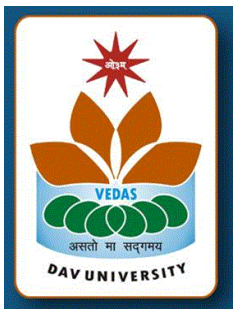
DAV UNIVERSITY, JALANDHAR

DAVUNIVERSITYJALANDHAR



Course Scheme & Syllabus

FOR

M.Sc. (Hons.) Environmental Sciences

(Program ID-78)

1st TO 4th SEMESTER

Examinations 2013–2014 Session Onwards

Syllabi Applicable For Admissions in 2013

DAV UNIVERSITY, JALANDHAR

Scheme of Courses M.Sc. (Hons.)
M.Sc. Environmental Sciences

Semester 1

S.No	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
							A	B	C	D	
1	EVS502	Air Pollution and Control	4	1	0	4	25	25	25	25	100
2	EVS503	Environmental Chemistry	4	1	0	4	25	25	25	25	100
3	EVS504	Sanitary Engineering and Practices	4	0	0	4	25	25	25	25	100
4	EVS505	Environmental Geology	4	1	0	4	25	25	25	25	100
5	EVS506	Principles of Ecology	4	1	0	4	25	25	25	25	100
7	EVS507	Environmental Science Lab I (Based on EVS 502 and EVS 503)	0	0	4	2	-	-	-	-	50
8	EVS508	Environmental Science Lab II (Based on EVS 504, EVS 505 and EVS 506)	0	0	4	2	-	-	-	-	50
		Total	**20**	**4**	**8**	**24**					**600**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type and Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type and Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks
L: Lectures T: Tutorial P: Practical Cr: Credits

DAV UNIVERSITY, JALANDHAR

Scheme of Courses M.Sc. (Hons.)
M.Sc. Environmental Sciences

Semester 2

S.No	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
							A	B	C	D	
1	EVS509	Environmental and Industrial Microbiology	4	1	0	4	25	25	25	25	100
2	EVS510	Remote Sensing and GIS	4	1	0	4	25	25	25	25	100
3	EVS511	Environmental Impact Assessment and Monitoring	4	0	0	4	25	25	25	25	100
4	EVS512	Instrumentation methods of Environmental Analysis	4	1	0	4	25	25	25	25	100
5	ZOO514	Biostatistics	4	1	0	4	25	25	25	25	100
6	EVS513	Environmental Science Lab III (Based on EVS 509, EVS 510, EVS 511 and 512)	0	0	4	2	-	-	-	-	50
7	ZOO518	Biostatistics Lab	0	0	4	2	-	-	-	-	50
8	EVS514	Field Study/ Industrial Visit	0	0	0	0	-	-	-	-	**S/US**
			20	**4**	**8**	**24**					**600**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type and Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type and Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks
L: Lectures T: Tutorial P: Practical Cr: Credits

DAV UNIVERSITY, JALANDHAR

Scheme of Courses M.Sc. (Hons.)
M.Sc. Environmental Sciences

Semester 3

S.No	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
							A	B	C	D	
1	EVS601	Environmental Engineering and Mitigation of Water Pollution	4	1	0	4	25	25	25	25	100
2	EVS602	Natural Resource conservation	4	1	0	4	25	25	25	25	100
3	EVS603	Climatology	4	1	0	4	25	25	25	25	100
4	EVS604	Environmental Biotechnology	4	1	0	4	25	25	25	25	100
5		Interdisciplinary (To be offered from outside the department)	4	0	0	4	25	25	25	25	100
6	EVS605	Environmental Science Lab IV (Based on EVS 601 and EVS 602)	0	0	4	2	-	-	-	-	50
7	EVS606	Environmental Science Lab V (Based on EVS 603 and EVS 604)	0	0	4	2	-	-	-	-	50
9	EVS607	Seminar	0	0	0	0	-	-	-	-	S/US
			20	**4**	**8**	**24**					**600**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type and Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type and Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks
L: Lectures T: Tutorial P: Practical Cr: Credits

DAV UNIVERSITY, JALANDHAR

Scheme of Courses M.Sc. (Hons.)
M.Sc. Environmental Sciences

Semester 4

S.No	Paper Code	Course Title	L	T	P	Cr	% Weightage				E
							A	B	C	D	
1	EVS608	Environmental Laws and Policy	4	1	0	4	25	25	25	25	100
2	EVS609	Wastewater Treatment Plant Design	4	1	0	4	25	25	25	25	100
3	EVS610	Solid Waste Management Techniques	4	1	0	4	25	25	25	25	100
4	CSA651	Computer Programming in Ecology	4	0	0	4	25	25	25	25	100
5	BOT601	Scientific Writing and Research Methodology	2	0	0	2	25	25	25	25	50
7	EVS611	Environmental Science Lab VI (Based on EVS 608, EVS 609 and EVS 610)	0	0	4	2	-	-	-	-	50
8	CSA652	Computer Programming in Ecology Lab	0	0	4	2	-	-	-	-	50
9	EVS612	Project	0	0	0	2	-	-	-	-	50
			18	**3**	**8**	**24**					**600**

