Kuvempu University

Department of Post Graduate Studies and Research in
ENVIRONMENTAL SCIENCE

M.Sc. Environmental Science

Programme Scheme, Syllabus and Model Question paper

(With Effect from August 2018)

Approved by the BOS held on 11th January, 2018 and Faculty (Science & Technology) meeting held on 27th February, 2018, Approved by Academic Council meeting held on 22-03-2018

(Ref: KU:Acad:AC-4(149):537:2018-19, dated 30-04-2018)

KUVEMPU UNIVERSITY

Department of Environmental Science
M.Sc., Environmental Science
Syllabus – Under Choice Based Credit System
(With effect from August 2018)

Scheme

I Semester

Paper code	Paper Title	Credit/Hrs		Total	Marks		Total marks
		Th	Pr		IA	Th/Pr	
ES. HC-1.1	Multidisciplinary Nature of Environmental Science	4	2	6	25	75	100
ES. HC-1.2	Environment and Ecosystem	4	2	6	25	75	100
ES.HC-1.3	Environment for Development	4	2	6	25	75	100
ES.SC-1.4	Aquatic Ecology	4	2	6	25	75	100
ES.SC-1.5	Radiation and Environment	4	2	6	25	75	100
ES.PrHC-1.1	Based on HC-1.1	-	-			50	50
ES.PrHC-1.2	Based on HC-1.2					50	50
ES.PrHC-1.2	Based on HC-1.3					50	50
ES.PrSC	Based on softcore paper- ES.SC-1.4/1.5					50	50
	Total			**24**	**100**	**500**	**600**

Note: Each student will take THREE Hardcore and ONE Softcore papers, totaling 24 credits and 600 Marks

II Semester

Paper code	Paper Title	Credit/Hrs		Total	Marks		Total marks
		Th	Pr		IA	Th/Pr	
ES.HC-2.1	Environmental Chemistry and Environmental Statistics	4	2	6	25	75	100
ES.HC-2.2	Environmental Pollution	4	2	6	25	75	100
ES.SC-2.3	Energy and Energy Resources	4	2	6	25	75	100
ES.SC-2.4	Solid Waste Management and Resource Recovery	4	2	6	25	75	100
ES.SC-2.5	Natural Resources and Conservation	4	2	6	25	75	100
ES.PrHC-2.1	Based on HC-2.1	-	-			50	50
ES.PrHC-2.2	Based on HC-2.2					50	50
ES.PrSC	Based on softcore paper- ES.SC-2.3/2.4/2.5					50	50
IDE	Environmental Education			2	10	40	50
	Total			**20**	**85**	**415**	**500**

Note: Each student will take TWO Hardcore and ONE Softcore and ONE IDE papers, totaling 20 credits and 500 Marks.

III Semester

Paper code	Paper Title	Credit/Hrs		Total	Marks		Total marks
		Th	Pr		IA	Th/Pr	
ES.HC-3.1	Environmental Engineering & Science	4	2	6	25	75	100
ES.HC-3.2	EIA, GIS and Environmental Microbiology	4	2	6	25	75	100
ES. SC-3.3	Global Environmental Changes & Natural Hazards	4	2	6	25	75	100
ES.SC-3.4	Water quality Science	4	2	6	25	75	100
ES.SC-3.5	Air Pollution Monitoring	4	2	6	25	75	100
ES.SC-3.6	Environmental Nano-Science	4	2	6	25	75	100
ES.PrHC-3.1	Based on HC-3.1	-	-			50	50
ES.PrHC-3.2	Based on HC-3.2					50	50
ES. Pr SC	Based on softcore paper- ES.SC-3.3/3.4/3.5/3.6					50	50
IDE	Drinking water Resources, quality & management			2	10	40	50
	Total			**20**	**85**	**415**	**500**

Note: Each student will take TWO Hardcore and ONE Softcore and ONE IDE papers, totaling 20 credits and 500 Marks

IV Semester

Paper code	Paper Title	Credit/Hrs		Total	Marks		Total marks
		Th	Pr		IA	Th/Pr	
ES.HC-4.1	Ecotoxicology	4	2	6	25	75	100
ES.HC-4.2	Occupational Health and Safety & Environmental Law	4	2	6	25	75	100
ES.PrHC-4.1	Based on HC-4.1	-	-			50	50
ES.PrHC-4.2	Based on HC-4.2					50	50
	PROJECT WORK			4			200
	Total			**16**	**85**	**415**	**500**

Note: Each student will take TWO Hardcore and ONE Project work, totaling 18 credits and 400 Marks

Overall, M.Sc. Environmental Science has 82 Credits, with 2000 total Marks

Approved by BOS meeting held on 11th January 2018 and Faculty (Science & Technology) 27th February 2018

The Scheme and syllabus is effective from July/August 2018 admissions.

I SEMESTER

ES. HC-1.1: Multidisciplinary Nature of Environmental Science….64 Hrs

Unit 1: ***Introduction***: Multidisciplinary and interdisciplinary nature of environments; importance of various subjects; biology, physics, statistics, microbiology, bio-chemistry, geology, toxicology, engineering, economics, law and sociology in environmental studies. -8 hrs

Unit 2: ***Fundamentals of environmental chemistry and geochemistry***: Chemistry: Scope: of environmental chemistry, Stoichometry, Gibb's energy, Chemical potential, Chemical equilibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system. Geochemistry: Fundamental concepts, structure and components of geosphere; lithosphere, hydrosphere, and atmosphere. Energy budget of the earth. Climates of India. -12 hrs

Unit 3: ***Physical aspects of environment***: The solar system and meteorology: sun as a source of energy, nature of its radiation; heat budget of earth; earth's temperature and atmosphere. Meteorology fundamentals: pressure; temperature; wind; humidity; radiation; atmospheric stability; turbulence and diffusion. Radiation and environment: discovery of radioactivity- Units and definition of radioactivity. Radiation from cosmic origin; ionizing and non-ionizing radiations. Methods of radioactive measurements -12 hrs.

Unit 4: ***Environmental Biology***: Basic ecological principles and concepts; scope of ecology; principles and concepts of ecosystem; types of ecosystem; terrestrial and aquatic. Flow and energy fixation, construction of ecological pyramids. Primary succession, secondary succession and ecological climax, impacts of development of ecosystem, population, community ecology, predator and prey relationship. - 12 hrs.

Unit 5: ***Social environment***: Social, economic, agriculture and industrial issues of environment; Socio cultural habits in human communities. Demand for food and environmental crises. Basic concepts of sustainable development, social environmental issues and urban problems related to energy. Water conservation, rain water harvesting and watershed management. -10 hrs

Unit 6: ***Institutions for environment conservation***: Bombay Natural History Society (BNHS). World Wide Fund for nature (WWF); Centre or Science and Environment (CSE), Centre for Environmental Education (CEE), Kalpavriksh, Salim Ali Centre for Ornithology and Natural History (SACON); Wildlife Institute of India (WII), Botanical Survey of India (BSI), Zoological Survey of India (ZSI). - 10 hrs.

Practical:

1. Good Laboratory Practices- guidelines
2. Determination of Surface Tension and Density of water
3. Determination of Viscosity of water sample
4. Determination of Acidity, Alkalinity and pH of Water Samples
5. Normality; Molarity; Equivalent weight of elements and compounds
6. Acid Base Reaction
7. Instrumentation: pH meter, colorimeter, spectrophotometer, BOD incubator, Turbidity meter, Portable Weather Station.

Reference (Latest Edition of the Following)

1. E. P Odum and G.W. Barret. Fundamentals of Ecology.
2. Chapman, JL and Reiss, MJ. Ecology principles and application. Cambridge University press.
3. Write R and Boorse, D. Environmental Science— Toward a Sustainable Future: International Edition.
4. Master, G Joseph. K, Nagendran R. Introduction to Environmental Science and Engineering. Pearson Education, Singapore.
5. Ronald A Bailey, Herbert M Clark, James P Perris, Sonja Krause, Robert L Strong. Chemistry of Environment, Academic Press.

ES. HC-1.2: Environment and Ecosystem ……64 hrs

Unit 1: ***Environment:*** Definition of Environment; Development and environment; the pursuit of development. Basics of Structure and function of Environment; Ecology; environment; Ecosystem function-classification of environmental system- by function-isolated systems; closed systems and open systems; by degree of human disturbance-Natural system; modified system and controlled systems; Environmental limits; Environmental Crisis. ---10 Hrs

Unit 2: ***Energy in Ecological System***: Definition of ecosystem; abiotic and biotic components. Ecological relationships. Energy of life; sources of energy in the earth ecosystem; the first and second law of thermodynamics. Concept of productivity. The flow of energy through ecosystem; Food chain, food web and trophic levels; Produces, consumer and decomposers-Ecological pyramids. ….10 hrs

Unit 3: ***Ecosystem and Living Things*****:** Interaction of living organisms: Niche, competitive exclusion, Limiting factors, co-evolution, symbiosis-Mutualism, Commensalism, Parasitism. Changes in communities over time- primary and secondary succession-pioneer community, climax community, climax community. …10 hrs

Unit 4: ***Ecosystem and the Physical Environment*****:** The cycling of material within ecosystem-biogeochemical cycle- the carbon cycle, Nitrogen cycle, Phosphorus cycle and Hydrologic cycle. Physical Environment; climate, sun-solar energy, wind- atmospheric circulation, Oceanic currents, types, patterns and importance. …..10 hrs

Unit 5: ***Major Ecosystem of the World***: Geography of life. Salient features and characteristics of biomes; major terrestrial biomes- Tundra, Taiga, Temperate forest, Grasslands. Deserts, Savanna, Tropical Rain Forests. Aquatic Biomes and Life zones; Freshwater ecosystems- lentic and lotic. Estuaries, Marine. …10 hrs

Unit 6*:* ***Population and Biotic Community:*** Concept of population, community, ecosystem, biosphere and ecosphere. Population density, abundance, indices. Population attributes- natality, mortality, emigration, immigration, distribution. Population growth form and concept of carrying capacity. Population regulation, dispersal, population energy flow. Allele's principle. Population interactions. Principles of Limiting factors; Liebigs law of minimum, Shelford law of tolerance. Ecological indicators. Human population explosion and consequences. Biotic community Concept, Intercommunity classification; Concept of Ecological dominance. Community analysis, Species diversity in communities, Patterns in communities. Ecotone and edge effect. …. 14 hrs.

