Review s Literature</b> : Submission and Presentation- 10 marks</div></div></div></div></div>				
<b>(Papers will have separate passing head for theory examination and internal evaluation 32+8=40 )</b>				
Course Contents				
<b>Module 1:</b> 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.				<b>8 Hrs.</b>
<b>Module 2:</b> Physics of atmosphere, Solar radiation, Wind circulation, Lapse rate, Inversion, Stability conditions, Pasquill stability model, maximum mixing depth, Wind rose, Plume behavior, Global effects of air pollution: Green house effects, acid rain and ozone layer depletion, Heat island effect, Visibility, Photochemical reaction				<b>8 Hrs.</b>
<b>Module 3:</b> 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.				<b>8 Hrs.</b>

<b>Module 4:</b> Operation design and component detailing of Settling chamber, Cyclone, Wet collectors, Fabric filter, and Electrostatic precipitator	<b>8 Hrs.</b>
<b>Module 5:</b> Principles of absorption, Adsorption, Basic design of absorption and adsorption units, Incineration and after burner, Control of SO <sub>2</sub> , NO <sub>x</sub>	<b>8 Hrs.</b>
<b>Module 6:</b> Automobile Source Emission of pollutants from automobiles, Photochemical smog, Reduction of emissions by different methods, Alternative fuels and their utilizations	<b>8 Hrs.</b>

Environmental Management System				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100
<b>Textbooks and References:</b>				
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.				
4. “Environmental Auditing”, Published by CPCB, Govt. of India Publication, New Delhi.				
5. Mhaskar, A.K., Environmental Audit”, Media Enviro Publications, 2002.				
6. K. Whitelaw and Butterworth, ISO 14001: Environmental System Handbook, 1997.				
<b>Assessments: As per SUK Guidelines</b>				
• <b>Theory Examination: is to be conducted by the university with duration of 3 hours per paper.</b>				
• <b>Internal Examination is to be conducted by the concerned departments or research centers in the following form:</b>				
1. <b>For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each</b>				
2. <b>For paper – 3 the internal evaluation will be as follows:</b>				
a) <b>Seminars ( Submission and Presentation)- 10 marks</b>				
b) <b>Review s Literature : Submission and Presentation- 10 marks</b>				
<b>(Papers will have separate passing head for theory examination and internal evaluation 32+8=40 )</b>				
Course Contents				
<b>Module 1:</b> 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.				<b>8 Hrs.</b>
<b>Module 2:</b> <b>Environmental Ethics:</b> Ethics in society, Environmental consequences, Responsibility for environmental degradation, Ethical theories and codes of Ethics, Changing attitudes, Sustainable development. <b>Environmental Legislation:</b> Water (prevention and control of pollution) act 1974, The environmental act 1986, The Noise Pollution (Regulation and Control) Rules, 2000. Environmental economics.				<b>8 Hrs.</b>
<b>Module 3:</b> Definitions and Concept, Scope, Objectives, Types of impacts, Elements of EIA, Baseline studies.				<b>8 Hrs.</b>

Methodologies of EIA, Prediction of impacts and its methodology, Uncertainties in EIA, Status of EIAs in India.	
<b>Module 4:</b> Definitions and concepts, Scope and Objectives, Types of audit, Accounts audit, Environmental audit statement, Qualities of environment auditor. Environmental Impact Statement (EIS)	<b>8 Hrs.</b>
<b>Module 5:</b> 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.	<b>8 Hrs.</b>
<b>Module 6:</b> Definition, Importance, Development, Structuring, Monitoring, Cost aspects. Strategy for siting of Industries, Environmental Labeling, Life-Cycle Assessment.	<b>8 Hrs.</b>



