SURESH GYAN VIHAR UNIVERSITY

Accredited by NAAC with 'A' Grade

Teaching and Examination Scheme

To commence from the Academic year: 2018-2020

Department: School of Applied Sciences **Year: I**

Program : M.Sc. Environmental Science **Semester-I**

S. No.	Course Code	Course Name	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
				L	T/S	P		CE	ESE
	(A)University Core:								
1.	PC-501	Proficiency in Co-Curricular Activity	2	0	0	0		100	
	FD102	Foundation Course-I	1	1	0	0	3	25	75
	(B)Program Core:Theory								
2	MES 501	Ecology and Ecosystem	3	3		-	3	40	60
3	MES 503	Biodiversity and Conservation	3	3		-	3	40	60
4	MES 505	Air and water pollution control	3	3		-	3	40	60
5	MES 507	Environmental Issues: Regional and Global	3	3		-	3	40	60
6	MES 509	Design of Physicochemical Treatment system	3	3		-	3	40	60
	ProgramCore: Practical								
7	MES 551	Practical-I	2			3	4	60	40
8	MES 553	Minor Project -I	3			3	2	60	40
9	MES 555	Seminar–I	1		2			60	40
	(C)Program Elective: •								
	(D)Open Elective: •								

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Teaching and Examination Scheme

To commence from the Academic year: 2018-2020

Department: School of Applied Sciences **Year: I**

Program: M.Sc. Environmental Science **Semester-II**

S.No.	Course Code	Course Name	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
				L	T/S	P		CE	ESE
	(A)University Core:								
1	PC-502	Proficiency in Co-Curricular Activity	2					100	
2	EM-502	Employability Skills I	1		0	2	3	60	40
	FD104	Foundation Course-II	1	1	0	0	3	25	75
	(B)Program Core:Theory								
3	MES 502	Solid and Hazardous Waste Management	3	3		-	3	40	60
4	MES 504	Environmental Policies, Legislation and Ethics	3	3		-	3	40	60
5	MES 506	Sustainable Development and Green City	3	3		-	3	40	60
6	MES 508	Environmental Disasters and Management	3	3		-	3	40	60
7	MES 510	Instrumentation for Environmental Monitoring and Analysis	3	3		-	3	40	60
	ProgramCore: Practical								
8	MES 552	Practical-II	2			3	4	60	40
9	MES554	Seminar–II	1		2			60	40
10	MES 556	Minor Project -II	3			3	2	60	40
10	MES 558	Industrial Training	1						100
	(C)Program Elective:								
	D)Open Elective:								

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Teaching and Examination Scheme

To commence from the Academic year: 2018-2020

Department: School of Applied Sciences **Year: II**

Program: M.Sc. Environmental Science **Semester-III**

S. No.	Course Code	Course Name	Credits	ContactHrs/Wk.			Exam Hrs.	Weightage (in%)	
				L	T/S	P		CE	ESE
	(A)University Core:								
1.	EM-601	Employability Skills II	1			2	3	60	40
2.	PC-601	Proficiency in Co-CurricularActivity	2					100	
	(B)Program Core:Theory								
3	MES 601	Environmental Impact Assessment	3	3		-	3	40	60
4	MES 603	Environmental Clearance and Environmental Audit	3	3		-	3	40	60
5	MES 605	Renewable Energy Technology	3	3		-	3	40	60
6	-	**Elective I**	3	3		-	3	40	60
7	-	**Elective -II**	3	3		-	3	40	60
	ProgramCore: Practical								
8	MES 651	Practical-III	2			3	4	60	40
9	MES 653	Minor Project -III	3			3	2	60	40
10	MES 655	Seminar–III	1		2			60	40
	(C)*Program Elective: •								
	(DOpen Elective:								

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List of Programme Elective - III SEM

S. No.	Course Code	Course Name	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
				L	T/S	P		CE	ESE
1	MES 607	Design of Biological Treatment System	3	3			3	40	60
2	MES 609	Life Cycle Assessment and Design of Environment	3	3			**3**	40	60
3	MES 611	Environmental Microbiology	3	3			**3**	40	60
4	MES 613	Environmental Chemistry	3	3			**3**	40	60
5	MES 615	Statistics, Environmental Modelling and Research	3	3			**3**	40	60
6	MES 617	Remote Sensing and GIS Applications in Environment Management	3	3			**3**	40	60

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Teaching and Examination Scheme

To commence from the Academic year: 2018-2020

Department: School of Applied Sciences **Year: II**

Program: M.Sc. Environmental Science **Semester-IV**

S. No.	Course Code	Course Name	Credits	Contact Hrs/Wk.			Exam Hrs.	Weightage (in%)	
				L	T/S	P		CE	ESE
		A. Practical& Sessional:							
1	MES 602	Dissertation/Project Work	20			-	2		100
		Total	**20**				**-**	**-**	**-**