Practical-

1. Primary productivity of Pond- light and dark bottle experiment
2. Producers and consumers of pond ecosystem- Enumeration
3. Relationship between producers and consumers of pond ecosystem- Number and biomass
4. Guild of biotic community- based on feeding (example fish)
5. Diversity indices- Shannon-wiener, Simpson and Brullion index.
6. Adaptation of organisms to swift flowing water (Example fish)
7. Identification of Benthic communities of River
8. Survey and Sampling techniques (quadrates, line transect) in forest

References: (Latest Edition of the Following)

1. Peter H. Raven, David M. Hassenzahl, Mary Catherine Hager, Nancy Y. Gift, Linda R. Berg. Environment. John Wiley and Sons, Inc. UK.
2. Eugene P. Odum: Fundamentals of Ecology. Cengage Learning
3. Hynes HBN. The ecology of Running Waters. Liverpool University Press
4. Begon M, Harper JL, Townsend CR. Ecology- Individuals, Populations and Communities. Blackwell Scientific Publications. London

ES. HC-1.3: Environment for Development …..64 hrs

Unit 1: ***Our common future*****:** Link between development and Environment; Evolution of Ideas and action – Interrelationship among environment; economic and social issues; population and human resources; food security; species and ecosystem; energy; industry and urbanization. Remedy towards sustainable development - 10 hrs

Unit 2: ***Agenda 21:*** Comprehensive plan of action towards sustainable development- social and economic issues; poverty, human health and population; - conservation and management of natural resources – atmosphere; forests; biological diversity; wastes and toxic chemicals. Role of local authorities, women, farmers, children and youth, indigenous peoples, workers and trade unions, NGOs, the scientific and technological community, and business and industry in implementing sustainable development. Means of implementation- technology transfer; financing; science; education and public information. -12 hrs

Unit 3: ***Environment as a foundation for development*****:** Human beings as centre of concerns for sustainable development and their relationship to a healthy and productive life in harmony with nature. Concept of good development- increasing the asset base and its productivity; empowering poor people and marginalized communities; reducing and managing risks; and long-term perspective for intra- and intergenerational equity. -10 hrs

Unit 4: ***Human Wellbeing*****:** Health- complete physical, mental and social wellbeing; material need and ecosystem goods and services for ecofriendly livelihood; environmental security; Environmental change and human well-being. --10 hrs

Unit 5: ***Environmental changes- pressures and drivers*****:** demographic changes, economic demand and trade, science and technology, institutional and socio-political frameworks - state of the environment with impacts on the environment itself, and on society and economic activity (changes in emissions, land use and resource extraction).
-10 hrs

Unit 6: ***Drivers of Environmental changes***: Massive population increase; Rapid technological innovation; explosion in energy use and economic integration. Affluence; Technology; poverty; market failure; policy/political failure; economic growth; nature of economic system; culture and values; forces of globalization. Consequences of degradation on environmental quality and sustainability. -12 hrs

Practicals

1. Study of Millennium Development Goal of UNEP
2. Collection and identification of herbs used by local community for medicine
3. Identification of local/indigenous wild fruits
4. Collection, identification and assessing the economic values of local food crops
5. Collection and identification of oil yielding native plant seeds
6. Estimation of Oil in native plant seeds
7. Isolation and estimation of active ingredients of herbs
8. People Biodiversity Register

References (Latest Edition of the Following):

1. Bill Adams. Green Development: Environment and Sustainability in a Developing World. Routledge Publisher. Oxon.
2. Diego Martino and Zinta Zommers. Environment for Development, UNEP

Soft-core papers

ES. SC-1.4: Aquatic Ecology …….64 hrs

Unit 1. ***Aquatic Environment***: Introduction; Classification and structure of aquatic environments; Freshwater, marine and brackish water ecosystems; distinctive features and importance. …10 hr.

Unit 2. ***Aquatic Ecosystems***: ***Freshwater Ecosystem***-Introduction; classification; lentic (lake, reservoir, pond, bog, marsh, swamp, pool) and lotic system (river, tributaries, stream, glacial streams, nullahs, seepage streams); Salient features of each type. Origin of rivers. ***Marine ecosystem*****:** the marine environment, physico-chemical properties, Oceanic phenomenon of thermal current; thermohaline circulation. Stratification of marine habitat. ***Estuarine Ecology*****:** Definition and classification, nutrient and water current in estuary. Effect of Climate change on all aquatic ecosystems. …12 hrs

Unit 3. ***Biodiversity of Aquatic ecosystems:*** Plankton: Phyto and Zooplankton, Inter relationship: Macrophytes: Adaptation and succession. Types of macrophytes and their role in ecosystem; Important fauna and flora of lentic and lotic systems. Limiting factors controlling distribution of fauna and flora in lentic, lotic and estuarine environment. Primary and secondary productivity of aquatic ecosystem. ……10 hrs

Unit 4. ***Wetlands***: Definition and classification of Wetlands; Fresh water wetlands, Marshes, Bogs, Swamps, Peat lands. Wetland Functions and Values; Nutrient cycling in aquatic systems. Productivity, trophic states and eutrophication. Marine wetland. Ecosystem services of wetlands …….10 hrs

Unit-5: ***Wetlands Conservation and Wetland Management*****:** Threats to wetland; siltation, pollution, encroachment, urbanization, over exploitation of fauna and flora. Influence of climate change on Wetlands. Management of weeds, siltation, nutrient levels and control of overexploitation. Status of wetland biodiversity and conservation priorities. Criteria for wetland restoration, protection and management. ……12 hrs

Unit 6. ***Wetland Conservation planning*****:** Ramsar Convention; Ramsar sites, criteria for ramsar sites. World list of ramsar sites and their uniqueness. Ramsar sites in India. Wetland conservation protocol-local regional and national; National Wetland Rules 2010. Other issues related to water: river linking project. Dams and diversion of river waters.…10 hrs

Practicals

1. Estimation of physico-chemical parameters of water bodies
   a) Transparency – sacchi disc,
   b) Current velocity
   c) Water sampling techniques- Kremmerer water Sampler, Bottle water sampler
   d) Sediment sampling -using core sampler, grab sample
   e) Processing and preservation of water and sediment sampling

2. Sampling of Phytoplankton, identification and enumeration
3. Sampling of Zooplankton, identification and enumeration
4. Sampling of aquatic macrophytes, taxonomic identification upto species
5. Sampling and identification of benthic invertebrates of river
6. Sampling and identification of freshwater fishes.
7. Bio-mapping techniques

References (Latest Edition of the Following):

1. Michael Kaill and John.K. Frey. Environments in Profile –An aquatic perspective.
2. Chapman JL and M.J. Reiss. Ecology- Principles and Applications.
3. Balasubramaniyan.A. Ecology Environment and pollution M/S Indira publishers, Mysore
4. Siddiqui, KA. Ecology and Environmental Biology. Kushal Publications and distributors.
5. Daniel Botkin. Edward Keller. Environmental Science-Earth as a living planet. John Wiley and Sons. New York.

ES. SC-1.5: Radiation and Environment ------64 hrs

Unit 1. ***The Nuclear Environment*****:** Introduction; cosmic radiation; natural and anthropogenic sources of radioactivity and distribution in environment- rocks and soils, uranium and thorium ores, the atmosphere, water, food and building construction materials. Application of stable nuclides, radionuclides and ionizing radiations in the study of earth and its environment; diagnostic; medicine and other applications. Radiation physics; isotopes; radioactive elements; unit of radiation: Radiation detection and dosimetry. Nuclear energy and nuclear fuel cycle, effect of nuclear cycle on environment. ….. 10 hrs

Unit 2: ***Effect of Radiation:*** Radiation pollution; hazards of radio-active wastes; Radio isotopes and their applications: food; agriculture; medicine; industry. Industrial radiography. Radiation detection, measurements and radiation standards. Radioactive decay. Risk and benefits of radiation. …….. 10 Hrs

Unit 3. ***Introduction to radiation chemistry***; ionizing and non-ionizing, microwave and fallout radiation. Effect of radiation on plant and animal: Vascular, skeletal, nervous and reproductive system in plants-Gene mutation; carcinogenicity; teratogenicity; chromosome damage; abnormalities and population decline. …… 12 hrs

Unit 3: ***Radiation protection and control measures****:* Monitoring and preventive measures: prevention at source; nuclear reactor safety measures; nuclear power plant safety measures. Occupational radiation exposure; safety measures in industry and medicine. ……10 hrs

Unit 5: ***Disposal of Radioactive Waste*****:** Characterization of radioactive waste, storage and disposal; Waste Storage of waste and disposal technologies: Calcinations; vitrification; crystalline ceramic forms of stages. Disposal: space disposal; ice disposal; partitioning and transmutation; offshore disposal of waste; Drilled emplacement; Ocean dumping. Radio-active Waste management programmes. Current practices disposal of radioactive wastes in different sectors …….12 hrs

Unit 6: ***Radiation episodes***: Pattern of accidents and causes. Important episodes: Hiroshima and Nagasaki, Bikini atoll episode; Three Mile Island episode; Chernobyl accident; Fukushima (Japan) nuclear disaster 2011; Marcoule (France) Nuclear Accident 2011. …….. 10 hrs

Practicals

1. Radiation counting using GM counter

2. Radiation Protective Devises-Identification and commenting
3. Natural Radioactive materials- Quartz, Silica, granite, marble etc., -Identification
4. Radiation detecting instruments- Identification and commenting
5. Calculations of half-life; radioactive decay and conversion of units.