A: Continuous Assessment: Based on Objective Type Tests
B: Mid-Term Test-1: Based on Objective Type and Subjective Type Test
C: Mid-Term Test-2: Based on Objective Type and Subjective Type Test
D: End-Term Exam (Final): Based on Objective Type Tests
E: Total Marks
L: Lectures T: Tutorial P: Practical Cr: Credits

DAV UNIVERSITY, JALANDHAR

Course Title: Air Pollution and Control
Paper Code: EVS 502

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To acquaint the students with latest environmental technology on how to combat with air pollution and related problems.

Possible outcome: This will assist the students for designing of air pollution control equipments in research and industries.

Unit 1: Chemical composition of air

Composition of air: Layers of Atmosphere, importance of atmosphere, meteorological conditions and air circulation; Classification of elements; Chemical speciation: Particles, ions and radicals in the atmosphere; Chemical processes for formation of inorganic and organic particulate matter; Thermo-chemical and photochemical reactions in the atmosphere; Oxygen and ozone chemistry; Chemistry of air pollutants; Photochemical smog.

(10 Lectures)

Unit 2: Sources of air pollution

.

Primary and Secondary air pollutants and their sources; Transport and diffusion of air pollutants; Gas law: Behaviour of pollutants in the atmosphere; Methods of monitoring and control of air pollution: SO2, NOx, CO, SPM; Effect of pollutants on human beings, plants, animals, materials and climate; Acid rain; Air Quality standards. (12 Lectures)

Unit 3: Chemistry of air pollutants

First and second law of thermodynamics; Heat transfer processes; Scale of meteorology: pressure, temperature, precipitation, humidity, radiation and wind; Atmospheric stability, inversion and mixing height; wind rose; Effect of lapse rate on plume behavior; Maximum mixing depth; Gaussian dispersion model; Effective stack height.

(12 Lectures)

Unit 4: Control of air pollutants

Control devices for particulate matter: Gravitational settler, centrifugal collector, wet collector, fabric filters and electrostatic precipitator; Control of gaseous contaminants : Adsorption, absorption, condensation and combustion including catalytic combustion; Stack and analysis of temperature, flow velocity, composition; Green belt design; Control of air pollution by process change; Management strategies for air pollution abatement; Vehicular pollution and urban air quality. (14 Lectures)

Practical:

1. Determination of wind speed by anemometer.
2. To study SPM in ambient air by high volume sampler.
3. Analysis of $SO_2$and NO_X by wet chemistry method.
4. To study the effects of SO_2 on plant (Leaves and flowers).
5. To study the effects of H_2S on plant (Leaves and flowers).
6. Presentation and interpretation of wind data by wind rose.
7. Determination of wind velocity.
8. Measurement of air humidity and temperature.
9. Detection of Ammonia from ambient air.
10. Determination of Air pollution index.
11. Plants as air Pollution Indicators: At least 2 examples of Museum specimen or fresh sample.
12. Diagrammatic representation of different layers of atmosphere, their characteristics and temperature relationships.

References:

1. Lodge, JP. *Methods of Air Sampling and Analysis*. New York: Lewis Publication, 1995.
2. Nevers, ND. *Air Pollution Control Engineering*. New York: McGraw-Hill Publishing Company, 1995.
3. Peavy, HS, Rowe, DR, and Tchobanoglous G. *Environmental Engineering*. Singapore: McGraw-Hill Book Company, 1985.
4. Rao, MN, and Rao HVN. *Air Pollution*. New Delhi: Tata McGraw-Hill Publishing Company Limited, 1989.
5. Stern, A C, and Boubel A. *Fundamentals of Air Pollution*. New York: Academic Press, 2000.
6. Theisen, GH, and Eliassen R. *Solid Waste: Engineering Principles and Management issues.* New York: Mc-Graww Hill, 1977.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Chemistry
Paper Code: EVS 503

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To acquaint the students with the dynamics and principle of environmental chemistry and their toxic effects on environment.

Possible outcome: The perspective for research of students will increase in field of environmental chemistry.

Unit 1: Fundamentals of environmental chemistry

Concept and scope of environmental chemistry; Branches of environmental chemistry; Fundamentals of environmental chemistry; Stoichiometry; Gibbs' energy; Chemical potential; chemical equilibria; Acid base reactions; Solubility product; Solubility of gases in water; The carbonate system; Unsaturated and saturated hydrocarbons; Radionuclides; Physical processes of pollutant transport and dispersion**:** Transport media, transport of pollutants in air. (12 Lectures)

Unit 2: Dispersion of pollutants in water and soil

Dispersion of pollutants in soil: Adsorption and decomposition of organic pollutants in soil, fate of soil pollutants; Sorptive properties of soil: Colloids, cation exchange capacity, anion retention, absorption of organics; Detrimental effects of soil pollution and soil erosion; Siltation of lakes, methods to minimize soil pollution, soil pollution monitoring; Physical transport in surface water, dispersion of pollutants in ground water, biochemical processes in water involving microorganism; Major types of water pollutants: Oxygen demanding wastes, disease causing agents, synthetic organic compounds, plant nutrients, inorganic chemicals and minerals, sediments, oil; Impact of water pollution on environment, radioactive and thermal pollution.