Physico-Chemical Methods for Water and Wastewater Treatment				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100
<b>Textbooks and References:</b>				
<div>1. Peavy H, S, Rowe D, R, and Tchobanoglous G, “Environmental Engineering”, McGraw-Hill Book Company, Indian edition 2017.</div> <div>2. Metcalf and Eddy “Wastewater Engineering Treatment and Reuse”, Tata McGraw Hill Publication, Indian Edition 2017.</div> <div>3. Davis, M, L, and Cornwell, D, A, “Introduction to Environmental Engineering”, Tata McGraw Hill Publishing Company, Special Indian Edition, 2010.</div> <div>4. Unit Operations and Processes in Environmental Engineering, 2nd Edition, by Tom D. Reynolds and Paul A. Richards, PWS Publishing Company, 1995.</div>				
<b>Assessments: As per SUK Guidelines</b>				
<div>• <b>Theory Examination:</b> is to be conducted by the university with duration of 3 hours per paper.</div> <div>• <b>Internal Examination</b> is to be conducted by the concerned departments or research centers in the following form:</div> <div>1. For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each</div> <div>2. For paper – 3 the internal evaluation will be as follows:</div> <div>a) <b>Seminars</b> ( Submission and Presentation)- 10 marks</div> <div>b) <b>Review s Literature</b> : Submission and Presentation- 10 marks</div> <div><b>(Papers will have separate passing head for theory examination and internal evaluation 32+8=40 )</b></div>				
Course Contents				
<b>Module 1:</b> 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				<b>8 Hrs.</b>
<b>Module 2:</b> Types of aerator, Design of gravity aerators ,Coagulation and flocculation, Stability and destabilization of colloids, Transport ofcolloidal particles, Design of rapid and slow mix units, Types of settling, Design of sedimentation tanks, Tube settler, Grit chamber (horizontalflow and aerated)				<b>8 Hrs.</b>
<b>Module 3:</b> Gravity and pressure filtration, filter hydraulics, Analysis of filtration process, Backwash hydraulics, Rate control patterns and methods, Design of dual media and pressure filter				<b>8 Hrs.</b>
<b>Module 4:</b> Causes and Types of adsorption, Adsorption equilibria and adsorption isotherm, Process, Analysis and design of batch and continuous flow activated carbon adsorber Ion Exchange				<b>8 Hrs.</b>

process, Exchange materials and capacity, Exchange reactions, Design and operation of softener for hardness and TDS removal	
<b>Module 5:</b> Membrane separation processes, Design and operation of Reverse osmosis, Ultrafiltration, and Electrodialysis. Membrane fouling: Causes, and Control.	<b>8 Hrs.</b>
<b>Module 6:</b> Kinetics of disinfection, Ozone disinfection: Chemistry, System components, Modeling. UV disinfection: Source, System components, Estimation of UV dose. Principles and theories of Chemical oxidation.	<b>8 Hrs.</b>

Biological Methods for Wastewater Treatment				
Teaching Scheme				
Lectures	Seminar	Library Work	Total	
40	10	10	60	
Examination Scheme				
Credits	Theory	Internal	Minimum for Passing	Total Marks
04	80	20	40	100
<b>Textbooks and References:</b> <ol style="list-style-type: none"><li>1. Peavy H, S, Rowe D, R, and Tchobanoglous G, “Environmental Engineering”, McGraw-Hill Book Company, Indian edition 2017.</li><li>2. Metcalf and Eddy “Wastewater Engineering Treatment and Reuse”, Tata McGraw Hill Publication, Indian Edition 2017.</li><li>3. Karia, G, L, and Christian R, A, “Wastewater treatment”, PHI learning private limited, 2008.</li><li>4. Unit Operations and Processes in Environmental Engineering, 2nd Edition, by Tom D. Reynolds and Paul A. Richards, PWS Publishing Company, 1995.</li></ol>				
<b>Assessments: As per SUK Guidelines</b> <ul style="list-style-type: none"><li>• <b>Theory Examination:</b> is to be conducted by the university with duration of 3 hours per paper.</li><li>• <b>Internal Examination</b> is to be conducted by the concerned departments or research centers in the following form:<ol style="list-style-type: none"><li>1. For paper 1 and 2 the internal evaluation will include 2 Seminars of 10 Marks each</li><li>2. For paper – 3 the internal evaluation will be as follows:<ol style="list-style-type: none"><li>a) Seminars ( Submission and Presentation)- 10 marks</li><li>b) Review s Literature : Submission and Presentation- 10 marks</li></ol></li></ol></li></ul> <p><b>(Papers will have separate passing head for theory examination and internal evaluation 32+8=40 )</b></p>				
Course Contents				
<b>Module 1:</b> Fundamentals: Measurement of organic pollutant, Biochemical transformation, Bioreactor configuration, Aerobic, Anoxic and Anaerobic Biochemical operations, Kinetics of Biochemical operations: Biomass growth, Substrate utilization, Yield Kinetics of (Aerobic/Anoxic, Anaerobic) biomass growth				<b>8 Hrs.</b>
<b>Module 2:</b> 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.				<b>8 Hrs.</b>
<b>Module 3:</b> Biological nitrogen and phosphorous removal, Kinetics of nitrification and denitrification Process design of ASP, SBR and RBC for carbon oxidation – nitrification and denitrification				<b>8 Hrs.</b>

<b>Module 4:</b> 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	<b>8 Hrs.</b>
<b>Module 5:</b> 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.	<b>8 Hrs.</b>
<b>Module 6:</b> Land treatment systems: Processes, Removal mechanisms, Design and operation of slow rate, rapid infiltration and overland flow systems.	<b>8 Hrs.</b>