References (Latest Edition of the Following)

1. Chandler, S. D. Radioactive waste control and controversies. Vol-3. Gordon and Bleach Science Publishers.
2. Murugeshan, R. Modern Physics. S. Chand & company, Ltd
3. Miller, G.T. Environmental Science-An Introduction, Wadsworth Publishing Company, California
4. Kopkar, S. M. Environmental Pollution – Monitoring and Control. New Age International Ltd, New Delhi

II Semester

ES. HC-2.1: Environmental Chemistry and Environmental Statistics --64 Hrs

PART A: Environmental Chemistry (32 Hrs)

Unit 1: ***Atmospheric Chemistry***: Introduction; chemical reactions in the atmosphere in troposphere and in stratosphere (Oxygen, Nitrogen Ozone, Water vapour, Photochemical smog, Volatile Organic Compound). Aerosol-types, production and distribution; Aerosols, atmospheric particles and radiation. Atmospheric turbidity and related environmental problems; Inversions, global climate and photochemical reactions. A brief account on Global warming; Greenhouse effect; Ozone depletion; Acid rain. - 10 hrs

Unit 2: ***Chemistry in Aqueous Media*****:** Water cycle; Structure and properties of water- Density; melting point and boiling point; specific heat; heat of vaporization, surface tension and viscosity. Hydrogen bonding, clathrates and miscibility; ions; autoionization; weak acid bases and buffers. Co-ordination chemistry of water. Water as a solvent. Water Usage- Water pollutants; pathogens; oxygen demanding wastes; nutrients; salts; heavy metals; thermal pollution; pesticides; volatile Organic compounds. Emerging Contaminants; Endocrine disrupting agents (EDCs); Polybrominated biphenyl ethers (PBDEs); Perflurocarboxylates (PFCAs). Status of Surface water quality; BOD; COD; NOD; and other parameters. - 12 hrs

Unit 3: ***Chemistry of Soil*****:** Soil formation and composition of soil; weathering and solubilizing mechanisms; Micro and Macronutrients of soil. Soil contamination- Non-metallic compounds; heavy metals; Synthetic agrochemicals; industrial wastes. Bioremediation of surface soil. Bioindicators of soil contamination and soil health. Soil physico-chemical parameters- Moisture content; pH; redox potential; percolation; density; porosity; saturation capacity; particle fractionation; cation exchange capacity; total exchangeable bases; chemical parameters - 10 hrs

PART B: Environmental Statistics (32 Hrs)

Unit 4: ***Introduction:*** Statistics; statistical variables; data; independent and dependent variables; qualitative and quantitative variables; ordinal variable. Statistical Methods-Numerical measures, graphical methods-types of graphs and applications; Frequency distributions; grouped and cumulative frequency; frequency distribution diagrams; histograms; frequency polygons...10 Hrs

Unit 5: ***Descriptive statistics*****:** The central tendency-mean; median and mode, types of arithmetic mean- weighted, harmonic and geometric mean- application and significance. Variability-Range; variance; standard deviation; standard error; confidence interval; coefficient of variation. Exploratory data analyses-Scatter plots; frequency distribution histograms; steam and leaf plot; Box and Whisker plot. Probability theory**;** calculation of probability; binomial distribution. …….10 Hrs

Unit 6: ***Inferential statistics and Ecological Models:*** Statistical inferences- Hypothesis testing; null and alternate hypothesis; procedure for hypothesis testing; χ^2 test, student "t' test, F test, Analysis of variance. Correlation and Regression-types and applications. Ecological models; types of models; Population growth models, Life history strategies, r/K concept; Lotka-Volterra models, Leslie's matrix. Water and Air pollution models- Stream flow models and atmospheric dispersion models. ……12 Hrs

Practicals:

1. Air sampling techniques/ Emission Test
2. Estimation of LHV and HHV of selected fuels
3. Estimation of Heavy metals (Copper, Zinc, Lead and Mercury) in soil sample
4. Estimation of carbon-carbonate in soil sample
5. Descriptive statistics- Arithmetic mean, Weighted arithmetic mean, geometric mean, harmonic mean
6. Calculation of standard deviation, standard error, coefficient of variation for the given set of data
7. Calculation of correlation coefficient (Karl Pearson and Rank method)
8. Problems on Population Growth Models.

References (Latest Edition of the Following):

1. Allan J. Cann. Maths from Scratch for Biologist. John Wiley and Sons, Ltd. Toronto.
2. Rosner, B.. Fundamentals of Biostatistics. Daxbury Press. Boston.
3. Begon, M and Mortimer, M. Population ecology. UBS Publishers. New Delhi.
4. Spiro TG, Purvis-Roberts K, Stigliani WM. Chemistry of the Environment. Viva Books. New Delhi.
5. Bailey RA, Clark HM, Ferris JP, Krause S, Strong, RL. Chemistry of the Environment. Academic Press, California.
6. Masters GM and Ela WP. Introduction to Environmental Engineering and Science. PHI, New Delhi.

ES. HC-2.2: Environmental Pollution …….64 Hrs

Unit 1: ***Water Pollution*****:** Introduction; water resources, sources and water pollutants; category and composition of waste water. status of surface water quality; BOD; The effect of Oxygen demanding wastes on water bodies; water quality index. Ground water pollution, Aquifers, Hydraulic gradient, Darcy's Law, Contaminant transport, Cone of depression, capture- zone curves, control of ground water plumes, contaminants in ground water. Waste water remediation technologies for surface and ground water. Effect of Water pollution on ecosystem and biota. …12 Hrs

Unit 2: ***Water Quality Control*****:** Introduction, municipal and waste water systems in India, BIS standard for Drinking Water, Water quality standards for irrigation, industry, fishery and other ventures. Water treatment systems; waste water treatments; hazardous waste in Indian water bodies; solid wastes, sewerage and sewage disposal technologies. Waste treatment technologies for industries and ETP. ..12hrs

Unit 3: ***Air Pollution*****:** Introduction; Overview of Emissions, Pollutant sources, characteristics, Primary and secondary pollutants, toxic air pollutants. Air quality standards. Motor Vehicle emissions and stationary emissions- composition and control. Formation of Aerosol and its effects. Indoor Air quality standards. Air Pollution and Meteorology. Air pollutant and pollution assessment technologies; Models to predict smoke and pollutant dispersal in Air, Box model, Gaussian Plume model. Effect of air pollution on biota. .. ..12 Hrs

Unit 4: ***Soil Pollution and Solid Waste*****:** Introduction; Sources of soil pollutants- Municipal, Agriculture, poultry, industrial and other sources of soil pollutants. **Solid waste**: Classification and characterization of solid waste; Hazardous solid waste, Biomedical waste, Leachate of solid waste, etc., Transboundary movement of wastes. Physical, chemical, biological treatment of waste, Disposal and recycling of solid waste. Effect of soil pollution on ecosystem and biota. **E- waste:** Introduction; Sources, characterization, Hazardous materials in e-waste, recycling of e-waste. ….10 Hrs

Unit 5: ***Noise and Thermal Pollution*****:** Introduction, Noise and vibration; sources of noise pollution, Noise and Health, Noise level measurement, permissible levels, Sonic boom, Impulsive noise, Anechoic Chamber and Reverberating sound. Nosie topography. Control of Noise (regulations). Effect of noise biota. Thermal Pollution: Introduction, sources of thermal pollution, effect of discharge of heat and effect of thermal pollution, Measurement of thermal pollution, Effect of thermal pollution. Fly-ash and environmental Hazard. Effect of thermal pollution on ecosystem and biota. ….10 Hrs

Unit 6: ***Status of Environmental Pollutions in India***: Prevention and control of generation, reuse and recycle of Waste. Acts and regulation to control pollution. National programme to control wastes. ….. 8 Hrs

Practicals:

1. Estimation of BOD and COD for the given water Sample
2. Acid base reactions in effluent treatment system
3. Collection, classification and segregation of Household waste
4. Analysis of Phosphate and sulphate in waste leachate
5. Recording the noise using noise recorder
6. Construction of models to predict smoke and pollutant dispersal in Air- Box model and Gaussian Plume model
7. Collection, segregation and classification of biomedical waste
8. Isolation, identification of bioindicators of waste water

References (Latest Edition of the Following):

1. Gilbert M. Masters and Wendall, P. Ela. Introduction to Environmental Engineering and Science. PHI learning Pvt. Ltd.
2. Khopkar, S. M. Environmental Pollution- Monitoring and Control. New Age International Publishers, New Delhi.
3. William W Nazaroff and Lisa A Cohen. Environmental Engineering Science. Wiley Publishers.

ES. SC-2.3: Energy and Energy-Resources ……..64 Hrs

Unit 1: ***Introduction to Energy Resources***: Growing Energy Need-Energy crises; factors influencing energy crises; Developmental strategies; energy supply-demand. Energy consumption in developed and developing countries. Resources of Energy; Non-renewable (fossil fuels; coal; natural gas; petroleum) and renewable (biomass; biogas, solar, nuclear, hydropower, wind and tidal, and geothermal). Concept of clean energy. ……10 hrs

Unit 2: Fossil Fuels-*Coal, Oil, Natural gas and Petroleum fuels*: Coal: formation of coal, forms of coal- peat, lignite, sub-bituminous coal, bituminous coal, steam coal, anthracite, graphite, chemistry and composition. Heat of combustion, thermal conductivity, specific and latent heat. Major Coal reserves. Advantages and disadvantages of coal energy. Fly ash and its consequences. Sub-terrainian coal fire. Oil and Natural gas: Geological exploration for oil and natural gas, Status and reason for declining reserve of oil and natural gas. Global oil demand and supply. Environmental problem associated with oil and natural gas. Synfuels and other potential fossil fuels resources. Petroleum fuels: Composition, Chemistry of petroleum fuels; Empirical equations for thermal properties (Heat of combustion, thermal conductivity, specific and latent heat). Crude oil reservoirs and Unconventional oil reservoirs. Uses of petroleum fuels. Environmental effects of use of petroleum fuels; Ocean acidification, global warming, oil spills etc., Alternative to petroleum-for vehicle fuel, industry, electricity. ……20 hrs

Unit 3: ***Biomass and Biogas***: Definition, Biomass sources. World resources; Food crops, woody crops, natural vegetation, commercial planting, genetically modified varieties. Biomass Conversion; Thermal, chemical, biochemical and electro-chemical conversion. Environmental impact of biomass fuel. Biogas production and techniques; landfill gas. Chemical composition of biogas. Benefits of biogas, Global development of biogas. Contribution of biomass and biogas to nature conservation. …… 10 hrs