MES 501	**Ecology and Ecosystem**
Version	I
Prerequisite	Basics of Environmental Studies
Objectives:	To introduce about ecological modeling, single and multi species modeling. Introduce the concepts of river and stream water modeling, water quality parameters modeling. To educate about the microbial energetic in various reactors systems.
Expected Outcome	Developed conceptual schematics required for Ecological system analysis and an ability to translate pertinent criteria into system requirements
UNIT-I	**Ecology and Ecological factors**
Ecology as an interdisciplinary subject, Biosphere, origin of life and speciation. Structure and Composition of atmosphere, hydrosphere, lithosphere and biosphere. Climatic and soil factors, Laws of limiting factors – Liebig's law of minimum, Shelford's law of tolerance. Abiotic and Biotic factors and interactions- Co-evolution, Neutralism, symbiosis, commensalism, mutualism, antagonism, antibiosis, parasitism, predation; competition- inter and intra specific.	
UNIT-II	**Population and Community**
Levels of Organization, population characteristics, population regulation– biotic potential and environmental resistances (r and k selections); Factors of population regulation – density dependent and density independent; and carrying capacity; genecology, Ecads, Ecotypes, Ecospecies, Niche, Keystone species, invasive species. Genetic model for range extensions. Community – analytical and synthetic characters; Ecotone, Edge effect.	
UNIT –III	**Ecosystem**
Concept, structure, function and types- abiotic and biotic components, food chain, food web; Ecological pyramids Ecological energetics - The Energy flow in Biosphere and in Ecosystems. Laws of thermodynamics, h and y shaped models, ecological efficiency, biogeochemical cycles- pools and fluxes, cycling ofnitrogen, carbon, phosphorus, sulphur, calcium. Primary and secondary productivity.	
UNIT-IV	**Integrated Principles of Ecosysytem**
Ecosystem stability and homeostasis, McArthur hypothesis, stability indices, biodemographic and biogeochemical regulation, Development and evolution (succession) in an ecosystem, tabular and microcosm models of stability.	
UNIT-V	**Ecosystem Diversity**
Characteristics of Terrestrial and aquatic ecosystem (lotic, lentic, eusturine, wetlands, mangrove, grassland, forest, desert, mountain). Biomes- classification, characteristics and distribution.	
Text Book	1. Begon, M., Townsend, C. R., and Harper, J. L.. Ecology from Individuals to Ecosystems. Wiley-Blackwell, USA. 2005. 2. Botkin, Daniel B. and Keller, Edward A. Environmental Science: Earth as a Living Planet. 6th ed. John Wiley & Sons, USA, 2007. 3. Chapman, J. L. and Reiss, M. J. Ecology: Principles and Applications. Cambridge University Press, UK., 1998. 4. Cunningham, W. P. and Cunningham, M. A. Principles of Environment Science. Enquiry and Applications. 2nd ed. Tata McGraw Hill, New Delhi, India, 2004. 5. Odum, E.P. Ecology: A Bridge between Science and Society. Sinauer Associates, Inc.,USA, 1997. 6. Rieley, J. O. and Page, S. E. Ecology of plant communities. Longman scientific and technical co published with John Wiley and Sons .1990.
Reference Books	1. Kemp, M. J. Environmental Science. The McGraw-Hill Companies. 1997. 2. Nebel, B. J. and Wright, R. T. Environmental Science. Prentice Hall.1981. 3. Odum, E.P. Fundamentals of Ecology. W.B. Saunders, USA. Indian Reprint 1996, Natraj Publishers, Dehradun, India, 1991.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 503	**Biodiversity and Conservation**
Version	I
Prerequisite	Basics of Environmental Studies
Objectives:	To introduce about biodiversity. Introduce the Forest resources, To educate about the microbial energetic in various reactors systems. To developed Conservation strategies
Expected Outcome	Developed conceptual schematics required for Conservation of Biodiversity and an ability to translate pertinent criteria into system requirements
UNIT-I	**Forest Resources**
Forest ecosystem goods and services, forest types, succession, forest resources of India, forestry programmes – social forestry, farm forestry, urban forestry, community forestry. Forest fragmentation. Plantations.	
UNIT-II	**Biodiversity**
Definition, Types of diversity and significance, criteria and measurement of biodiversity, factors affecting biodiversity, IUCN Criteria of endangerment, Red Data Books. Endemics and Epibiotics. Megabiodiversity nations, Hotspots of biodiversity, biodiversity.	
UNIT –III	**Conservation strategies**
in-situ conservation through participatory conservation, Protected Area network, biosphere reserves, National Parks, sanctuaries, sacred groves; ex-situ conservation, gene pools, germplasm banks.. Wildlife of India, Preservation of Breeding Stock; Artificial stocking and Habitat Improvement, Game Farming. Valuation of Biodiversity, Bioprospecting. Biopiracy. REDD.	
UNIT-IV	**Agrobiodiversity**
Vavilovian centres, Secondary centres of origin and spread, farmers varieties and land races, Wild relatives of cultivated plants. Registration of plant varieties. Long term and medium term conservation of germplasm. Field Gene banks, Role of National Bureaus in conservation of domestic and agrobiodiversity, livestock, microbes, insects, fishes.	
UNIT-V	**Biodiversity Conservation Efforts**
Convention on Biological Diversity, Rio Summit +5, Biosafety protocols, World Heritage sites, National Biodiversity strategy and Action Plan for different biogeographic regions.	
Text Book	1. Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA. 2007. 2. Enger, E.D. and Smith, B. F. *Environmental Science: A Study of Interrelationships*. 11th ed. McGraw Hill Inc., USA. 2006. 3. Frankel, O.H., Brown A.H.D. and Burdon, J.J. *Conservation of Plant Biodiversity*. Cambridge University Press, UK. 1995. 4. Gadgil, Madhav and Rao, P.R.S. *Nurturing Biodiversity: An Indian Agenda*. Centre for Environment Education, Ahmadabad, India. 1999. 5. Heywood, V.H. and Watson, R. T. *Global biodiversity Assessment*. UNEP-Cambridge, 1995.
Reference Books	1. Hunter, Malcolm L., Jr., and Gibbs, James P. *Fundamentals of Conservation Biology*. 3rd ed. Wiley-Blackwell. 2006. 2. Jeffries, M. *Biodiversity and Conservation*. 2nd ed. Routledge, UK. 1997. Reports And Statistics on Dynamic Ground Water Resources of India, Govt. Of India, Ministry of Water Resources.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 505	**Air and water pollution control**
Version	I
Prerequisite	Basics of Environmental Studies
Objectives:	To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends
Expected Outcome	After completion of this course, the student is expected to be able to: Apply sampling techniques Apply modeling techniques Suggest suitable air pollution prevention equipments and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards
UNIT-I	**Environmental pollution**
Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental Laws and rules, standards	
UNIT-II	**Pollution Prevention**
Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste utilization. Material and energy balance for pollution minimization. Water use minimization , Fugitive emission/effluents and leakages and their control-housekeeping and maintenance.	
UNIT –III	**Air Pollution Control**
Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, Design of cyclones, ESP, fabric filters and absorbers.	
UNIT-IV	**Water Pollution Control**
Physical treatment, pre-treatment, solids removal by setting and sedimentation, filtration centrifugation, coagulation and flocculation.	
UNIT-V	**Biological Treatment**
Anaerobic and aerobic treatment biochemical kinetics, trickling filter, activated sludge and lagoons, aeration systems, sludge separation and drying."Pollution Control Acts, Rules	
