Central University of Punjab

Centre for Environmental Sciences and Technology

Course Structure of Ph.D. Course work
(Integrated M.Phil.- Ph.D. in Environmental Sciences and Technology)

Academic Session 2015-16

CENTRE FOR ENVIRONMENTAL SCIENCES AND TECHNOLOGY
Scheme of Courses Ph.D.
M.Phil.- Ph.D. Environmental Science and Technology (Batch 2015-16)

Sl.No	Paper Code	Course Title	L	T	P	Cr	Total marks
Optional Courses: Two courses to be taken							
1	EVS 711	Water Treatment Technologies	5	1	0	5	100
2	EVS 712	Biological Wastewater Treatment Technologies	5	1	0	5	100
3	EVS 713	Bioenergy and Bioproducts	5	1	0	5	100
4	EVS 714	Application of Remote Sensing and GIS in Environmental Management	5	1	0	5	100
		Total	10			10	200

***Students may opt any two relevant courses within or outside the Centre**

Synopsis should be submitted at the end of Semester II

L: Lectures T: Tutorial P: Practical Cr: Credits

Total Marks : Continuous Assessment and End-Term Exam

Course Title: Water Treatment Technologies

	T		C	rkss
4	1			

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Paper Code: EVS 711

Unit 1: Introduction
Water as elixir of life, Water Pollution: Causes and Management, Drinking water, Standards for water Quality, Water analysis, water purification, Waste water & treatment technologies.
(14 Lectures)

Unit-2: Sedimentation and Ion exchange
Sedimentation: Principle and process of sedimentation, Coagulation, methods for determining Optimum coagulation dose, Flocculation process etc.
Water softening, demineralization, deionization, ion specific resins, packing of resins, resin regeneration. (14 Lectures)

Unit-3: Adsorption
Characteristics of adsorbents like Silica gel, Zeolites, Activated carbon. Waste materials as adsorbents, research for new adsorbents, chemistry of adsorption, particle size analysis, zeta potential, adsorption kinetics, adsorption equilibrium etc. Adsorption Isotherms (Freundlich, Langmuir, BET, Kisliuk etc.), Adsorption chillers,Adsorption spillover,Polymer adsorption.Sand filter, Charcoal filter, Dual media filter, Pressure filter, filter media, Filter operation. Inclusion based removal of organic pollutants like dyes, pesticides and PCBs, polymer immobilization of host for water treatment. 14 Lectures)

Unit-4: Reverse Osmosis
Membrane Processes, types of membrane, characterization of membranes, nano-membranes and their formation, efficiency of different membranes in removal of different elements. Chemical oxidation and precipitation.Deflurodation, iron, manganese & arsenic removal. (14 Lectures)

Suggested Readings:

1. American Water Works Association and James Edzwald (2011). *Water Quality & Treatment: A Handbook on Drinking Water*. McGraw-Hill Professional, New York.
2. Eckenfelder, W.W. Jr., Ford, D.L. and Englande, A.J. Jr. (2009). *Industrial water quality*. McGraw-Hill, New York.
3. Eaton, A.D., American Public Health Association, American Water Works Association and Water Environment Federation (2005). *Standard Methods for the Examination of Water and Wastewater*. Washington, D. C: American Public Health Association.
4. Patnaik P. (2011). *Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes.* CRC Press.
5. Rouquerol, F., Rouquerol, J., and Sing, K.S.W. (1999). *Adsorption by Powders and Porous Solids: Principles, Methodology, and Applications*. Academic Press, San Diego.
6. American Water Works Association and James Edzwald (2011). Water Quality & Treatment: A Handbook on Drinking Water. McGraw-Hill Professional, New York.Eckenfelder, W.W. Jr., Ford, D.L. and Englande, A.J. Jr. (2009). Industrial water quality. McGraw-Hill, New York.
7. Eaton, A.D., American Public Health Association, American Water Works Association and Water Environment Federation (2005). Standard Methods for the Examination of Water and Wastewater. Washington, D. C: American Public Health Association.
8. Patnaik P. (2011). Handbook of Environmental Analysis: Chemical Pollutants in Air, Water, Soil, and Solid Wastes. CRC Press.