(14 Lectures)

Unit 3: Soil chemistry

Inorganic and organic components of soil; Nitrogen pathways and NPK in soils; Physico-chemical, bacteriological sampling and analysis of soil quality; Soil pollution control; Industrial waste effluents and heavy metals, their interactions with soil components; Soil micro-organisms and their functions; Degradation of different insecticides; fungicides and weedicides in soil; Different kinds of synthetic fertilizers and their interactions with different components of soil; Rocks, weathering, processes of soil formation and soil classification.

(11 Lectures)

Unit 4: Environmental geochemistry

Concept of REE; Classification of trace elements; Mobility of trace elements; Geochemical cycles; Biogeochemical factors in environmental health; Human use of trace elements and health; Possible effects of imbalance of some trace elements; Diseases induced by human use of heavy metals.(10 Lectures)

Practical:

1. Collection of river/ dug well/ bore well by random sampling method. Preservation of water samples and validity of water sample for chemical analyses.
2. Estimation of pH, Turbidity, and TDS form given water sample.
3. Estimation of alkalinity from given water sample.
4. Estimation of Hardness, Ca and Mg from given water sample.
5. Estimation of Chlorides by Silver nitrate method.
6. Estimation of Na and K from given water sample by flame photometrically.
7. Estimation of Sulphate from given water sample.
8. Estimation of Phosphate from given water sample.
9. Determination of water holding capacity of soil.
10. Quantitative analysis of soil organic carbon.
11. To study the physical characteristics of soil such as colour, texture, temperature etc.
12. To determine soil salinity and alkalinity.

References:

1. Alloway, BJ, and Ayres DC. *Chemical Principles of Environmental Pollution*. London: Blackie Academic and Professional, 1997.
2. Hemond, HF, and Fechner E. *Chemical Fate and Transport in the Environment*. San Diego: Academic Press, 1994.
3. Karikalan, VL. *Environmental Engineering*. Delhi: Dhanpati Rai & Co. (P) Ltd., 2002.
4. Manahan, SE. *Environmental Chemistry*. Chelsea, Michigan: Lewis Publishers, 1991.
5. O' Neill, P. *Environmental Chemistry*. London: Chapman and Hall, 1993.
6. Peavy, AS, Rowe, DR, and Tchobanoglous, G. *Environmental Engineering*. Singapore: McGraw Hill, 1985.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Sanitary Engineering and Practices
Paper Code: EVS 504

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint the students with the need of good sanitary and hygiene conditions for healthy environment.

Possible outcome: This will assist the students for designing of sanitary equipments.

Unit 1: Concepts of Sanitary Engineering

History and importance; Layout of sanitary engineering; relationship between water supply and sanitary engineering; sanitary works; Principles of sanitation; Necessity of collection and disposal of waste; sewage disposal, layout of sewage disposal system; Quantity of sewage: Classification of sewage, sanitary sewage or dry weather flow, Sources of dry weather flow, Factors effecting dry weather flow, Determination of dry weather flow; Storm sewage: Necessity of storm sewers, factors affecting storm sewage, determination, time of concentration, design of sewers, flow diagrams, partial flow diagrams. (14 Lectures)

Unit 2: Sewerage system

Methods of collection as sanitation: Dry or conservancy method, Water carriage method; Sewerage system: sewers and their types, sewer joints, Spigot and socket point, collar joints, mechanical joint, bandage joints, flush joints, manholes, drop holes, lamp holes, filled and poured type joints. (10 Lectures)

Unit 3: Building drainage and Maintenance

Principle of house/building drainage: plumbing system, sanitary fitting and fixtures, wash basin, kitchen sinks, bath tubs, drinking fountains, traps and types; Maintenance of sewage system**:** Maintenance and purpose of inspection, causes of damage to sewer, problems in sewer maintenance, breaking and clogging of sewers, hazards and preventions, precautions during cleaning and maintenance of sewers, safety equipments. (11 Lectures)

Unit 4: Sewage treatment and Disposal

Quality of sewage: Physical, chemical and biological examination of sewage, composition of sewage, exothermal, endothermal and biochemical reactions; Primary, secondary and tertiary treatment methods, sedimentation process, sedimentation with coagulation, filtration, trickling filters, activated sludge process, aeration of sewage, drying and disposal, oxidation ponds, Methods of sewage disposal, sewage disposal by dilution, land treatment methods, sewage farming, sewage sickness, sewage pumping and air ejectors.