Text Book	1. Vallero D;"Fundamentals ofAir Pollution", 4 th Ed;Academic Press. 2. Eckenfelder W.W;"Industrial Water Pollution Control", 2Ed; McGraw Hill. 3. Kreith F. and Tchobanoglous G.,"Handbook of SolidWaste Management", 2 Ed; Mc Graw Hill. 4. Pichtel J;"Waste Management Practices: Municipal,Hazardous and Industrial", CRC.
Reference Books	1. Tchobanoglous G.,Burton F. L. and Stensel H.D.,"WasteWater Engineering: Treatment and Reuse", 4th Ed; TataMcGraw Hill.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 507	**Environmental Issues: Regional and Global**
Version	I
Prerequisite	Basics of Environmental Studies
Objectives:	To introduce the emerging concepts of climate Change and projecting future climate change, understand data analysis and application.
Expected Outcome	After completion of this course, the student is expected to be able to: Understand Global Issue and their solution Apply Sustainable techniques
UNIT-I	**Population**
Population explosion, Malthusian theory, Population distribution, population un-sustainability, population growth, population pyramids, pattern of India population, scale of urbanization, migration trends- rural and urban, Population displacement due to developmental projects. International initiatives on population related issues.	
UNIT-II	**Environment and human health**
Hazardous chemicals, pesticides and their impact, polychlorinated biphenyls (PCBs), Lead, mercury, arsenic, cadmium, asbestos, dioxins. Environment and development, poverty and environmental degradation, water requirement, Community participation in water conservation, Water harvesting, role of NGOs in environmental protection. Social consequences of development and environmental changes,	
UNIT –III	**Global Issues**
Acid rain and its effects on ecosystems (flora, fauna and human beings). Ozone layer depletion, causes and consequences of Ozone depletion, CFCs, Montreal Protocol. Climate change, global warming- causes and impact of global warming, International initiatives to control global warming, Kyoto Protocol.	
UNIT-IV	**Natural Resources**
Depletion and regeneration of natural resources, Renewable and non- renewable resources, Biotic Resources- Forests, agriculture, fisheries, livestock, biodiversity and its conservation, Abiotic Resources- Surface and ground water, Energy, non-energy mineral resources, land resources, soil erosion, ecosystem services. Sustainable development	
UNIT-V	**Sustainable development**
Principles of sustainable development, Evolution of ideas about sustainability, Boundaries of sustainable development. Concept of environmentally sustainable development, Environmental dimensions of sustainability. Issues of environmentally sustainable urban environment, Sustainable transport indicators.	
Text Book	1. Rajagopalan, R. *Environmental Studies: From crisis to cure*, Oxford University Press, New Delhi, 2008.*in Public Health*. Jones and Bartlett Publishers, London, 2008. 2. Singh, J.S., Singh, S.P. and Gupta, S.R. *Ecology, Environment and Resource Conservation.* Anamaya Publishers, New Delhi, India. 2006. 3. UNEP. *Global Environment Outlook* 3. Geneva: UNEP, Global Resource Information Division. 2003. 4. World Commission on Environment and Development (WCED): *Our Common Future*, Oxford University Press, London. 1987.
Reference Books	1. Botkin, Daniel B. and Keller, Edward A. *Environmental Science: Earth as a Living Planet*. 6th ed. John Wiley & Sons, USA. 2007. 2. Cunningham, W. P. and Cunningham, M. A. *Principles of Environment Science. Enquiry and Applications*. 2nd ed. Tata McGraw Hill, New Delhi. 2004.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 509	**Design of Physicochemical Treatment system**
Version	I
Prerequisite	Basics of Environmental Studies
Objectives:	To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.
Expected Outcome	Developed conceptual schematics required for the treatment of water and wastewater and an ability to translate pertinent forcing criteria into physical and chemical treatment system.
UNIT-I	**Introduction**
Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physico-chemical treatment – Selection criteria-types of reactor- reactor selection-batch-continuous type-kinetics	
UNIT-II	**Treatment principles**
Physical treatment - Screening – Mixing, Equalization – Sedimentation – Filtration – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration electrodialysis, distillation – stripping and crystallization – Recent Advances. Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends	
UNIT –III	**Design of municipal water treatment plants**
Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifier – tube settling – filters – Rapid sand filters, slow sand filter, pressure filter, dual media Disinfection - Displacement and gaseous type - Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends.	
UNIT-IV	**Design of industrial water treatment plants**
Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –Flow charts – Layouts –Hydraulic Profile, PID - construction and O&M aspects – case studies, Residue management – Upgradation of existing plants, Recent Trends.	
UNIT-V	**Design of wastewater treatment plants**
Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks-sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization-Neutralization-Chemical Feeding Devices-mixers-floatation units-oil skimmer Flow charts – Layouts –Hydraulic Profile, PID, construction and O&M aspects – case studies, Retrofitting - Residue management – Upgradation of existing plants – Recent Trends.	
Text Book	1. Lee, C.C. and Shun dar Lin, "Handbook of Environmental Engineering Calculations", Mc Graw Hill, New York, 1999. 2. F.R. Spellman, "Hand Book of Water and Wastewater Treatment Plant operations", CRC Press, New York (2009). 3. David Hendricks, "Fundamentals of Water Treatment Process", CRC Press New York (2011).
Reference Books	1. Metcalf and Eddy, "Wastewater Engineering, Treatment and Reuse", Tata McGraw Hill, New Delhi, 2003. 2. Qasim, S.R., Motley, E.M. and Zhu.G. "Water works Engineering – Planning, Design and Operation", Prentice Hall, New Delhi, 2002.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 502	Solid and Hazardous Waste Management
Version	I
Prerequisite	Nil
Objectives:	To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment.
Expected Outcome	On completion of the course, the student is expected to be able to understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
UNIT-I	**Sources, classification and regulatory framework**
Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.	
UNIT-II	**Waste characterization and source reduction**
Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes – Waste exchange - Extended producer responsibility - Recycling and reuse	
UNIT –III	**Storage, collection and transport of wastes**
Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport	
UNIT-IV	**Waste processing technologies**
Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment-	
UNIT-V	**WASTE DISPOSAL**
Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.	
Text Book	1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil, “Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.
Reference Books	1. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York, 2001. 2. CPHEEO, “Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi, 2000. 3. Vesilind P.A., Worrell W and Reinhart, "Solid waste engineering", Thomson Learning Inc., Singapore, 2002. 5 Paul T Williams, "Waste Treatment and Disposal", Wiley, 2005
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 504	**Environmental Policies, Legislation and Ethics**
Version	I
Prerequisite	Basics of Environmental Studies
Objectives:	To introduce the emerging concepts of Environmental Policies To understand data analysis and application.