Unit 4: ***Nuclear Energy*:** Fission and fusion reactions. Atoms and radioactivity. Conventional Nuclear fission. Production of electricity from nuclear power. Breeder Nuclear fission. Merits and demerits of Nuclear power over hydal thermal power plant and coal based power plant. Problems associated with nuclear power plants. Safety in nuclear power plant. Radioactive wastes and environmental problems. ……10 hrs

Unit 5: ***Solar and wind Energy*** : Solar energy definition; Harnessing of solar energy using technologies such as solar heating, photovoltaics, solar-thermal energy, solar architecture and artificial photosynthesis. Application of thermal energy associated with solar- water heating, heating, cooling, ventilation, cooking, water treatment etc., Electricity production, photovoltonics, concentrated solar power. Solar energy equipment and ISO

standards for solar energy equipment. Wind energy basics, equation for wind power. Wind farms. Small scale wind power productions. Environmental effects. Amalgamation of solar and wind power. Indian approach for solar and wind power. …….8 hrs

Unit 6: ***Hydro-thermal, geothermal and tidal energy***: Energy generated hydro-power, geothermal and tidal. Generating methods; types and capacities; Advantages and Disadvantages. Environmental impact. …….6 hrs

Practicals

1. Comparison of density, surface tension, viscosity of Diesel and Kerosene
2. Comparison of density, surface tension, viscosity of vegetable oil and crude oil.
3. Ash estimation of crude oil and vegetable oil
4. Estimation of Ash content of peat and charcoal
5. Calculation of HHV and LHV of Methane and Butane
6. Photovoltaic cell
7. Determination of surface albedo
8. Visit to Wind mill.

References (Latest Edition of the Following):

1. Richard S Stein and Joseph Powers. The Energy Problem. World Scientific Publishing Co. Pte. Ltd. Singapore.
2. John Twidell and Tony Weir. Renewable Energy Resources. Taylor and Francis, New York.
3. Gilbert M. Masters and Wendall, P. Ela. Introduction to Environmental Engineering and Science. PHI learning Pvt. Ltd.

ENV. SC-2.4: Solid Waste Management and Resource Recovery …64 hrs

Unit 1: ***Solid waste: Definition of solid waste*****:** sources, classification and types of solid wastes: Municipal waste, agricultural waste, biomedical waste and industrial waste, E-Waste Characteristics. Solid waste Problems - impact on environmental health – Concepts of waste reduction, recycling and reuse. …. 12 hrs

Unit 2: ***Urban Solid waste collection, segregation and transporting methods****:* Handling of residential, commercial, market waste. Collection and storage methods: Transportation systems- …. 8 hrs

Unit 3. ***Biomedical and hazardous waste management***: Biomedical waste: Definition, sources, classification, collection, segregation, Treatment and disposal. Hazardous Wastes: Hazardous waste definition: Sources and characteristics: handling, collection, storage, transport and treatment, Physical and biological routes of transport of hazardous substances –Sampling and analysis of hazardous wastes. ……..12 hrs

Unit 4: ***Disposal of municipal solid waste (MSW)*****:** Opens dumps impacts on environment, health and environmental effects. site selection, design, and operation of sanitary landfills; Leachate and landfill gas management; landfill closure and post-closure environmental monitoring; landfill remediation. Regulatory aspects of municipal solid waste management. ……12 hrs

Unit 5: ***Solid waste management solutions: Source reduction:*** Industrial, commercial and residential areas. Solid waste processing technologies. Mechanical and thermal volume reduction. Biological and chemical techniques for energy and other resource recovery: Waste reuse and recycling- Paper, plastics, Glass, Scrape metals. Biodegradable waste - composting methods Microbial and vermicomposting methods and uses. …….10 hrs

Unit 6: ***E-Waste and Management***: Waste characteristics, generation, collection, transport and disposal Public policy of waste management: Sustainable solid waste management- Regulatory perspectives, integrated waste management. ……..10 hrs

Practicals:

1. Classification and composition of solid wastes
1. Density and moisture content of municipal solid waste
2. Visit to biomedical waste treatment plant
3. Hospital waste disinfecting methods/ Incineration Unit
4. Leachate collection and analysis- pH, BOD, Chloride, Phosphate, Nitrate.
5. Waste management techniques; Sanitary landfills construction techniques
6. Quantification of solid waste

7. Vermicomposting Techniques

References (Latest Edition of the Following):

1. Charles A. Wentz. Hazardous waste management. McGraw Hill International.
2. George Tchobanoglous, Hilary Theisen & Sammuel A. Vigil. Integrated solid waste management, McGraw- Hill.
3. CPCB guidelines. Criteria for hazardous waste landfills.
4. Anjaneyulu. Hazardous waste management. Allied Publishers Ltd.
5. Daniel B. Botkin and Edward A. Keller. Environmental Sciences. Wiley Intercedence student Edition.
6. Harry M. Freeman. Standard handbook of Hazardous waste treatment and disposal. McGraw Hill.
7. Botkin, D. and E. K. Future. Environmental Science – Earth as a living planet.
8. Sindhu, P. S. Environmental chemistry. New Age Int. Publishers
9. Wright R. T. and B. J. Nebel. Environmental science – Towards sustainable future. Prentice Hall India Pvt. Ltd. New Delhi
10. Abbasi, S. A. and E. Ramasami. Biotechnological methods of pollution control.
11. Cunningham, W. P. and M. A. Cunningham. Principles of Environmental Science. Tata McGraw Hill Publ. New Delhi
12. Trivedi, P. R. and G. Raj. Solid waste pollution. Akshadeep Publishing House, New Delhi

ES. SC-2.5: Natural Resources and Conservation …..64 Hrs

Unit 1: ***Earths Natural Resources*****:** Introduction: Ecological services of major ecosystems of the world. Renewable and Non-renewable; Continuous and extrinsic resources. Natural resources and associated problems -- 10 Hrs

Unit 2: ***Forest Resources:*** Composition; function; Economic and Environmental benefits; energy; medicine and life supporting resources. deforestation; causes of deforestation-timber extraction, dams, habitat fragmentation. Anthropogenic influence on forest resources; over exploitation, encroachment, habitat quality depletion, grazing etc., - 10 Hrs

Unit 3: ***Water Resources*****:** Hydrosphere; proportion of different types of water; lentic and lotic water; ground water. Use and over exploitation of surface and ground water. Problems associated with water resources- flood, drought and pollution-conflict over water. Status of water resources in India. - 10 Hrs

Unit 4: ***Land and Mineral Resources*****:** Land degradation; landslide; soil erosion; overgrazing, mining, desertification, pollutions and their consequences on habitat quality. Mineral-Kinds of minerals, structure and properties; metal and metallic compounds, rare earth metals, non-metals, building materials, gems etc., noble metals and fossil fuels. Mineral resources of India …… 10 Hrs

Unit 5: ***Food Resources and Energy Resources***: Introduction, types, characteristics. World food problem; Agriculture and over grazing; Modern agriculture and environmental effect. Agro-chemicals; soil salinity; status of food resources and food contamination in India. Growing energy demand; energy resources; renewable and non-renewable. Status of energy resources in India. Approach to fulfil the demand, new policy and schemes.
---12 Hrs

Unit 6: ***Natural Resources and Conservation*****:** Problems associated with overexploitation of natural resources, consequences on environmental quality and life supporting systems of the earth. Role of human communities and conservation, lifestyle, resource sharing and sustainable development. ---12 Hrs

Practicals:

1. Identification of mineral resources
2. Identification of biofuel resources and biofuel important parts
3. Estimation of energy and crude ash of biofuels
4. Collection, categorization of forest resources
5. Soil character (water holding capacity) of different types of soil

6. Estimation of total soil salinity
7. Estimation/identification of food contaminants in Vegetables and Fruits
8. Identification of wildfood resources

References (Latest Edition of the Following):

1. Andrew S. Goudie. The Human Impact on the Natural Environment: Past, Present and Future. Wiley-Blackwell Publ.
2. John Walther. Earth's Natural Resources. Jones and Bartlet Learning.
3. Tiwari G.N. and Ghosal M.K., Renewable Energy Resources, Narosa Publ.
4. Chauhan, D. S and S. K. Srivastava. Non-conventional energy resources, New Age International Publisher, New Delhi

Interdepartmental Elective Courses (IDE)

ES. IDEC. 1. Environmental Education 32 Hrs

Unit 1. ***Introduction:*** Scope of Environmental Education; Man, and Environment; Population and Economic growth; industrialization; urbanization; consumerism; environmental ethics.…4 Hrs

Unit 2. ***Drivers of Environmental Degradations:*** Historical causes of environmental changes – massive population increase; technological innovations; explosion in energy use; Economic integration and environmental changes. Environmental Degradations: Population and resource consumption; Affluence and poverty; policy; technology and economic growth and forces of globalization. ----- 6 hrs

Unit 3. ***Environment and Sustainable Development:*** importance and approaches- public awareness; national and international perspectives; Environmental conservations- Conventions, Public awareness and participation, Regional Best practices towards sustainable development ----- 6 hrs

Unit 4. ***Environmental Awareness Programmes***: Scope and Importance and objectives of environmental awareness and training; formal and non-formal environmental education programmes; national green corps. ----- 4 hrs

Unit 5. ***Formal and Non-Formal Environmental Education:*** Formal Environmental Education in schools; appreciation courses; environmental management studies; centers for environmental studies. Non-formal environmental educations- National Environmental Awareness Campaign (NAEC); Eco-clubs (National Green Corps); Global Learning and Observations to Benefit the Environment (GLOBE); Mass awareness programmes.…6 hrs

Unit 6. International and National Initiatives: UN Decade of Sustainable Development; Focal points; Citizen Science (CS); Education for Sustainable Development (ESD); Science Education (SE); Climate Change Education (CCE). Stockholm Declaration; Belgrade Charter; Tbilisi Declaration. Environmental Awareness in University Education in India; Role of MOEFCC; Institutions and NGO's. Women and Environmental Education. ------ 6 hrs

References (Latest Edition of the Following):

1. Beatty. A. Climate Change Education. Washington, DC: The National Academies Press
2. Palmer, J.A. Environmental Education in the 21st Century: Theory, Practice, Progress, and Promise. Routledge.