(12 Lectures)

Practical / Assignments:

1. Study of different collar joints.
2. Study of sanitary fitting and fixtures.
3. Study of sewers and their types.
4. Study of different flush joints, manholes.
5. Visit to waste water treatment plants.
6. Determination of sludge volume index of a sludge sample.
7. Determination of sludge density index of sludge sample.
8. A study of local city map.
9. A survey of local industrial unit (Activated Sludge Process).
10. A survey of local industrial unit (Oxidation pond).

References:

1. Bijlani, HU, and Rao PSN. *Water supply and sanitation in India*. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd., 1990.
2. Gupta, NL. *Urban Water Supply.* New Delhi: Rawat Publications, 1994.
3. Shah, C.S. *Water supply and Sanitation*. New Delhi: Golgotia Publishing Company, 1998.
4. Sharma, JL. *Public health Engineering.* New Delhi: Satya Prakashan, 2000.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Geology
Paper Code: EVS 505

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To acquaint the students with the fundamental concepts of geo science in relation to environmental aspects.

Possible outcome: The perspective for research of students will increase in field of environmental geology.

Unit 1: Earth crust and Processes

Earth's processes; Concepts of residence, time and rates of natural cycles; Catastrophic geological hazards; Composition of earth, rocks and minerals, magmas, igneous rocks, weathering, clastic and non clastic sediments and sedimentary rocks, metamorphic rocks; Prediction and perception of the hazards and adjustments to hazardous activities; Lithosphere and plate tectonics: Earth's interior and crust, lithosphere and asthenosphere, continents and ocean basins, earth's relief features, geologic time scale, second order relief features of continents, alpine chains, continental shields and mountain roots.

(12 Lectures)

Unit 2: Volcanic and tectonic landforms

Initial and sequential land forms igneous rock bodies; Composite volcanoes, calderas; Flood basalts and shield volcanoes; Cinder cones; Volcanic activity and land forms; Geothermal energy sources; Landforms of tectonic activity: Foreland fold belts, faults, rift valley landforms, earthquakes, Seismic sea waves; Landforms of weathering and mass wasting: Wasting of slopes, geometry of rock breakup, effects of physical and chemical weathering, lime stone caverns, karst landscapes, mass wasting, arctic tundra; Landforms made by running water: Fluvial processes and landform normal and accelerated slope erosion, infiltration capacity, land use and sediment yield, accelerated soil erosion, stream erosion and transport.

(14 Lectures)

Unit 3: Landforms and rock structure

Ground water in sedimentary strata: Coastal plains, deformed strata, sedimentary domes, black hills dome, syncline anticline, plunging folds, fault scrap, fault trap, exposed batholiths, erosional landforms of volcanoes; Landforms made by waves and currents: Water waves, waves in deep water, shoaling waves and breakers, marine erosion, beaches, beach profile, littoral drift, wave refraction, tidal currents and tidal power coastlines. (12 Lectures)

Unit 4: Soil forming processes

Concepts of pedon and polypedon; Soil colour, texture, consistence, structure, soil horizons, soil solution, ions, colloids and cation exchange, acidity and alkalinity temperature and water regimes biological processes, pedogeny; World soils**:** Comprehensive soil classification system, diagnostic horizons, salient features of Marbut system of soil classification, characteristics of different soils. (10 Lectures)

Practical / Assignments:

1. To Study the internal structure of earth.
2. Study of plant fossil forms from different geological periods.
3. Identification of type of rock - Igneous, sedimentary and discuss their properties.
4. Hand specimen identification of common rocks (Granite, sandstone, Schist).
5. Hand specimen identification of common minerals (Quartz, kfeldspar, muscovite).
6. Identification of Soil texture - clay, sand, loamy.
7. Identification of Soil types - red soil, black soil.
8. Estimation of Ca and Mg from given soil sample.
9. Estimation of Nitrates from given soil sample.
10. Estimation of Na and K from given soil samples by flame photometer.
11. Model study of structural folds and faults.
12. Microscopic study of common rocks.

References:

1. De Dlij, HJ, and Muller PO. *Physical Geography of the Global Environment*. New York: John Wiley & Sons, Inc., 1996.
2. Donn, WL. *The Earth*. New York: John Wiley & Sons Inc., 1972.
3. Skinner, BJ, and Porter SC. *Physical Geology*. New York: John Wiley & Sons, 1987.
4. Strahler, AN. *Modern Physical Geography.* New York: John Wiley & Sons, Inc., 1992.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Principles of Ecology
Paper Code: EVS 506

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To acquaint the students with the concept of ecology so that they get well versed with different ecosystems and their interactions.

Possible outcome: The perspective for research of students will increase in field of ecology to set database for ecological parameters.