Expected Outcome	After completion of this course, the student is expected to be able to: Understand Acts, Rules and Regulations Apply Environmental Ethics and Landmark Judgments
UNIT-I	**Environmental Policy**
National Environmental Policy, National Policy on EIA and Regulatory framework, State Environmental issues and policy framework. Constitutional Provisions (Article 48A, 51A). Role of Ministry of Environment & Forests, Central and State Pollution Control Boards.	
UNIT-II	**Acts, Rules and Regulations**
Acts, rules and amendments thereof - Wildlife (Protection) Act 1972, Water (Prevention and Control of Pollution) Act 1974; Forest Conservation Act 1980, Environment (Protection) Act 1986, Environmental Protection Act & Environmental rules 1986. Air (Prevention and Control of Pollution) Act 1981; Bio-Medical Waste (Management & Handling) Rules, 1998; EIA rules, Hazardous Waste (Management, Handling Rules, 1989); Transboundary Movement Rules, 2008. Plastics manufacture, Sale and Usage Rules, 1999. Coastal Regulation Zones (CRZ) Rules 1991. Public Liability Insurance Act, 1991. Rules, Regulations and Guidelines given for Municipal Solid Waste [MSW]; Electronic Waste [EW]; Industrial Location Policy.	
UNIT –III	**Environmental Treaties and Conventions**
Evolution and development of International Environmental laws with reference to Stockholm Conference on Human Environment, 1972, Ramsar Convention on Wetlands, 1971, Montreal Protocol, 1987, Basel Convention (1989, 1992), Earth Summit at Rio de Janeiro, 1992, UNEP, GEF, UNFCC and IPCC, Kyoto Protocol, 1997; Earth Summit at Johannesburg, 2002. UN Summit on Millennium Development Goals 2000, Copenhagen Summit 2009.	
UNIT-IV	**Environmental Ethics and Landmark Judgments**
Value education, individual, community, corporate social responsibility. Movements related to Environment – Sacred groves, Bishnoi tradition, Chipko movement, Tehri dam, Sardar Sarovar, Narmada dam, Almatti dam, Silent Valley. Role of NGOs. Sustainable Development: Definition and concepts.	
UNIT-V	**Environmental policies & programmes in India**
Environmental policies & programmes in India- Institutions & National, Centres for Natural Disaster reduction, Supreme Court directive on introduction of subject of environmental studies at different levels, introduction of CNG in public transport. Compensatory Afforestation. Environmentally Significant Days.	
Text Book	1. Jaswal, P.S. and Jaswal, N. *Environmental Law*. PioneerPublications, Delhi. 2003. Leelakrishnan, P. *Environmental Law in India*. LexisNexis Butterworths Wadhwa, Nagpur. 2005. 2. Shastri, S.C. *Environmental law in India*. Eastern Book Co, Lucknow. 2008. 3. The Wildlife [Protection] Act, 1972 [as amended up to 1991, Natraj Publishers, Dehradun, India, 1994. 4. Tiwari, R. K. *Global Environmental Policies*. A B D Publishers.2007.
Reference Books	1. Constitution of India [Referred articles from Part-III, Part-IV and Part-IV-A]. CPCB, 2010, [Revised], *Pollution Control Acts, Rules and Notifications* Issued there under.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 506	Sustainable Development and Green City
Version	I
Prerequisite	Nil
Objectives:	Understand the opportunities and constraints that affect a city's ability to implement environmental policy
Expected Outcome	Identify and analyze the potential of policies that can make cities greener • Critically evaluate claims of urban environmental sustainability, and the merits of different approaches to quantifying a city's environmental impact •
UNIT-I	**Green City**
Definitions of Green City Significance to Urban Planning, Components and Hierarchy of GI; Regional Parks and Reserves, Protected Areas, Community Parks and Open Spaces, Conservation Corridors, Urban Rivers, Green Belts Etc. • Economic, Social and Environmental Benefits of Green Infrastructures.	
UNIT-II	**Ecosystem Services**
Ecosystem Services, Conceptual Exploration of 'Green Growth' Idea • Objectives of GI Planning From Regional to Neighborhood Scale; Land Conservation, Biodiversity Conservation, Protection of Fragmented Ecological Habitats, Restoration of Disturbed Habitats, Ecotourism, Managing Disaster Risks, Ameliorating Urban Heat Island Effect and Energy Conservation.	
UNIT –III	**Urban Space Quality**
Urban Space Quality, Community Health, Etc. • Approaches for Planning Green Infrastructures; Integration with Land Use Planning, Making Grey and Blue Infrastructures Efficient, Urban Regeneration through Enhanced Urban Landscapes and Design, Community Participation.	
UNIT-IV	**Introduction to Environmental Policies**
Introduction to Environmental Policies and Historical Overview of Environmental policies (Pre-Independence and Post-independence era).; An overview of Relationship between Environmental policies and Economics, Industries, Agriculture etc in so far as their Impact on Ensuring Sustainable Development/Environment ; Environmental Policy Instruments ; National Environmental Policies and Programmes in India.	
UNIT-V	**Sustainable Development**
Sustainable Development: Concept of and issues in Sustainable Development, Strategic Planning for Sustainable Development, Economic reforms and sustainable development.	
Text Book	
Reference Books	
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 508	Environmental Disasters and Management
Version	I
Prerequisite	Nil
Objectives:	To educate the students on aspects of Disaster Management Develop the different Disaster Management technique
Expected Outcome	Ability to identify the environmental problems in Disaster Management
UNIT-I	**Disaster**
Causes and phases of disaster, Rapid onset and slow onset disasters. Nature and responses to geo-hazards, trends in climatology, meteorology and hydrology. Seismic activities. Changes in Coastal zone, coastal erosion, beach protection. Coastal erosion due to natural and man made structures.	
UNIT-II	**Floods and Cyclones**
Causes of flooding, Hazards associated with flooding. Flood forecasting. Flood management, Integrated Flood Management and Information System (IFMIS), Flood control. Water related hazards- Structure and nature of tropical cyclone, Tsunamis – causes and physical characteristics, mitigation of risks.	
UNIT –III	**Earthquakes**
Causes and characteristics of ground-motion, earthquake scales, magnitude and intensity, earthquake hazards and risks, Volcanic land forms, eruptions, early warning from satellites, risk mitigation and training, Landslides, rock-falls, avalanches, mine related hazards and mitigation.	
UNIT-IV	**Mitigation efforts**
UN draft resolution on Strengthening of Coordination of Humanitarian Emergency Assistance, International Decade for Natural Disaster Reduction (IDNDR), Policy for disaster reduction, problems of financing and insurance. Training for emergency. Regulation/guidelines for disaster tolerance building structures.	
UNIT-V	**Coastal Disaster**
A regional survey of Land Subsidence, Coastal Disaster, Cyclonic Disaster & Disaster in Hills with particular reference to India, Ecological planning for sustainability & sustanable development in India-Sustainable rural development:A Remedy to Disasters, -Role of Panchayats in Disaster mitigations, Environmental policies & programmes in India-Institutions & National, Centres for Natural Disaster reduction	
Text Book	1. Gautam Ashutosh. *Earthquake: A Natural Disaster*, Ashok Publishing House, New Delhi. 1994 2. Sahni, P.and Malagola M. (Eds.).*Disaster Risk Reduction in South Asia*, Prentice-Hall of India, New Delhi. 2003. 3. Sharma, V.K. (Ed.). *Disaster Management*, IIPA, New Delhi. 1995. 4. Singh T. *Disaster management Approaches and Strategies*, Akansha Publishing House, New Delhi. 2006 5. Sinha, D. K. *Towards Basics of Natural Disaster Reduction*, Research Book Centre, New Delhi. 2006 6. Smith, K. *Environmental Health, Assessing Risk and Reduction Disaster*, 3rd Edition, Routledge, London. 2001