III Semester

ES.HC-3.1 Environmental Engineering and Science 64 hours

UNIT – 1: Water Treatment: Introduction and scope: different sources of water; Self-purifications of of effluent in aquatic bodies. Methods of water purification-sedimentation; coagulation and flocculation; Filtration; types of filtration and filters and disinfection of water. Advanced technologies - fluoridation; membranes; reverse osmosis; electro dialysis and ion exchange methods. floridation – 12 Hrs

UNIT– 2: Industrial effluent and domestic sewage treatment and disposal: Primary, Secondary and Tertiary treatment methods- Physical treatment methods: Sedimentation; filtration through granular media. Biological treatment: activated sludge process; trickling filters; anaerobic digestion. Treatment methods for pulp, paper, sugar, distillery, iron and steel and food processing industry effluents. Designing of STP, WTP and ETP. ----12 hrs

UNIT – 3: Air pollution: Nature of air pollution problems; criteria pollutants (CO, NO_2, SO_2, PM_{10}, and $PM_{2.5}$, O_3, Pb); Hazardous air pollutants. Air pollutant treatment technologies: Sampling and analysis of gaseous pollutants. Particle control technology and devices - absorption; adsorption; incineration; catalytic redox, condensation and membrane recovery, devices like-settling chamber, cyclones, scrubbers, electrostatic precipitators and filters. Monitoring and control techniques: Ambient and stack emission monitoring; Air quality standards. Indoor air pollution- Sources; Classification; Respirable particulates; Radon and biological contaminants; Biofilters. -12 hrs

UNIT –4: Solid Waste Management: Sources and generation of solid waste; characterization, classification and chemical composition. Integrated solid waste management: Source reduction; recycling and disposal. Green product design strategies; product system life extension; ecolabels; life cycle assessment. Management techniques- dumping of garbage; Commercial, Industrial Agriculture, Mining and Power Plant discharges. -10 hrs

UNIT – 5: Hazardous Waste Management techniques: Sources of hazardous waste; hazardous waste minimization: techniques and tools. Hazardous waste treatment process: Physical, chemical, thermal and biological treatment. --- 6 Hrs .

UNIT – 6: Recycling of Waste and Disposal of Sewage, solid waste and Hazardous waste: Water recycling; scope and criteria; various methods of cleaning of waste water for recycling. Disposal of Sewage; composting, land disposal. disposal by dilution. Sewage sickness and control. Disposal of Solid waste- Composting and incineration– Biomedical waste disposal and management. Recycling of wastes -eg. Food waste, leather, paper, pulp, fly ash etc., Hazardous waste disposal methods: land fill, deep well injection, Ocean disposal. Hazardous waste environmental release and remediation: site characterization; quantitative risk analysis; remediation ----12 hrs

Practical

1. Determination of Biological Oxygen Demand in waste water
2. Solve the given problems on BOD
3. Determination of Chemical Oxygen demand in waste water
4. Determination of oil and grease in wastewater
5. Determination of H_2S in waste water
6. Determination of fluoride in water samples
7. Determination of residual chlorine in water
8. Characterization of solid waste
9. Identification and commenting on
    a) Respirable Dust Sampler
    b) Electrostaticprecipitator (Models)
    c) Clarifiers (models)
    d) Jar-test apparatus
    e) Grit chambers
    f) E-waste
    g) Stack Monitoring Unit
    h) Fly ash
    i) Bagasses
    j) Biomedical waste
    k) Pesticides
    l) Press mud
    m) Molasses

REFERENCES:

1. Jerry A Nathanson, Basic Environmental Technology, Prentice Hall of India Pvt. Ltd. (2003).
2. Rao M.N. and Datta A.K., Waste Water Treatment, Oxford & IBH Publishing Company Pvt. Ltd. (1987).
3. Hammer M.J., Water and Waste Water Technology, John Willey (1986).
4. Garg S.K., Sewage Disposal and Air Pollution Engineering, Khanna Publications (1990).
5. Goel P.K., (ed), Advances in Industrial Waste Water Treatment, Techno Science Publications, Jaipur (1999).
6. Masters, GM and Ela, WP (2008). Introduction to Environmental Engineering and Science. 3rd Ed. Prentice Hall of India Pvt. Ltd.
7. Nazaroff, WW and Alvarez-Cohen, L. (2004). Environmental Engineering Science. Wiley Student Edition. John Wiley and ons. New Delhi

ES.HC-3.2 Environmental Impact Assessment, GIS and Environmental Microbiology 64 hours

UNIT – 1: Introduction to EIA: Definition and Origin of EIA; Scope, objectives and principles, types and stages. Recent EIA guidelines (Notification of Government of India), Importance of public participation in environmental decision making. Environmental Impact Statement (EIS), Environmental Management Plan (EMP), Environmental Management System (EMS). Assessment of impact (physical, social, economic, natural etc), Merits and Demerits of EIA ……12 hrs.

UNIT – 2: EIA techniques: Ad-hoc method; checklist method; overlay mapping method; matrix method. Assessment, Prediction and evaluation of impacts on Air, water, noise and biological environment. Mitigation measures. EIA in project planning and implementation section. EIA of water resource projects, industries, mining, oil refineries and highway construction, Life Cycle Assessment (LCA) ---12 hrs.

UNIT – 3: Environmental Audit: Introduction, scope, objectives and procedures for environmental auditing, Audit stages (Pre-Audit, On-site Audit, Post – Audit activities), Environmental Audit under Environmental Protection Act, 1986, Audit items (Waste Audit, Energy audit, Safety Audit, resource audit), benefits of environmental auditing, International Organization for Standardization. ISO standards: ISO 14000 family. --10 hrs.

UNIT – 4: GIS: History and development; GIS technique and technology; spatial analysis of geographical information system. Application of GIS; Geostatistics and environmental variables; Open Geospatial Consortium Standards; Web mapping; Semantics; GIS in local government; monitoring local environment and GIS in Education ---- 10 hrs

UNIT – 5: General Microbiology: History, scope of microbiology, eukaryotic and prokaryotic cell structure, classification of microbes, general characters of microbes. Sterilization techniques used in microbiology, factors affecting sterilization and disinfection, Preparation of media for isolation and culture of microorganisms. Microbial toxins, Microbes and biogeochemical cycles (Nitrogen, sulphur, carbon and phosphorous cycles), microbial fuel cells --10 hrs.

UNIT – 6: Microbial Interactions: Microbial interaction in soil: Factors influencing the soil microflora, Role of microorganisms in soil fertility, Symbiotic nitrogen fixation, De-nitrification, Mycorrhiza and its types, Microbial communities with man, animals and plants. Environmental Biotechnology- Bio-pesticides and bio-fertilizers, Environmental monitoring through microorganism, microbial leaching of low grade mineral ores, Biosensors and its applications, Phyto-technology in waste water treatment. Recombinant biotechnology, plant and animal tissue culture. Role of microbes in environmental management, Bioremediation, types (*in situ* and *ex-situ*) benefits and limitations. ----10 hrs.

Practicals:

1. Sterilization techniques.
2. MPN techniques for coliform analysis
3. Preparation of different types of microbial culture media
4. Safety in microbiological laboratory.
5. Survey and documentation of occupational diseases and causes in a given areas
6. Measurement of noise level in different environment by sound level meter (SLM)
7. Field visit to assess air pollution and indicators of air pollution
8. Case studies on safety standards in industry.
9. Case studies on environmental audit.
10. Case studies on impact assessment: River valleys, mining projects.
11. F-GIS
12. GPS- Hands on training on GPS
13. Mapping

References:

1. Munn, RE, 1979. Environmental impact assessment: principles and procedures, 2nd Edn. New York: Wiley.
2. Canter, W. Larry, 1996. Environmental impact assessment. McGraw-Hill International editions. 660p.
3. Trivedi PR, 2014. Environmental Impact Assessment, Published by APH, Publishing Corporation, New Delhi
4. Peter Wathern, 1998. Environmental Impact Assessment: Theory and Practice 1st Edition, Published by Routledge, Reno, NV, U.S.A.
5. Pelczar, MJ, Chan, ECS and Krieg, NR, 1998. Microbiology. 5th edition. Tata McGraw-Hill Education Pvt. Ltd. US
6. Kulkarni VS., Kaul, SN and Trivedi R.K, 2001. Handbook of EIA, Scientific Publishers, India
7. Raina M.Maier, Ian L. Pepper, Charles P. Gerba, 2006. Environmental Microbiology, Elsevier Publication, Raj kamal Electric Press, Delhi.
8. Sharma PD, 2005. Environmental Microbiology Published by Narosa Publishing House.
9. Rao AS, 2009. Introduction to Microbiology. I Edition Published by PHI Learning.
10. Ronald M. Atlas and Richard Bartha, 1982 Microbial Ecology: Fundamentals and Applications 4th Edition
11. Singh, B.D, 2010. Biotechnology. Kalyani Publishers. 701 pages
12. Thakur, I.S. 2011. Environmental Biotechnology: Basic Concepts and Applications, 2nd Edition. I.K. International Publishing House, New Delhi.
13. Glazer AN & Nikaido H., 2007, Microbial Biotechnology, 2nd Ed., Cambridge University Press,

ES.SC-3.3 Global Environmental Changes and Natural Hazards 64 hours

UNIT- 1: **Atmosphere of the Earth**: Structure of the atmosphere; Principal layers- Exosphere; thermosphere; mesosphere; stratosphere and trophosphere. Physical properties; pressure and thickness, temperature, density and mass. Optical properties; scattering, absorption, emission, refraction. Atmospheric circulations; Composition of dry air. Evolution of earth atmosphere; earliest, second and third atmosphere. -----10 hrs