Unit 1: Introduction to Ecology

Ecology: Concept and major branches; Population Ecology: Concept of Metapopulation; Population characteristics- Population growth and its dynamics: Natality, mortality, growth patterns, Age distribution, Malthusian theory, Characteristics of population; Dynamics and Interactions; Regulation; Population genetics; Concept of Metapopulation, Community Ecology: Concept, Characteristics and dynamics; Interactions; Development of community (Plant Succession); Parasitism; Prey-Predator relationship.

(12 Lectures)

Unit 2: Ecosystem and its components

Theory of Island Biogeography, Major Ecosystems: Terrestrial Ecosystem - Forest, grassland, arid, cropland, Wetland, Ponds, lakes, rivers, oceans, estuaries. Major terrestrial Biomes: Forest, Desert, and Grassland; Relationship between Precipitation and temperature in determining the vegetation; Forest Types of India, deserts of India and world; Ecological pyramids; Ecological energetics : The Energy flow in Biosphere and in Ecosystems; Laws of thermodynamics, h and y shaped models; ecological efficiency.(10 Lectures)

Unit 3: Invasion of species

Biological Invasion: Concept; Pathways of Invasion, Process of Invasion, Mechanism of Invasions; Impact of Invasive Species - Ecological, Environmental, Economical; Some examples of major invasive plants and animals in India; Concept of Speciation*:* Types and process; Extinction*:* A brief history and reasons. (12 Lectures)

Unit 4: Biodiversity and its components

History of biodiversity, Measurement of diversity: alpha, beta and gamma diversity; Hotspots of biodiversity of world; Biodiversity hotspots of India; Red data book; Concept of **e**ndangered and threatened species: IUCN Categories of Extinction, Endangered and threatened animals and plants of India; Biodiversity conservation: Concept of Protected Area Networks – National Parks, Wildlife Sanctuaries, Biosphere Reserves.

(12 Lectures)

Practical:

1. To determine minimum number and size of quadrat for studying vegetation in a grassland.
2. To calculate density, frequency, abundance and dominance of plant species in grassland using quadrat method.
3. To calculate the Importance Value Index (IVI) of species.
4. To calculate index of diversity, richness, evenness and dominance of species.
5. To find out association between two species using Chi-square method.
6. To calculate similarity index between two adjoining communities.
7. To study and enlist various biotic and abiotic components of pond and forest ecosystem.
8. To study ecology of some major exotic invasive weeds.
9. Estimation of species diversity by Shannon - Weiner diversity index method.
10. To determine basal cover of trees in a forest ecosystem/forest plantation.

References

1. Begon, M, Townsend, CR, and Harper JL. *Ecology from Individuals to Ecosystems.* USA: Wiley-Blackwell, 2005.
2. Botkin, D B, and Keller Edward. *Environmental Science: Earth as a Living Planet*. 6th ed. USA: John Wiley & Sons, 2007.
3. Chapman, J L, and Reiss M J. *Ecology: Principles and Applications*. UK: Cambridge University Press, 1998.
4. Cunningham, WP, and Cunningham MA. *Principles of Environment Science*. Enquiry and Applications. 2nd ed. New Delhi: Tata McGraw Hill, 2004.
5. Frankel, OH, Brown, AHD, and Burdon JJ. *Conservation of Plant Biodiversity*. UK: Cambridge University Press, 1995.
6. Kohli, RK, Jose, S, Singh, HP, and Batish DR. *Invasive Plants and Forest Ecosystems.* CRC Press / Taylor and Francis, 2009.
7. Leveque, C. *Ecology: From Ecosystem to Biosphere*. USA: Science Publishers, 2003.
8. Odum, EP. *Fundamentals of Ecology*. W.B. Saunders, Dehradun USA: Indian Reprint 1996 by Natraj Publishers, 1991.
9. Odum, EP. *Ecology: A Bridge between Science and Society*. USA: Sinauer Associates, Inc., 1997.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental and Industrial microbiology
Paper Code: EVS 509

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To acquaint the students to understand the difference techniques by using microorganism to combat with pollution.

Possible outcome: The perspective for research of students will increase in field of microbiology and assist the students for various techniques used in industries.

Unit 1: Industrial Microbiology

Introduction to Microbiology: History, scope, Types, structure, biology and classification of bacteria, mycoplasma, fungi, algae and virus identification; Primary and secondary metabolites; Major industrial products – Foods: Single Cell Protein, Mushrooms, Cheese and Yogurt, Spirulina, Fermented Meat, Sauerkraut, Pickles, Coffee Beans, Chocolate, Olives, Soy sauce; Flavoring agents and Food Supplement: Vinegar, Nucleotides, Amino Acids, Vitamins; Beverage Containing Alcohol: Wine, Beer, Distilled Beverages; Organic Acids: Citric acid, Itaconic acid ; Enzymes and Microbial Transformation; Inhibitors; Genetically Engineered Microorganisms : Human insulin, Human Growth Hormones and Vaccines.