Reference Books	1. Bolt, B.A. *Earthquakes* , W. H. Freeman and Company, New York. 1988 2. Carter, N,W. *Disaster Management: A Disaster Manager's Hand Book*, Asian Development Bank, Manila. 1992
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 510	**Instrumentation for Environmental Monitoring and Analysis**
Version	I
Prerequisite	Nil
Objectives:	To educate the students on aspects of Sampling Methods Development of different Analytical Instruments
Expected Outcome	Ability to Monitoring and Analysis techniques
UNIT-I	**Sampling Methods**
Sampling methodologies for Air, Water, Soil, Noise and Radioactivity in environmental matrices. Sampling protocols- Selection of sites, Time and frequency for sampling. Preservation, Storage and Handling of samples. Good Laboratory Practices.	
UNIT-II	**Analytical Instruments**
Principles, working and applications of High volume sampler, Respirable Sampler, Impactors, Cyclones, Particle Size Analyser, Gas Analysers, Spectrophotometer (UV-Visible), Flame Photometer, Atomic Absorption spectrophotometer (AAS).	
UNIT –III	**Advanced Microscopy and Chromatographs:**
Principles, working and applications of Phase contrast, fluorescent, polarization Microscopes, SEM. Gas Chromatograph (GC), GC-MS, HPLC, Ion chromatograph, X-ray diffraction, ED-XRF, WD-XRF, ICP-MS, ICP-AES	
UNIT-IV	**Radiation Detectors and Monitors**
Principles and working of radiation detectors- gas filled, scintillation (inorganic and organic) and semiconductor. Principles and working of Alpha Counter, Beta Counter, Gamma-ray Spectrometer, Liquid scintillation Counter, Beta-Gamma survey meters, Alpha, Beta and Gamma contamination Monitors.	
UNIT-V	**Special Analytical methods**
Special Analytical methods: Colorimetry, Spetctromentry, Flourimetry, Nephelometry, turbidimetry	
Text Book	1. De, A.K. *Environmental Chemistry*, New Age International, New Delhi. 2000. 2. Keith, L. H. *Principles of Environmental Sampling*. American Chemical Society.1988. Murphy, W.J. *Analytical Chemistry*, American Chemical Society, USA. 1977 3. Reeve, R. *Introduction to Environmental Analysis*. John Willey & Sns.2002. 4. Shukla, S. K. and Srivastava, P. R. *Methodology of Environmental monitoring and Assessment.* Commonwealth Publishers.1992.
Reference Books	1. Baird, C. and Cann, M. *Environmental Chemistry*. W.H. Freeman and Company 2008. Chatwal, G. R., and Anand, S. K. *Instrumental Methods of Chemical Analysis*. Himalaya Publishing House, Delhi. 2007.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 601	**Environmental Impact Assessment**
Version	I
Prerequisite	Nil
Objectives:	To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.
Expected Outcome	After the completion of course, the student will be able to understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts. The student will also know about the legal requirements of Environmental and Risk Assessment for projects.
UNIT-I	**Overview of EIA**
Objectives and development of EIA. Benefits of EIA, Indian directions of EIA**.** Rapid and comprehensive EIA perspectives. Sources and collection of data for EIA.	
UNIT-II	**EIA Methodology**
Outline of EIA process, Screening, Scoping, Purpose of scoping, impact implications, Baseline studies and superimposition of projected plant emission impacts, checklist, matrices, Overlays and Geographical Information System, Impact analysis and Predictions, Environmental Impact Statement [EIS]; Public hearing as part of EIA.	
UNIT –III	**Environmental Management and ISO Certification**
Environmental Management Systems (EMS), ISO 14000 (EMS). Components of Environmental Management System-Objectives, Policies, Implementation and Review. Life Cycle Analysis –LCA.	
UNIT-IV	**Public Participation**
Social impact assessment (SIA), Strategic Environmental Assessment (SEA), Public involvement, Public Hearing compulsion, restoration and rehabilitation methodologies, Mitigation criteria, Project modification, Post project analysis.	
UNIT-V	**Identification of process**
Identification of process operation imbalances resulting in resource loss and their impact on environment	
Text Book	1. Canter, L. Environmental Impact Assessment.2nd Edition. McGraw-hill Book Company, New York.1996. Cutter, S.L.. Environmental Risks and Hazards. Prentice Hall of India, New Delhi.1999. 2. Glasson, J. Therivel, R. and Chadwick, A.. Introduction to Environmental Impact Assessment. Routledge, London. 2006. 3. Kulkarni, V. and Ramachandra, T.V.. Environmental Management. Capitol Pub. Co., New Delhi. 2006. Morris, P. and Therivel R. (Eds) Methods of Environmental Impact Assessment. 2nd Edition, Spon Press London. 2001. 4. Paliwal, U.L. Environment Audit. Indus Valley Publications. Jaipur2002 5. Petts, J. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell 28 Publishers, UK 2005.
Reference Books	1. Anjaneyulu, Y. and Manickam, V. Environmental Impact Assessment Methodologies. B.S. Publications.2002. 2. Boland, R.G.A. (Ed) Environmental Management Training. Sterling Publishers Pvt. Ltd. New Delhi, 1993.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 603	**Environmental Clearance and Environmental Audit**
Version	I
Prerequisite	Nil
Objectives:	To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks.
Expected Outcome	After the completion of course, the student will be able to understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts. The student will also know about the legal requirements of Environmental and Risk Assessment for projects.
UNIT-I	**EIA Notification**
EIA in Indian context, EIA Notification 2006, Prior environmental clearance requirements, EIA authority - State and Central government, Committees for Environmental Clearance, Application for EC, Form 1- contents. Categorization of projects, list of projects, activity, financial overlays, conditions and specifications.	
UNIT-II	**Project types**
General idea, categorization criteria important considerations/features developmental projects - mining, cement industry, thermal power, pulp and paper industry, Road /highway construction.	
UNIT –III	**Reports for Environmental Clearance**
Generic structure of environmental impact assessment document – Executive summary of Project, Introduction, Project description, Project benefits, Policy legal and administrative framework, EIA methodology, Description of Environment, prediction of environmental impacts, evaluation of impacts, Environmental impact statement (EIS), Impact evaluation, Environmental Management Plan (EMP),	
UNIT-IV	**Environmental audit**
Objectives, frequency and criteria audit team, Environmental appraisal, accounting and environmental audit. Environmental guidelines for sitting of industry	
UNIT-V	**Environmental risk assessment and management**
Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipathway exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs-	
Text Book	1. GOI – Ministry of MoEF Gazette Notification under sub-rule (3) of Rule 5 of Environment (Protection) Rules. 2006. 2. Morris, P. and Therivel R. (Eds) Methods of Environmental Impact Assessment. 2nd Edition, Spon Press London. 2001. 3. Petts, J. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell Publishers, UK 2005. 4. Rajaraman, N. Environment Audit. The Management Accountant.1997. 29
Reference Books	1. Bose, S. and Parekh, A. The Environment Audit:-Holy Grail or Essential Management Tool. The Management Accountant.1994. 2. Corello, V. T., Mumpower, J. L., Stallen, P. J. M., Uppuluri, V. R. R. Environmental Impact Assessment,Technology assessment and Risk Analysis. Springer-Verlag Berlin Heidelberg.1985. 3. Glasson, J. Therivel, R. and Chadwick, A.. Introduction to Environmental Impact Assessment. Routledge, London. 2006