UNIT-2: Climate: Definition; climate classification. Climate change and greenhouse gasses-amplification and dampening. Radiative forcing of climate change. Absorption of infrared radiation, greenhouse effect and global warming; effect of global warming; global energy balance; Energy principles. Measure to curb global warming. IPCC and role of IPCC in climate regulations. ----- 10 hrs

UNIT-3: **Green House Gasses**: Major greenhouse gasses (CO_2, O_3, CH_4, N_2O, Halocarbons; aerosols, water vapor and other minor gasses); sources; properties and global warming potential; greenhouse gasses and earth-atmosphere balance. Carbon dioxide: atmospheric concentrations; carbon cycle. Carbon emission sources; fossil fuels and their carbon intensity; landscape change and other sources. Methane: sources; agriculture, animal husbandry, wetland and forest; methane cycle. Stabilization of greenhouse gases. ---12 hrs

UNIT-4: **Prediction of climate change**: Evidence of past climate; Isotopes and temperature; Antarctic ice core. Earth orbital variation and sunspot; global temperature models. Atmospheric carbon dioxide concentrations; change and effects of global warming. Current status and prediction of Impact of global environmental issues on agriculture, animal husbandry, fish production, forestry, and other productive ventures of human livelihood. --- 10 hrs

UNIT-5: Global environmental issues: Ozone: Tropospheric and stratospheric ozone; chemistry of ozone; ODP; Formation of ozone layer; Ozone destruction-depletion of ozone layer; effect of ozone layer depletion; Measures to protect the ozone layer. Acid Rain: types and formation of acid rain; precursors-sources; effect of acid rain on ecosystem and control strategies. Deforestation; world forest cover, deforestation-cause and effect. Measures to control deforestation. REDD and REDD+. Transboundary movement of Waste. ----12 hrs

UNIT-6: Natural Hazards: General features of Tropical cyclones, floods and storms, Earthquakes, Avalanche, Volcanic eruptions, Fires. Prediction of natural disasters, precaution and disaster management. Link between global environmental changes and natural hazards. ---- 10 hrs

Practicals:

Practical

1. Recording and estimating the climatic parameters
   a) Humidity, b) Rainfall, c) Wind and d) Light
2. Mathematical expression on temperature and precipitation
3. Calculation of Pluviometric or Emberger index
4. Study and present the details of Montreal protocol

5. Group discussion on Kyoto agreement.
6. Portable weather station
7. Estimation of methane content in different forest soils
8. Estimation of carbon content in different types of soil

References

1. Houghton, J.T. 1995. The Science of Climate Change. Cambridge University Press
2. Miller GT. 2000. Environmental Science and introduction. Wiley publishers
3. Masters, GM and Ela, WP, 2008. Introduction to Environmental Engineering and Science. 3rd Ed. Prentice Hall of India Pvt. Ltd. New Delhi.
4. Nazaroff, WW and Alvarez-Cohen, L. 2004. Environmental Engineering Science. Wiley Student Edition. John Wiley and ons. New Delhi.
5. Joseph, K and Nagendran, R. 2004. Essentials of Environmental Studies. Pearson Eduction, New Delhi

ES.SC-3.4 Water Quality Science 64 hrs

UNIT-1: **Sources and general properties of water**: Oceans, Ground water, Lakes and reservoirs, Rivers, Atmospheric water; Distribution of water on the earth; Hydrological cycle; Water balance; Physical and chemical properties of water. ----12 hrs

UNIT- 2: **Water Use and Demand**: Drinking; Industrial; Agriculture- global water usage, per capita consumption. Water quality concern. Water Pollution; Socio-economic and environmental problems associated with water demand ----10 hrs

UNIT- 3: Water quality: Water quality demand for human consumption; industrial and domestic use and environmental water quality. Physical, chemical, Environmental and Biological parameters of Water quality. Sampling and measurement of water for quality-sample collection; testing-chemical analysis and real-time monitoring. Drinking water indicators; Environmental indicators (physical, chemical and biological). ---12 hrs

UNIT-4: Water quality standards: National specifications of Water quality for drinking, domestic and bathing, Irrigation/agriculture and Industrial purposes. Drinking water standard: WHO, BIS standards ----- 10 hrs

UNIT 5: **Consequences of water pollution**: Water borne diseases; agriculture productivity; salinity of soil; drinking water contamination- pesticides, agro-chemicals, heavy metals and other contaminants — 10 hrs

UNIT 6: Water treatment methods: Primary treatment, Filtration of water, Disinfection , Chlorination and water softening; Wastewater reuse and recycling methods: Advanced techniques , Sustainable management of water resources — 10 hrs

Practicals

1. Water Sampling: Surface and Ground water samples - collection methods
2. Water quality test: Physical, Chemical and Biological parameters- Determination of pH, color, conductivity, chlorides DO, BOD
3. Hardness, sulfates, Phosphates, TDS, in water samples
4. Bacteriological analysis of drinking water
5. Demonstration of
    a) Drinking water treatment plant
    b) Types of filters
    c) Purifying agents
    d) Water testing kit

References

1. Botkin, D and E.K, Future, 1995. Environmental Science – Earth as a living planet.
2. Sindhu, P.S. 2004. Environmental chemistry, New age Int. Publishers
3. Gupta. P.K. 2004. Methods in Environmental Analysis; water, soil and air. Agrobios (India)

4. Wright, R.T. and B.J. Nebel. 2002. Environmental Science – towards sustainable future. Prentice Hal India Pvt. Ltd. New Delhi
5. Cunningham, W.P. and M.A. Cunningham, 2003. Principles of Environmental Science Tata McGraw Hill Publ. New Delhi
6. Trivedi, P.R. and G.Raj. 1992. Solid waste Pollution. Akshadeep Publishing House, New Delhi
7. American Public Health Association (APHA) 1992. Standard methods of water and waste water analysis, Washington DC.
8. NN Basak 2003 Environmental Engineering. Tata McGraw Hill publishing
9. P.K. Goel 1997 Water pollution Cause, Effects and Control. New age International publishers
10. V.Subramanian 2002 A text Book in Environmental Science ; Narosa publishing house

ES.SC-3.5: Air Pollution Monitoring 64 hrs

UNIT 1: Air Pollution: Definition; Scope of air pollution monitoring; Composition of atmosphere; Air pollution Sources- Anthropogenic and natural; Pollution emission factors; Health effects; agriculture effects; economic effect; Implication of Air Pollutions ----10 Hrs

UNIT 2: Air quality standards: Origin and concept of Air quality; Air quality Index (AQI); Definition, application and structure of Index; AQI and health implications; National Air Quality Index; Computing the AQI. Air quality parameter and criteria- Ambient air quality standards in India.
----10 Hrs

UNIT 3: Air Pollution Sampling and Analyses: Ambient Air Sampling guidelines; Air Sampling and analysis- Sulphur dioxide, Oxides of nitrogen, Suspended particulate matters, Respirable particulate matters, ozone, carbon monoxide, non-methane hydrocarbons, Volatile organic compounds. Measurement and analyses of meteorological parameters: Ambient weather parameters-wind speed, wind direction, solar radiation, relative humidity, temperature. Wind roses. ----12 Hrs

UNIT 4: **Instrumentation in Air Quality and monitoring:** Out door air quality monitoring systems; Engine emission monitoring systems. Portable weather stations; Air monitoring stations; Dust monitors; particulate monitors, Ozone monitors; smog monitors and different types of air samplers for chemical analysis. Indoor air quality monitoring devices – portable Carbon dioxide, Carbon monoxide and VOC meters. ----12 Hrs

UNIT 5: Air Pollution Control Measures: Control of Particulate Emission – Control of Gaseous Emission – Flue Gas Treatment Methods: Stacks Gravitational and Inertial Separation, Settling Chambers, Separators, Cyclones, Filtration, Liquid Scrubbing, Spray Chambers, Packed Towers, Orifice and Ventury Scrubbers, Electrostatic Precipitators, Gas/solid Adsorption. ----10 Hrs

UNIT 6: Legal frame work for Air Pollution monitoring and prevention: Environmental Protection in India; Climate Change; Compensatory Afforestation Management (CAMPA); Comprehensive Environmental Pollution Index (CEPI); Air (Prevention and Control of Pollution) Act, 1981; Air (Prevention and Control of Pollution) Amendment Act, 1987. Case studies in India- Urban pollution. ----10 Hrs

Practicals:
1. High volume Air sampler- Demonstration of mechanism
2. Suphur dioxide estimation in air samples by acid titration method
3. Estimation of NO_X in air samples
3. Spectrophotometric alaysis of Oxides of carbon (CO and CO_2) in the air sample
4. Analysis of Ammonia in the Air sample by Neslers method
5. Aerospores-collection and identification
6. Air borne particle monitoring-particle size using microscope
7. Instrumentation- Vehicle Exhaust Analyser, Respirable Dust Sampler, Stack monitoring

References:

1. National Air Quality Index 2014. Central Pollution Control Board- MOEFC-GOI. PP. 41.
2. Keith Bucher, Global climate, Wiley, New York, 1976
3. Wayne, R.P. The Chemistry of the atmosphere, Oxford Uni.Press, N.Y. 1991
4. Rao M.N.and H.V.N Rao, Air pollution , Tata McGraw –Hill, New Delhi. 1992
5. Khopkar, S M. Environmental Pollution, Monitoring and Control, New Age International Publishers, New Delhi.