(12 Lectures)

Unit 2: Wastewater Microbiology

Water Microorganisms: Marine Microbiology, Fresh Water Microbiology ; Sewage Treatment : Ecological impact of raw sewage on receiving water, Public health impact of raw sewage discharge; Primary waste water treatment, Secondary treatment: Activated Sludge Process, Trickling Filters, Oxidation Ponds, Rotating Biological Contractors; Microbial treatment problems; Tertiary waste water treatment, Drinking Water Treatment; Microbial Analysis of Water: Total coliform bacteria analysis, Membrane-Filter Technique, Colorimetric and Fluorogenic Analysis, IMViC Test. Commercial blends of microorganisms/enzymes in wastewater treatment. (13 Lectures)

Unit 3: Microbial Waste Management

Waste as a Resource: Organic Compost, Vermicomposting, Biogas Production; Landfills; Pesticides: Alternatives to use of persistant pesticides; Bioremediation: Biodegradative organisms, Methodology of bioremediation, Advantages of bioremediation, Problem associated with bioremediation, Future of bioremediation; Acid mine drainage; Microbial Leaching: Copper Leaching, Uranium Leaching; Biodegradation: Biodegradation of Petroleum and Xenobiotics, Biofilteration: Biofilters, Microorganisms, Biofilter Media, Mechanism of Biofilteration.

(12 Lectures)

Unit 4: Aeromicrobiology

Important airborne pathogens: Plant, animal and human pathogens; Important airborne toxins; Bioaerosols : Nature of bioaerosols; Aeromicrobiological pathways; Microbial survival in air; Extramural aeromicrobiology; Intramural aeromicrobiology; Bioaerosols control; Control of microorganisms by physical agents: High temperature, Low temperature, Filtration, Desiccation, Osmotic pressure, Radiations; Control of microorganisms by chemical means: Phenol, Phenolics, Bisphenols, Biguanides, Halogens, Alcohols, Heavy metals and their compounds.

(12 Lectures)

Practical:

1. To study different principle and working of instruments used to perform microbiological experiments.
2. To study the Gram positive and Gram negative staining of Bacteria.
3. To determine the quality of milk samples using Methylene Blue.
4. To study microbial techniques: Media requirement, Inoculation and Streaking of plate.
5. To study the growth period in given strain of bacteria.
6. To prepare Potato Dextrose Agar (PDA) medium for routine cultivation of fungi.
7. To study aeromicroflora at different locations of DAV University, Jalandhar.
8. To isolate the microorganisms from soil by Pour Plate Technique.
9. To determine the coliform bacteria in given water sample using MPN Test viz. Preliminary test, Confirmatory Test and Complete Test.
10. To determine the motility of bacteria by Hanging Drop Method.
11. To demonstrate the bacterial growth in response to oxygen availability.
12. To study the mutagenicity of water samples using Ames Assay.

References:

1. Pelczar, M J, Chan, ECS, and Krieg N R. *Microbiology-Concepts and Applications*. New Delhi McGraw Hill Inc., 1993.
2. Perry, JJ, and Staley JT. *Microbiology- Dynamics and Diversity*. Florida, USA: Harcourt College Publishing, 1997.
3. Taussig, M J. *Microbiology (2^{nd} ed.).* Oxford, London: Blackwell Scientific Publications, 1984.
4. Tortora, GJ, Funke, BR, and Case CL. *Microbiology-An Introduction (7^{th}ed.*). Carson, USA: Benjamin Cummings, 2001.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Remote Sensing and GIS
Paper Code: EVS 510

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To apprise the students with the remote sensing techniques to study flora and fauna, and role of GIS in combating environmental issues.

Possible outcome: The perspective for research of students will increase in field of remote sensing to study various climatic and ecological parameters.

Unit 1: Remote sensing and its applications

Principles of Remote Sensing; Electromagnetic spectrum; Aerial Photography and image recognition; Sensors & platforms; IRS satellites & their sensors; Application of remote sensing in environmental studies: land use mapping, forest survey, habitat analysis, water management, drought monitoring and flood studies, wetland survey; Rainfall estimation, pollution studies, soil conservation, watershed management and vegetation mapping.

(12 Lectures)

Unit 2: Photography Techniques

Aerial Photographs: Interaction between light and matter, film technology; Characteristics of aerial photographs, Stereopairs of aerial photographs; Black and White Photography: Panchromatic, IR and UV photography; Multispectral Images: Colour photography, normal colour, IR and multispectral photography, multispectral scanner images; Remote Sensing Satellites: Specifications of Landsat, SPOT and IRS satellites. (10 Lectures)

Unit 3: Imaging Systems

Principles of image interpretation; visual image interpretation; Digital image processing- Image enhancement, image rectification, image classification techniques and Accuracy assessment; Thermal Infrared Images: Thermal processes and properties, IR detection and imaging technology, characteristics of IR images; Radar Images: Aircraft and satellite Radar systems; Imaging System: Multispectral scanner, return beam vidicon, thematic mapper, high resolution visible imaging system; Digital Image Processing: Image structure restoration and enhancement, information extraction, image processing system; Applications of Remote Sensing: Landuse and land cover analysis, resource exploration and environmental monitoring.