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 605	**Renewable Energy Technology**
Version	I
Prerequisite	Nil
Objectives:	To educate the students on aspects of Non-renewable Sources of Energy Development of different Analytical Instruments for Environmental implications
Expected Outcome	Ability to understand Biochemical conversion of waste to energy
UNIT-I	**Non-renewable Sources of Energy**
Fossil fuels-classification, composition, physico-chemical characteristic and energy content of coal, petroleum and natural gas. Gross-calorific value and Net- calorific value. Mining and uses of coal, oil and natural gas. Environmental impact of extraction, processing and smelting of minerals, recycling and recovery of resources.	
UNIT-II	**Renewable Sources of Energy**
Solar energy- Sun as a source of energy; solar radiation and its spectral characteristics, Harnessing of solar energy, Solar collectors, solar heaters, dryers, photovoltaic, solar ponds: Wind energy- harnessing of wind energy, wind mill; Generation of hydropower, tidal energy, ocean thermal energy conversion; Geothermal energy, Magneto-hydrodynamic power; Bio-energy- energy from biomass and biogas, anaerobic digestion.	
UNIT –III	**Nuclear energy**
Fission and fusion, Nuclear fuels – mining and processing of Uranium, concentration, Nuclear reators, Radioactive Waste Disposal -Concentration and Containment at Storage Site including at deep underground facilities , Delay for Decay of short lived radio nuclides, Dilution & Dispersion of residual waste; Bioaccumulation, Impact on environment.	
UNIT-IV	**Environmental implications**
Environmental implications of energy use; energy use pattern in India and the world, Renewable energy potential in India, emissions of CO2 in developed and developing countries including India, Impact of large scale exploitation of solar, wind, hydro and other renewable energy sources.	
UNIT-V	**Bio-chemical conversion of waste to energy**
Principles and Design of Anaerobic Digesters – Process characterization and control- The biochemistry and microbiology of anaerobic treatment - Toxic substances in anaerobic treatment - Methane generation by Anaerobic Digestion- Anaerobic reactor technologies - Commercial anaerobic Technologies- Single stage and multistage digesters- Digester design and performance-Gas collection systems-Methane Generation and Recovery in Landfills – Biofuels from Biomass	
Text Book	1. Ebbing, D.D., General Chemistry, (International 4th Edition) MA : Houghton Mifflin, Boston, 1993. Eisenbud, M.. , Environmental Radioactivity, Academic Press, Orlando, USA,1987. 2. Flowler, John M., Energy and the Environment, 2nd Edition, McGraw Hill, New York, 1984. 3. Santra, S.C. Environmental Science, 2nd Edition, New Central Book Agency (P) Ltd, Kolkata, India, 2005. 4. United Nations Scientific Committee on Effects of Atomic Radiation Report 2000, New York, USA, 2000. Weast R.C., Handbook of Chemistry and Physics, CRC Press, 1994. 5. Rao, P. S. and Rao, P. M. Environmental Management and Audit. Deep and Deep Publications.2000. Raymond, A. B. and Fenn, D. H. The Corporate Social Audit. Russell Sage Foundation New York.1992.
Reference Books	1. Andrew R.W., Jackson & Julie M. Jackson, Environmental Science – The Natural Environment and Human Impact, Addison Wesley Longman Limited, 1996. 12 Carless, Jennifer, Renewable Energy : A Concise Guide to Green Alternative, Walker, New York, 1993
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 607	**Design of Biological Treatment System**
Version	I
Prerequisite	
Objectives:	To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.
Expected Outcome	Developed conceptual schematics required for biological treatment of wastewater and an ability to translate pertinent criteria into system requirements.
UNIT-I	**Introduction**
Objectives of biological treatment – significance – Principles of aerobic and anaerobic treatment - kinetics of biological growth – Factors affecting growth – attached and suspended growth Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process- reactors-batch-continuous type.	
UNIT-II	**Aerobic treatment of wastewater**
Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactorsfluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfection – disposal options – reclamation and reuse – Flow charts, layout, PID, hydraulic profile, recent trends.	
UNIT –III	**Anaerobic treatment of wastewater**
Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds MBR, septic tank and disposal – Nutrient removal systems – Flow chart, Layout and Hydraulic profile – Recent trends.	
UNIT-IV	**Sludge treatment and disposal**
Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.	
UNIT-V	**Construction operations and maintenance aspects**
Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and Controlling of plant operations – capacity building - Retrofitting Case studies – sewage treatment plants – sludge management facilities.	
Text Book	1. Developed conceptual schematics required for biological treatment of wastewater and an ability to translate pertinent criteria into system requirements.
Reference Books	2. Arceivala, S.J., "Wastewater Treatment for Pollution Control", TMH, New Delhi, Second Edition, 2000. 3. Manual on “Sewerage and Sewage Treatment” CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999. 4. Metcalf & Eddy, INC, „Wastewater Engineering – Treatment and Reuse, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 609	**Life Cycle Assessment and Design of Environment**
Version	I
Prerequisite	Nil
Objectives:	To educate the structural design principles To educate the students on aspects of water retaining structures design Educating the product life cycle stages used in environmental engineering
Expected Outcome	Ability to apply integrated methods for impact assessment. Ability to do , environmentally conscious design. Ability to do the structural design of a complete water and wastewater treatment plant. Ability to do air pollution control devices design Ability to design for recycling practices
UNIT-I	**Engineering products and Processes**
Environment health and safety, Product life cycle stages, Material toxicity, pollution, and degradation, environmentally conscious design and manufacturing approaches, sustainable development, and Industrial ecology,. Eco-Lavels, Cleaner product concept, approaches, case Studies. Cleaner technologies for substitute assessment.	
UNIT-II	**Life Cycle Impact Assessment**
Concept, applications, framework standardization, scoping in impact analysis, conceptual framework of impact assessment, methods for characterising impacts, methods for conducting valuations, integrated methods for impact assessment.	
UNIT –III	**Design of Environment**
Motivation, concerns, definitions, examples, guidelines, methods and tools, recyclability assessment, design for recycling practices, re-manufacturability assessments, design for remanufacture/ Reuse practices. Industrial Ecology and Eco-Industrial Park.	
UNIT-IV	**Life- Cycle Analysis (LCA)**
LCA Concept, history, overview of LCA Methodology, Steps Tools, Identifying and setting Boundaries, inventory analysis, purpose and scope of inventory in different sectors, general issues in Life- Cycle inventory, Issues applicable to specific life-cycle stages, life cycle accounting and costing.	
UNIT-V	**Environmental Management**
ISO 14000 Environmental management standards, New business paradigms and associated design practices, Ecological risk and human risk, Eco-system impacts and uncertainty analysis, Application of LCA, Case studies of product LCA, Case Studies of process LCA, Limitationd of LCA, LCA project study.	