ES.SC-3.6 Environmental Nano Science 64 hrs

UNIT-1: Environmental Chemistry: Importance of Environmental Chemistry; types of reactions; redox reactions; Reaction kinetics; Electrochemistry and its applications; Physical equilibrium chemistry- fundamentals and applications; Trace contaminants and their analyses; pH- Principle; Measurement; Buffers and Buffer index. ---12 hrs

UNIT-2: Colloidal Chemistry: Introduction; Colloids; types of colloids; hydrophilic, hydrophobic and association colloids. stability of colloids- lyophilic and lyophobic. Applications of colloids. Colourimetry and its applications. ---10 hrs

UNIT 3: Nano-technology and the Environment: History of Nano-technology; Properties and Principles of nano materials; Sources of nano-materials; Engineered, incidental, natural. Types of nano materials. Structure of nano-materials. Environmental applications of nano materials; Potential impacts of nano materials on organisms and ecosystems. ---12 hrs

UNIT 4: Preparation of Nano-Materials: Introduction; Methods of synthesis; physical-mechanical and vapour; chemical-colloids, chemical reactions, Sol-gel techniques and biological-Green synthesis. Flame synthesis; Solid state combustion; Solution combustion synthesis; Catalyst-types and Characterization of Catalyst. --12 hrs

UNIT 5: General Application of Nano-technology: Application in Biomedical and Life sciences, treatment to diseases; semiconductors; defense and security; Photocatalysis and its applications –8 hrs

UNIT 6: Application of nano-technology in Environmental issues: Health Impact; Medical applications; Health hazards; Environmental applications; Green nano-technology; Nano-materials pollution; Social impact of Nano-technology. - 10 hrs

Practical Experiments

1. Redox-reactions
2. Estimation of electric conductivity in the given water samples
3. Jar test- coagulation experiment
4. Measurement of light intensity
5. Synthesis of nano-particle using suitable techniques
6. Principle, merits and demerits of the techniques:
    a. Colourimetry,
    b. Atomic Absorption Spectroscopy,
    c. Gas chromatography,
    d. HPLC,
    e. Ion exchange Chromatography and
    f. XRD
    g. Muffle Furnace
    h. UV-Visible Spectrophotometer

i. Scanning Electron Microscope
j. Energy Dispersive X ray
k. Transmission Electron Microscope
l. Sunshine meter

References

1. Sharma, B. K., Environmental Chemistry, 13th Edition, Krishna Prakashan Media (p) Ltd. 2014.
2. Bharat, B., Hand Book of Naniotechnology, 2nd Edition, Springer Publisher, 2007.
3. Maohong, F., Chin, P.H., Alan, E.B., Zhonglin, W., Rachid, S., and Ian, W., Environ-nanotechnology, Elsevier Publisher, Britan, 2010.
4. Masaru, K., Introductory Nano-science, physical and Chemical Concepts, Garland Science, Taylor and Francis Group USA, 2012.
5. Parag, D., Handbook of Nanotechnology, Pentagon Press New Delhi, 2009.
6. Omar, M., Introduction to Nanomaterials and Devices, A jofn Wiley and Sons INC., Publications, USA, 2012.
7. William, A.G., Donald, W.B., Sergey, E.L., and Gerald, J.L., Handbook of Nanoscience Engineering and Technology, 2nd Edition, CRC press. Taylor and Francis group, London, 2007.
8. Flavio-Leandro, D.S., and Edson, R.L., Nanoenergy: Nanotechnology Applied for Energy Production, Springer Publisher, Berlin, 2013.
9. Gabor, I.H., John, J.M., Harry, F.T., and Joydeep, D., Fundamentals of Nanotechnology, CRC press. Taylor and Francis group, London, 2009.
10. Des W. Connell, Darryl, H.W., Michaelst, J.W., and Peter, P.V., Basic Concepts of Environmental Chemistry, Lewis publishers, Newyork, 1997.
11. Peter-Atkins, and Julio-Depaula., Atkins Physical Chemistry, 8th Edition, Oxford University Press, 2006.
12. Kenneth, W.W., Raymond, E.D., Larry, M.P., and Georgre, G.S., Chemistry, 8th Edition (International Student Edition), Brooks/Cole, Cengage learning, Canada, 2007.
13. Goel, A., Surface Chemistry, Discovery publishing House, New Delhi, 2006.
14. Robert, L.A., Heterogeneous Catalysis Synthetic Chemist, CRC press. Taylor and Francis group, London, 2011.
15. Shanmugam, S., Nanotechnology, MJ Publisher, Chennai, 2011.
16. Vishwanayhan, B., Sivasanker, S., and Ramaswamy, A.V., Catalysis Principles and Applications, Narosa Publishing House, Chennai, 2002.

Interdepartmental Elective Courses (IDE)

ES. IDE. 2: Drinking Water Resources, Quality and Management 32 Hrs

Unit 1: ***Sources of Drinking water***: Surface water, under river flow, ground water, frozen water. Water uses; agriculture, industrial, domestic, recreation, environmental uses and their consequences on drinking water availability. …. 4 hrs

Unit 2: ***Water Stress:*** Water stress for domestic use; factors contributing to water stress: population growth, expansion of urbanization, climate change, depletion of aquifers, water pollution and contamination. ….. 6 hrs

Unit 3: ***Drinking water quality:*** Importance of the good quality water; health implication; water borne diseases and water washed diseases. Drinking water quality criteria; BIS and WHO recommended Physicochemical and biological parameters to ensure the quality. ….. 6hrs

Unit 4: ***Drinking water treatments:*** Pre-chlorination; aeration; Coagulation; flocculation; sedimentation; filtration; disinfection, storage and public distribution. Household water treatment: Filtration system; water softeners; distillation systems; disinfection and storage. …... 6 hrs

Unit 5: ***Drinking Water Domestic Supply System:*** Community storage for potable water; water distribution network; Pipelines, pressure vessels and underground cistern; pipeline network; components to convey water to domestic uses. Quality of water distribution network and quality of potable water. Water supply management. .6 hrs

Unit 6: ***Status of Drinking water in India***: Major sources of drinking water in India. Quality and contaminant in drinking water; Total water availability v/s per capita requirement, water conflict with special references to drinking water sources. Drinking water quality and management systems in India. Rainwater Harvesting- importance and method --- 4 hrs

References (Latest Edition of the Following):

1. James K. Edzwald. Water Quality and Treatment: A Handbook on Drinking Water. McGraw-Hill.
2. Drinking Water Specification. Bureau of Indian Standards. Publication Unit, BIS, New Delhi.
3. World Health Organization. 2011. Guidelines for drinking-water quality. WHO Press, World Health Organization, Geneva, Switzerland.

IV Semester

ES. HC-4.1: Ecotoxicology 64 Hrs

UNIT 1: **Introduction to toxicology and ecotoxicology**: Historic and Current Need for Ecotoxicology, Ecotoxicology-A Synthetic Science; Scope and basic division of eco-toxicology. Basic concept of eco-toxicology: Ecologic principles and theory of chemical interactions with individuals, populations, communities and ecosystems; Environmental toxicant and toxicity; environmental concentration of toxicants. Chemical movement, fate and exposure; single phase chemical behavior; transport of chemical in air, water and soil; chemical transport between phases; chemical behavior and bioavailability ---10 hrs

UNIT 2: **Toxinology**: Definition, Scope, Microbial toxins and their monitoring- Eg. Diphtheria toxin, Hemolysin, anthrax toxin, Clostridium toxin, Botulinum toxin. Plant (algal, fungal and higher plant) and animal toxins- classification, nature and chemistry of toxins. Action of poison on Human --- 10 hrs

UNIT 3: **Major Classes of Environmental Contaminants and their toxicity**: Background Chemistry and toxicity of heavy metals; persistent bioaccumulative and toxic compounds- pesticides, dioxin and furan, flame retardant, polychlorinated hydrocarbons, polychlorinated biphenyls (PCBs), Polycyclic Aromatic Hydrocarbons (PAHs); Radionuclides, Trace elements. Acute and chronic toxicity. Factors influencing the toxicity: Duration. Dose and dosage, dose response relationships, interactions of toxicants, statistical concept of toxicity; margin of safety, toxicity curves - 10 hrs

Unit 4: **Uptake, Biotransformation, Detoxification, Elimination and Accumulation**: Uptake of toxicants; biological magnification: Bio-concentration, Bioaccumulations and biotransformation. Detoxification process and accumulation- biochemical toxicology- Organic Compound Detoxification, Biomarkers; Metallothioneins, Stress Proteins, Oxidative Stress and Antioxidant Response, DNA Modification, Enzyme Dysfunction and Substrate Pool Shifts. Bioaccumulation of pesticides in aquatic and terrestrial organisms, invertebrates, livestock and poultry, birds and human beings- milk, adipose tissue, blood, factors affecting the bioaccumulations. Methods employed to measure bioaccumulation. -12 hrs

UNIT 5: Effect of Environmental Contaminants: Introduction, Cytotoxicity and histopathology: Gene and Chromosome Damage, Cancer. Sublethal effects to Individuals: growth, development, reproduction, physiology, immunology, behavior, detecting sublethal effects. Acute and chronic lethal effects to individuals: Effects on populations: population dynamics and demography,

metapopulations, population genetics. Effects of contaminants on community, ecosystem, landscape and global effects. ---12 hrs

UNIT 6: **Risk Assessment of Contaminants**: Contaminants-definition, emerging classes of contaminants. Effects of contaminants-Endocrine disrupting chemicals, agro-chemical and industrial contamination. Contamination and effect of Lead, Arsenic, Copper and Nickel in drinking water. Introduction to risk assessment, scope and importance; Population, community and ecological Risk assessment. Human risk assessment. ..10 hrs

Practicals

1. Estimation of mercury in tissues sample by dithizone method
2. Estimation of LD50 and LC50 values of a pesticide using fish fingerlings
3. Estimation of water contaminants- Copper, Nickel and Lead in drinking water
4. Detection of pesticide by finger printing techniques
5. Identification of poisonous and non poisonous snakes
6. Identify and comment on toxic parts of plants -

a) Bellodona, b) Caster, c) Lantana d) Lilly glory e) Chrysanthemum f) Vinca g) Poppy plant

7. Identify and comment on toxic parts of animals -

a) Fire ants b) scorpions c) snake (venomous) d) bees, e) wasps, f) spiders g) Cones h)Jelly fish i) Sea urchin

References

1. Anderson, D and D.M.Conning. 1990. Experimental Toxicology: The Basic issues. Royal society of Chemistry, London.
2. Dhaliwal, G.S. 1993. Pesticides: Their Ecological Impact in Developing Countries. Commonwealth Publishers, New Delhi.
3. Peter Calow, 1993. Handbook of ecotoxicology, Blackwell Science, London.
4. Moriarty, F. 1999. Ecotoxicology, 3rd ed. Elsevier Pub.
5. Timbrell, J. 2003. Principles of Biochemical toxicology, CRC Press.