(13 Lectures)

Unit 4: Geographical Information System

Introduction: Terminology and scope of GIS, principles of GIS; Application of GIS in Environmental studies: Disaster Management, Forestry, Agriculture, Water resource management, Watershed management, Coastal zone management; Types of Geographical Data, Data Structure, Vector and Raster data: their Advantages and Disadvantage; Input, verification, storage and output of geographical data; Global Positioning System (GPS): Basic principles, Applications to environmental studies.

(12 Lectures)

Practical / Assignments:

1. To study different part of photographic camera and its usage.
2. To study different satellites used for remote sensing.
3. To study status of any river using remote sensing techniques.
4. Reading of topo maps and Geological maps.
5. To analyze image by using MultiSpec Technique.
6. Map work related to meteorology.
7. To study the atmospheric parameters using maps.
8. Usage of topographic maps to study about land forms.
9. Preparation of hazard zoning maps with special reference to Punjab region.
10. Interpretation of satellite imagery for environmental mapping and pollution monitoring.
11. Identification, delineation and mapping of environmental hazards on satellite imagery.
12. GIS applications in environmental survey and monitoring.

References:

1. Curran, PJ. *Principles of Remote Sensing*. ELBS, Harlow Longman Scientific and Technical, 1988.
2. Lawrence, DP. *Environmental impact assessment: Practical solutions to recurrent problems.* New Delhi: John Wiley and Sons, 2003.
3. Morris, P, and Therivel R. *Methods of Environmental Impact Assessment.* Spoon Press, 2001.
4. Sabbins Jr, FF. *Remote Sensing: Principles and Interpretation*. New York: WH Freeman & Co., 1986.
5. Srivastava, DC. *Readings in Environmental Ethics: Multidisciplinary perspectives.* Jaipur: Rawat Publications, 2005.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Impact Assessment and Monitoring
Paper Code: EVS 511

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint the students with importance of environment impact assessment and various methodologies of impact assessment and monitoring.

Possible outcome: Awareness for procedure for EIA and can used for planning the projects.

Unit 1: Introduction of EIA

Introduction to Environmental Impact Analysis; Environmental impact statement & environmental management plan; Strategic Environmental Assessment (SEA): Principles & potential; EIA guidelines 1994, Notification of the Government of India, 2006; Various appendices and forms for application; EIA in project planning and implementation; Indian directions of EIA;Rapid and comprehensive EIA perspectives; Sources and collection of data for EIA. Restoration of environment.

(10 Lectures)

Unit 2: EIA Methodology

EIA Methodology: Project screening, scoping, base-line data, Impact identification, Prediction, evaluation, Valuation of environmental impacts, Mitigation, Public participation, presentation, review and decision making; Monitoring and auditing in EIA process; Component of EIA.

(10 Lectures)

Unit 3: Environmental Auditing

Introduction and Guidelines for environmental auditing; Environmental Auditing Procedure : Matrix methods and Batelle method of auditing; Types of Project activities requiring Environmental Clearance : Checklist for EIA, Generic structure of EIA Document, Procedure of Public hearing, Composition of EAC, SEAC Influence of EIA on projects and organizations, Benefits and future of EIA; Case Studies: Mining industry, Thermal power plant, textile industry, Dam, Flyover.
(14 Lectures)

Unit 4: Environmental Monitoring

Introduction to environmental monitoring; Quality of environment for life on earth and man; Advantages of Environmental Monitoring; Deterioration of environmental quality with reference to anthropogenic impact; Methods of assessment of environmental quality: Short term studies, surveys; Rapid assessment, Continuous short and long term monitoring.

(12 Lectures)

Practical / Assignments:

Perform EIA on: Dam, air port, Bridge, railway tract, urban city, Thermal power plant, Flyover.

References

1. Cutter, SL. *Environmental Risks and Hazards*. New Delhi: Prentice Hall of India, 1999.
2. Glasson, JTR, and Chadwick A. *Introduction to environmental impact assessment*. London Routledge, 2006.
3. Kulkarni, V, and Ramachandra, TV. *Environmental management*. New Delhi: Capitol Pub. Co., 2006.
4. Petts, J. *Handbook of Environmental Impact Assessment.* Volume 1 and 2. UK: Blackwell Publishers, 2005.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Instrumentation methods of Environmental Analysis
Paper Code: EVS512

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To upgrade the students with information on instrumental techniques of chemical analysis, practical work with the realistic samples from the environment so that they could know the basis of instrumentation and their role in environment protection.

Possible outcome: The techniques further used in research perspective to control environmental problems.