Text Book	1. Canadian Standards Association (1992). Environment Life Cycle Assessment. Onatario (Toronto), Canada: Canadian Standard association. 2. Jain, R.K. Urban, L.V. Stacey, G.S. Balbach, H.E. (1993). Environmental Assessment, Mc-Graw – Hills, New Yark.
Reference Books	1. Ciamborne, D. F. (1997), Environmental Life cycle Analysis, CRC Press.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 611	Environmental Microbiology
Version	I
Prerequisite	Basics of Biology
Objectives:	The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject. The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease causing organisms are also covered. An exposure to toxicology due to industrial products and by products are also covered.
Expected Outcome	The candidate at the end of the course will have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell. The candidate would be able to understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem. The candidate would have understood the role microbial metabolism in a wastewater treatment plant.
UNIT-I	**Classification and characteristics**
Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.	
UNIT-II	**Microbes and nutrient cycles**
Distribution of microorganisms – Distribution / diversity of Microorganisms – fresh and marine, terrestrial – microbes in surface soil, Air – outdoor and Indoor, aerosols, biosafety in Laboratory – Extreme Environment – archaebacteria – Significance in water supplies – problems and control. Transmissible diseases. Biogeochemical cycles-----Hydrological - Nitrogen, Carbon, Phosphorus, Sulphur, Cycle – Role of Micro Organism in nutrient cycle.	
UNIT –III	**Metabolism of microorganisms**
Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb‟s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.	
UNIT-IV	**Pathogens in wastewater**
Introduction to Water Borne pathogens and Parasites and their effects on Human, Animal and Plant health, Transmission of pathogens – Bacterial, Viral, Protozoan,and Helminths, Indicator organisms of water – Coliforms - total coliforms, E-coli, Streptococcus, Clostridium, Concentration and detection of virus. Control of microorganisms; Microbiology of biological treatment processes – aerobic and anaerobic, □ -oxidation, β-oxidation, nitrification and denitrification, eutrophication. Nutrients Removal – BOD, Nitrogen, Phosphate. Microbiology of Sewage Sludge.	
UNIT-V	**Toxicology**
Ecotoxicology – toxicants and toxicity, Factors influencing toxicity. Effects – acute, chronic, Test organisms – toxicity testing, Bioconcentration – Bioaccumulation, biomagnification, bioassay, biomonitoring, bioleaching.	
Text Book	1. Raina M. Maier, Ian L. Pepper, Charles P. Gerba, "Environmental Microbiology", Academic Press. 2. SVS. Rana, "Essentials of Ecology and Environmental Science", 3rd Edition, Prentice Hall of India Private Limited 3. Stanley E. Manahan, "Environmental Science and Technology", Lewis Publishers. 4. Hurst, C.J. (2002) Manual of "Environmental Microbiology". 2nd Ed. ASM PRESS, Washington, D.C. ISBN 1-55581 - 199 - X. 5. Frank C. Lu and Sam Kacew, LU‟s Basic Toxicology, Taylor & Francis, London (4th Ed), 2002
Reference Books	1. S.C.Bhatia, "Hand Book of Environmental Microbiology", Part 1 and 2, Atlantic Publisher 2. Gabriel Bitton, Wastewater Microbiology, 2nd Edition
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 613	**Environmental Chemistry**
Version	I
Prerequisite	Basics of Chemistry
Objectives:	To educate the students in the area of water, air and soil chemistry To impart knowledge on the transformation of chemicals in the environment
Expected Outcome	Students will gain competency in solving environmental issues of chemicals based Pollution Able to determine chemicals need calculations for treatment purpose Ability to identify contaminating chemicals
UNIT-I	**Introduction**
Stoichiometry and mass balance-Chemical equilibria, acid base, solubility product(Ksp) ,heavy metal precipitation, amphoteric hydroxides,CO2 solubility in water and species distribution – Chemical kinetics , First order- 12 Principles of green chemistry	
UNIT-II	**Aquatic chemistry**
Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation– Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction , pE – pH diagrams, redox zones – sorption-Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation .	
UNIT –III	**Atmospheric chemistry**
Atmospheric structure –-chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, CO2 capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination	
UNIT-IV	**Soil chemistry**
Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leachingHeavy metals by electrokinetic remediation.	
UNIT-V	**Environmental chemicals**
Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins,PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.	
Text Book	1. Colin Baird „Environmental Chemistry", Freeman and company, New York, 1997. 2. Manahan, S.E., "Environmental Chemistry", Eighth Edition, CRC press,2005. 3. Ronbald A. Hites ,"Elements of Environmental Chemistry", Wiley, 2007.
Reference Books	1. Sawyer,C.N., MacCarty, P.L. and Parkin, G.F., "Chemistry for Environmental Engineering and Science", Tata McGraw – Hill, Fifth edition, New Delhi 2003.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 615	**Statistics, Environmental Modelling and Research**
Version	I
Prerequisite	Nil
Objectives:	To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.
Expected Outcome	On completion of this course the students will be able to solve various problems in the field of engineering employing probability and statistical methods.
UNIT-I	**Climate Change and Climate Variability**
Introduction – Atmosphere - weather and Climate - climate parameters (Temperature ,Rainfall, Humidity, Wind etc) – Equations governing the atmosphere - Numerical Weather Prediction Models - Introduction to GCMs - Application in Climate Change Projections.	
UNIT-II	**IPCC SRES Scenarios**
Intergovernmental Panel on Climate Change (IPCC) - An Overview - Key Assumptions - Scenario Family - Storyline (A1, B1, A2, B2).	
UNIT –III	**Global Climate Model (GCM) and Regional Climate Model (RCM)**
Some typical GCMs (HadCM3Q-UK Met Office) - Issues with GCMs - Introduction to RCMs and LAMs - some typical RCMs like PRECIS, SimCLIM, MAGICC/SCENGENE - Advantages and Disadvantages of GCMs and RCMs.	
UNIT-IV	**Downscaling Global Climate Model - An Overview**
Need for downscaling - Selection of GCMs for regional climate change studies - Ensemble theory – Selection of - Ensembles, Model Domain (Spatial domain and temporal domain), Resolution and climate variables - Lateral boundary conditions - Methods of downscaling (Statistical and Dynamical) - examples from each and their limitations.	
UNIT-V	**Statistical Analysis /Post processing**
Multiple and Partial Correlation – Method of Least Squares – Plane of Regression – Properties of Residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation with total and partial correlations – Regression and Partial correlations in terms of lower order coefficient. Model validation - post processing – Introduction to Analysis tools - Ferret, R, Grads, IDL, SPSS, ArcGIS b. Climate change Impact - Vulnerability assessment – adaptation strategies.	
Text Book	1. McGuffie, K. and Henderson-Sellers, A. (2005) "A Climate Modelling Primer, Third Edition, John Wiley & Sons, Ltd, Chichester, UK. 2. Neelin David J, "Climate Change and Climate Modelling", Cambridge University Press 3. Thomas Stocker, "Introduction to Climate Modelling", Advances in Geophysical and Environmanetal Mechanics and Mathematics. Springer Publication
Reference Books	1. IPCC Fourth Assessment Report, Cambridge University Press, Cambridge, UK. 2. Barrat, Rod (2001). Atmospheric Dispersion Modelling, 1st Edition, Earthscan Publications. ISBN 1-85383-642-7.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	