Course Title: Biological Wastewater Treatment Technologies
Paper Code: EVS 712

LL	T	PP	Cr	MarksMa
55	1	00	55	100100

Unit 1: Introduction

An introduction to wastewater, its types, sampling methods and characterization of wastewater constituents - physical, chemical and biological; an overview of the biological wastewater treatment process and technologies

Microbiology of wastewater treatment: Role of microorganisms in wastewater, their composition and classification; microbial metabolism and their growth kinetics; Substrate removal and aerobic biological oxidation

(10 Lectures)

Unit 2: Aerobic and Anaerobic biological treatment process

Suspended (Activated sludge process), attached (trickling filter) and combined (Membrane bioreactor) growth biological treatment processes - process description, design, process control, operational problems and its applications

Anaerobic biological treatment process: Suspended (UASB, AnSBR, ABR) and attached (Attached growth anaerobic fluidized bed reactor, upflow packed bed attached growth reactor) growth biological treatment processes - process description, general design, process control, operational problems and its applications

(26 Lectures)

Unit 3: Biological Nutrient removal

Nitrogen removal - Biological nitrification and denitrification - process description, microbiology & technologies; Biological phosphorus removal - process description, microbiology & technologies

(8 Lectures)

Unit 4: Biological sludge stabilization

Anaerobic digestion, aerobic digestion, composting - process description and microbiology; Sludge pre-treatment.

(12 Lectures)

Suggested readings:

1. Tchobanoglous, G., Burton, F. L. and Stensel H. D. (2003) *Wastewater engineering: treatment and reuse*, McGraw-Hill Science, USA.
2. Crittenden, J. C., Trussell, R. R. and HandD. W. (2005). *Water treatment: principles and design*,2nd edition, Wiley Publishers, USA.
3. Grady, C.P. Leslie, G.T. Daigger, and H.C. Lim, (1999) Biological Wastewater Treatment, Second Edition, Marcel Dekker, Inc., New York
4. Viessman. W, Jr. and Mark J. (1998) Hammer Water supply and pollution control, 6th edition, Addison Wesley Longman, Inc.

Course Title: Bioenergy and Bioproducts

L	T	P	C	Marks
5	1	0	5	100

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Paper Code: EVS 713

Unit 1: Introduction

Bioenergy- Prospects and challenges; Types- first, second, third and fourth generation biofuels, conversion routes of biomass to bioenergy; Biodiesel production; Bioproducts-Microbial metabolites, conversion processes - Fermentation, Factors influencing metabolite production, Pathways. (12 Lectures)

Unit 2: Fermentation for bioenergy production

Bioethanol-Ethanol production from starch, sugar; lignocellulosic ethanol- pretreatments, saccharification, enzymatic hydrolysis, fermentation; metabolic pathways; factors; ABE fermentation.Biogas - feedstocks; processes in anaerobic fermentation; properties and composition of biogas, biogas plant- components, types; factors effecting biomethane formation; Biosolids- properties and application. Biohydrogen fermentation-Hydrogen production routes from biomass- dark, photo fermentation; metabolic process; factors; advances in hydrogen production- Genetic engineering, waste water utilization; Microbial fuel cell- principle and technology; ; algal biofuel- production, benefits and challenges. (16 Lectures)

Unit 3: Biopolymers

Natural biopolymers- Cellulose, Protein, Nucleic acids; Biocomposites, Biofibres; Bioplastics:Types- Poly hydroxyalkanoates, Polylactic acid, Properties, Feedstocks; Production process, Biodegradation; Applications, Environmental impacts. (14 Lectures)

Unit 4: Biorefinery

Concept of biorefinery;Applications-Energy, Fuel, Chemicals; Biorefinery of lignocellulose-Products from cellulose, hemicellulose, lignin; Paper and pulp industry; Enzyme production by solid state fermentation - cellulolytic,pectinolytic,ligninolytic,amylolytic and lipolytic enzymes; Environmental importance. (12 Lectures)

Suggested readings:

1. Michele Aresta, Angela Dibenedetto and Frank Dumeignil. (2012). Biorefinery: From Biomass to chemicals and fuels. Walter De Gruyter Publishers, Germany.
2. Levy, S.L. (2011). Biofuels, Biorefinery and renewable energy: Issues and Developments. Nova Science Publishers, USA.
3. Johnson, R.M., Mwaikambo,L.Y. and Tucker.N. (2003). Biopolymers. Smithers Rapra Technology Publishers, United Kingdom.
4. Brain McNeil and Linda Harvey. (2008). Practical Fermentation Technology. Wiley Publishers, United Kingdom.
5. EIRI Board. (2010). Modern Technology of Bioprocessing (Fermentation, Food, Enzyme, Pharmaceutical Industrial, Agricultural and Energy). Engineers India Research Institute Publishers,New Delhi.
6. Stansbury, P.F. (1999). Principles of Fermentation Technology, 2nd Edition. Butterworth-heinemann. Burlington, MA.
7. Pandey, A., Larroche, C. and Carlos Ricardo Soccol. and Claude –Gilles Dussap. (2009). Advances in Fermentation Technology. Asiatech Publishers Inc, New Delhi

CENTRE FOR ENVIRONMENTAL SCIENCES AND TECHNOLOGY
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Course Title: Applications of Remote Sensing and GIS in Environmental Management
Paper Code: EVS 714

L	T	P	Cr	Marks
5	1	0	5	100

Unit 1: Methods in Geosciences-An overview of GIS, GPS, Remote Sensing, Google Earth
Georeferencing; Digitization; Active and passive remote sensing; Types of platform; T ypes of orbits (Geostationary, Polar, Sun-synchronous); Scanning Systems (Pushbroom and Whiskbroom); Types of Sensors; GPS; Google Earth.

(10 Lectures)

Unit 2: GIS - Basic Concepts and Spatial Analysis
Concept of space and time; Elements of GIS; Map Projection; Data structures in GIS: Raster and Vector data, Hierarchical, Network and relational data, Geo-relational and object oriented vector data structure; Vector and Raster based analysis; Overlays operations; Map algebra; Grid based operations; Buffering; Network Analysis; Terrain Analysis; Spatial analysis (Supplemented with laboratory Practicals).

(14 Lectures)

Unit 3: Remote Sensing – Energy response mechanism and Digital Image Processing
Definition; Electromagnetic Radiation (EMR) spectrum; Types of Resolutions: Spatial, Spectral, Radiometric and Temporal; Spectral signatures; Energy response mechanism; Atmospheric windows; Basic geometric characteristics of aerial photographs; Scale; Resolution; overlaps; flight planning; factors governing interpretability; Elements of photo interpretation; False Colour Composite (FCC); Image Fusion; Image contrast; stretching and image filtering, Multispectral remote sensing, Remote Sensing of water and land surface features, Unsupervised and supervised classification, accuracy assessment (Supplemented with laboratory Practicals).

(18 Lectures)

Unit 4: Environmental Applications of Remote Sensing and GIS
Role in environmental modelling and management; natural hazard management (floods, landslides, earthquakes); monitoring water quality and soil quality; wasteland mapping; mineral/oil exploration; resource management; Environmental Impact Assessment (EIA) studies; site-suitability analysis; land use mapping; lithological and structural mapping; hydrogeological studies and groundwater zonation mapping, role of GIS in studying air pollutants dispersal and its modelling. (14 Lectures)

Suggested Readings

1. Lillesand, T.M., Keifer, R.W. and Chipman J.W. (2007). Remote Sensing and Image interpretation, Wiley India Pvt Ltd., India.
2. John R. Jensen (2008). Remote Sensing of the Environment (2nd Ed.) Dorling Kindersley India.
3. Basudeb Bhatta (2008). Remote Sensing and GIS, Oxford University Press, USA.

4. Hamlyn G. Jones and Robin A. Vaughan (2010). Remote Sensing Of Vegetation: Principles, Techniques, and Applications, Oxford University Press, USA.
5. Andrew Skidmore, Hendrik Prins (2010). Environmental Modelling with GIS and Remote Sensing, CRC press.
6. Chang, Kang-taung (2002). Introduction to Geographic Information Systems, Tata McGraw-Hill Publishers, USA.
7. Critchfield H. J. (2009). *General climatology*, PHI Learning, New Delhi.
8. Singh, S.(2011), *Physical geography*, PrayagPustakBhavan, Allahabad.
9. Strahler, A.N. and Strahler, (1996). *An introduction to physical geography*. John Wiley & Sons, UK.