ES. HC-4.2: Occupational Health and Safety & Environmental Law 64 hrs

UNIT-1: Occupational Health: Definition and scope; Overview of workplace health hazards,: Physical, chemical, biological, radiological, psychological and ergonomic hazards: overview of occupational diseases and their causes. Silicosis, Asbestosis, Anthracosis, Baggassosis, Byssinosis. -- - 8hr

UNIT-2: Industrial Hygiene: Definition and objectives. Environmental factors and their effects on Health of workers. Hazards at work places. Hazard recognition and evaluation procedure. Control measures. Benefits and goals of industrial hygiene program. Meaning and importance, Role and functions of occupational specialist. Medical facilities in factories. Statutory aspects of health and medical examinations. First aid, safety and health education. ----12 hrs

UNIT-3: Industrial Safety: Definition of safety, accident Hazard, near misses, Risk perception and loss control. Impact of accidents on society, individual and industry safety issues. Economic, social and legal reasons for accident prevention. Accident costs. ----- 10hr

UNIT-4: Personal Protective Equipments (PPEs): Types of PPEs. Use care and maintenances of PPEs.. Need and importance of safety policy. Formulation of accident prevention program. Safety organization role and responsibility of management executives, supervisors and workers. Trade union role in safety. Safety committees. Functions of safety and health personnel. –10 hr.

UNIT -5: Environmental laws: An introduction. Legal meaning of environment. Forms of pollution-causes and effects. Need for legal control. Fundamental principles of environmental protection: sustainable development. Polluter pays principle, precautionary principle, Environmental Impact Assessment, Environmental audit, Intellectual Property Right (IPR), Patent, copyright -----10 hrs.

UNIT-6: Environmental Protection Legislations: The Water (Prevention and control of Pollution) Act 1974; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986; Forest Act 1927; Forest Conservation Act 1980; The Wild Life Protection Act 1972(2002 Amendment); Biodiversity Act 2002; The Noise Pollution (Regulation) 2000. Legal control of Hazardous waste – Biomedical waste, genetic waste, e-waste. - 14 hr

Practicals

1. Noise level survey at workplace using sound level meter
2. Determination of 'CO' concentration in the working atmosphere using direct reading instruments
3. Estimation of Accident rates such as Frequency rate, Incidence rate & Severity rate
4. Demonstration of use of portable fire extinguishers
5. Identification of Hazards at construction site
6. Spirometer
7. Illumination survey at workplace using lux meter
8. Studying MSDS for hazardous chemical at working site.

9. Environmental safety and health -Audit -Procedures

References

1. Louis J. DiBerardinis. 1999. Handbook of Occupational safety and health. Wiley.
2. Jeremy W. Stranks. 2006. Health and safety hand book. Kogan Page Ltd.
3. Jack T. Garrett, Lewis, J. Cralley and Lester V. Cralley. 1988. Industrial hygiene management. John Wiley and Sons.
4. Harris, R.L., Cralley, L.V. and Cralley, L.J. 1994. Patty's Industrial hygiene and toxicology-3A. Wiley.
5. Environmental Law and Policy. Hughes David, 1992, Environmental Law, Butterworths. Jariwala C.M., 2004, Environmental Justice, APH Publishing Corporation, N. Delhi Leelakrishnan. P, 2004,
6. Environmental Law Case Book, Lexis Nexis, Butterworths Mohanty. S. K., 2004, Environment and Pollution Law, Universal Law Publishing Co. Pvt. Ltd.
7. Singh Gurdip, 2004, Environmental Law in India, Mcmillan & Co.
8. Singh Gurdip, 2003, International Environmental Law, in Gurdip Singh, International Law, Macmillan.
9. Shastri. S. C., 2005, Environmental Law, Eastern Book Company

MODEL QUESTION PAPER

M.Sc., Degree Examination……..Year
I/II/III/IV Semester (CBCS Scheme)
Title of the paper:

Time: 3 Hrs Max. Marks: 75

SECTION-A

Answer All Questions. All questions carry equal marks 6 x 2½ = 15 marks

1. Question from the Unit-1
2. Question from the Unit-2
3. Question from the Unit-3
4. Question from the Unit-4
5. Question from the Unit-5
6. Question from the Unit-6

SECTION-B

Answer All Questions. All questions carry equal marks 6 x 10 = 60 marks

7. a) Question from the Unit-1
   OR
   b) Question from the Unit-1
8. a) Question from the Unit-2
   OR
   b) Question from the Unit-2
9. a) Question from the Unit-3
   OR
   b) Question from the Unit-3
10. a) Question from the Unit-4
    OR
    b) Question from the Unit-4
11. a) Question from the Unit-5
    OR
    b) Question from the Unit-5
12. a) Question from the Unit-6
    OR
    b) Question from the Unit-6

MODEL QUESTION PAPER (for Elective Paper)

M.Sc., Degree Examination……..Year

I/II/III/IV Semester (CBCS Scheme)

Title of the paper:

Time: 1.5 Hrs Max. Marks: 40

Instructions to students: Answer all sections.

SECTION-A

Answer All Questions. All questions carry equal marks 6 x 1½ = 9 marks

1. Question from the Unit-1
2. Question from the Unit-2
3. Question from the Unit-3
4. Question from the Unit-4
5. Question from the Unit-5
6. Question from the Unit-6

SECTION-B

Answer All Questions.

7. a) Question from the Unit-1 05 Marks
   OR
   b) Question from the Unit-1

8. a) Question from the Unit-2 05 Marks
   OR
   b) Question from the Unit-2

9. a) Question from the Unit-3 05 Marks
   OR
   b) Question from the Unit-3

10. a) Question from the Unit-4 05 Marks
    OR
    b) Question from the Unit-4

11. a) Question from the Unit-5 05 Marks
    OR
    b) Question from the Unit-5

12. a) Question from the Unit-6 06 Marks
    OR
    b) Question from the Unit-6

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ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯ

ಶೈಕ್ಷಣಿಕ ವಿಭಾಗ, ವಿಶ್ವವಿದ್ಯಾಲಯ ಕಾರ್ಯಾಲಯ, ಕುವೆಂಪು ಶತಮಾನೋತ್ಸವ ಭವನ,
ಜ್ಞಾನಸಹ್ಯಾದ್ರಿ, ಶಂಕರಘಟ್ಟ - 577 451, ಶಿವಮೊಗ್ಗ ಜಿಲ್ಲೆ.

ಸಂಖ್ಯೆ:ಕುವಿಶ್ವವಿ/ಎಸಿ-4(149)537 /2018-19 ದಿನಾಂಕ:30-04-2018

ಗೆ,
ಅಧ್ಯಕ್ಷರು,
ಸ್ನಾತಕೋತ್ತರ ಪರಿಸರ ವಿಜ್ಞಾನ ಅಧ್ಯಯನ ವಿಭಾಗ,
ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯ,
ಶಂಕರಘಟ್ಟ

ಮಾನ್ಯರೆ,

ವಿಷಯ:- ಪರಿಷ್ಕೃತ ಪಠ್ಯಕ್ರಮ ಅನುಮೋದನೆಗೊಂಡಿರುವ ಕುರಿತು.
ಉಲ್ಲೇಖ:- ದಿನಾಂಕ:22-03-2018ರಂದು ನಡೆದ ವಿದ್ಯಾ ವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಯ ನಿರ್ಣಯ.

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ಮೇಲ್ಕಂಡ ವಿಷಯಕ್ಕೆ ಸಂಬಂಧಿಸಿದಂತೆ, 2018-19ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ತಮ್ಮ ವಿಭಾಗದ ಪಠ್ಯಕ್ರಮವನ್ನು ಪರಿಷ್ಕರಿಸಿದ್ದು, ಸದರಿ ಪಠ್ಯಕ್ರಮಕ್ಕೆ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಪ್ರಾಧಿಕಾರಗಳಾದ ಅಧ್ಯಯನ ಮಂಡಳಿ, ನಿಕಾಯ ಹಾಗೂ ವಿದ್ಯಾ ವಿಷಯಕ ಪರಿಷತ್ ಸಭೆಗಳು ಅನುಮೋದನೆ ನೀಡಿರುತ್ತವೆ. ಅದ್ದರಿಂದ 2018-19ನೇ ಶೈಕ್ಷಣಿಕ ಸಾಲಿನಿಂದ ಸಂಬಂಧಿಸಿದ ಪಠ್ಯಕ್ರಮವನ್ನು ಅಳವಡಿಸಿಕೊಳ್ಳಲು ಮುಂದಿನ ಕ್ರಮಕ್ಕೆಗೊಳ್ಳಬೇಕಾಗಿ ತಿಳಿಸಲಾಗಿದೆ.

ಮುಂದುವರೆದಂತೆ, ಸದರಿ ಪಠ್ಯಕ್ರಮದ Soft Copyಯನ್ನು ಶೈಕ್ಷಣಿಕ ವಿಭಾಗಕ್ಕೆ ಮಾಹಿತಿಗಾಗಿ ಹಾಗೂ ವಿಶ್ವವಿದ್ಯಾಲಯದ ಅಂತರ್ಜಾಲದಲ್ಲಿ ಅಪ್ಲೋಡ್ ಮಾಡಲು ಸಂಯೋಜನಾಧಿಕಾರಿಗಳು, ಯು.ಸಿ.ಎಸ್.ಎಲ್. ಕೇಂದ್ರ, ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯ, ಶಂಕರಘಟ್ಟ ಇವರಿಗೆ ಕಳುಹಿಸಿಕೊಡಲು ಕೋರಲಾಗಿದೆ.

ತಮ್ಮ ವಿಶ್ವಾಸಿ,

(ಡಾ. ದಿನೇಶ್ ಕುಮಾರ್ ಎಸ್.)
ಸಹಾಯಕ ಕುಲಸಚಿವರು
ಕುವೆಂಪು ವಿಶ್ವವಿದ್ಯಾಲಯ
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ಶಂಕರಘಟ್ಟ-577 451