MES 617	**Remote Sensing and GIS Applications in Environment Management**
Version	I
Prerequisite	Nil
Objectives:	To educate the students on aspects of Remote Sensing Develop the different remote sensing technique To educate the students on aspects of GIS and data management. Develop the GIS Applications for monitoring and management of environment
Expected Outcome	Ability to identify the environmental problems using Remote sensing Ability to apply the principle of RS and GIS for solving Environmental problems Ability to assess the Environmental Impacts using RS and GIS Ability to employ modern engineering tools in environmental studies Ability to function on a multi-disciplinary team
UNIT-I	**Remote sensing elements**
Historical Perspective, Principles of remote sensing, components of Remote Sensing, Energy source and electromagnetic radiation, Electromagnetic spectrum, Energy interaction, Spectral response pattern of earth surface features, Energy recording technology	
UNIT-II	**Remote sensing technology**
Classification of Remote Sensing Systems, , Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR	
UNIT –III	**Satellite remote sensing**
Satellites and their sensors, satellite orbits, Indian space programme - Research and development - ISRO satellites, LANDSAT, ERS, SPOT, TERRA and NOOA satellite series, Characteristics of Remote Sensing data ,Satellite data Products	
UNIT-IV	**Image processing and geographical information system**
Photogrammetry – Visual image interpretation, Digital image processing – Image rectification, enhancement, transformation, Classification, Data merging, GIS Concepts – Spatial and non spatial data, Vector and raster data structures, Data analysis, Database management – RS – GIS Integration, Image processing software, GIS software	
UNIT-V	**Case studies**
Monitoring and management of environment, Conservation of resources, Sustainable land use, Coastal zone management – Limitations – Case studies	
Text Book	1. Golfried Konechy, Geoinformation: "Remote sensing, Photogrammetry and Geographical Information Systems", CRC press, 1st Edition, 2002. 2. Burrough, P.A. and McDonnell, R.A., "Principles of Geographic Information systems" Oxford University Press, New York, 2001. 3. Lintz, J. and Simonet, "Remote sensing of Environment", Addison Wesley Publishing Company, New Jersey, 1998. 4. "Pmapler and Applications of Imaging RADAR", Manual of Remote Sensing, Vol.2, ASPR, 2001.
Reference Books	1. Lillesand, T.M. and Kiefer, R.W, "Remote sensing and image interpretation", John Wiley and sons, New York, 2004.
Mode of Evaluation: (Percent Weight-age)	
Recommended by BOS on :	
Adopted by Faculty on:	
Approved by Academic Council on :	