Unit 1: Introduction to techniques

Introduction to Analytical Methods: Titrometry, Gravimetry, Colorimetry, Spectrophotometry, chromatography, Atomic Absorption Spectrophotometry and Flame Photometry; Sample preservations; Handling of samples and chemical in lab; Sample handling of Volatile and non-volatile organic compounds; pH metry. (12 Lectures)

Unit 2: Biophysical Methods

Instrumentation and analytical methods involved in the following techniques: UV/visible, fluorescence, UV, circular dichroism, NMR and ESR spectroscopy, molecular structure determination using X- ray, fluorescence and X-ray diffraction and NMR; Molecular analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods. (11 lectures)

Unit 3: Chromatographic techniques

Introduction to chromatography; Chromatographic Techniques: Gas Chromatography, HPLC, Supercritical Fluid chromatography, Reverse phase liquid chromatography, Electrophoresis: Capillary, X-ray diffraction, X-ray fluorescence, Bomb colorimetrry, Mass Spectroscopy, Microscopy; Fluorescence. (11 Lectures)

Unit 4: Microbial Techniques

Basics of Microbiological analysis: Laminar flow, autoclaving, preparations of media for culture growth; Handling of radioactive and hazardous samples; Determination of radionuclide in the environmental samples : Gamma spectrometry, alpha particle spectrometry, beta particle spectrometry, liquid scintillation measurement; Utilization of different techniques for analysis of Polycyclic Aromatic Hydrocarbons(PAHs), Pesticide residues, Polychlorinated Biphenyls in the Environment. (14 Lectures)

Practical:

1. Preparation of a standard solution.
2. Preparation of a standard curve.
3. To analyze the moisture content of a sample using gravimetry
4. Analysis of sample using titrimetry.
5. To analyze the pH of a sample.
6. To analyze the sample Using Spectrophotometry.

7. A visit to different labs to demonstrate the functioning of instrumentation as listed in the syllabi.

References:

1. Brown, TA. *Gene cloning and DNA analysis*, *An Introduction*. 4th Edition, Oxford, UK: Blackwell Scientific Publication, 2001.
2. Chatwal, GR, and Anand SK. *Instrumental methods of chemical analysis*. Delhi: Himalaya Publishing House, 2007.
3. De, AK. *Environmental Chemistry.* New Delhi: New Age International, 2000.
4. Friefelder, D. *Physical Biochemistry, Applications to Biochemistry and Molecular Biology.* WH Freeman and Company, 1982.
5. Goldsby, RA, Kindt, TJ, and Osborne, BA. *Immunology. 4th Edition*, New York: WH Freeman and Company, 2000.
6. Murphy, WJ. *Analytical chemistry*. USA: American Chemical Society, 1977.
7. Plummer, DT. *An Introduction to Practical Biochemistry*. New Delhi: Tata McGraw- Hill Publishing Company Limited, 1988.
8. Riley, T, and Tomilson C. *Principles of Electro analytical Methods*. Chichester, England: John Wiley and Sons Ltd., 1987.
9. Sheehan, D. *Physical Biochemistry*: *Principles and Applications.* Chicester, England: John Wiley and Sons Ltd., 2000.
10. Wilson, K, and Walker J. (Eds.). Practical *Biochemistry: Principles and Techniques.* UK: Cambridge University Press, 1995.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

L	T	P	Credits	Marks
4	1	0	4	100

Course Title: Biostatistics
Paper Code: ZOO514

Course Objective: The main objective of the course is to give applications of Statistical Methodology in life sciences to summarize and analyse the data, and modeling of real life data through standard distributions.

UNIT-A 14 hours

- Biostaistics- Definition and relevance in biological research.
- Descriptive Staistics: Meaning, Objectives,
- Organization of data, Population, sample, variable, parameter, primary and secondary data, screening and representation of data, frequency distribution, tabulation, bar diagram, histograms, pie diagram
- Measures of Central Tendency: Arithmetic Mean, median, mode, quartiles and percentiles
- Measures of Dispersion: Range, variance, standard deviation, coefficient of variation;
- Skewness and Kurtosis

UNIT-B 10 hours

- Inferential Statistics: Hypothesis testing, Errors in Hypothesis Testing- Null Hypotheis, Alternative Hypothesis, Type I and Type II errors, Confidence Limits. Setting up of level of significance. One tailed and Two- tailed tests, Probability and distributions- definition of probability (frequency approach), independent events. Addition and multiplication rules, conditional probability, examples- bernoulli, binomial, poisson and normal distributions; bivariate data- scatter plot,
- Correlation and Regression: Correlation coefficient (r), properties, interpretation of r, partial and multiple correlations, linear regression: Fitting of lines of regression, regression coefficient, Bivariate and Multiple Regression.

UNIT-C 12 hours

- Parametric and Non-Parametric Statistics: Definition, Advantages, Disadvantages, Assumptions
- Parametric Tests: Student's t-test, One Way Analysis of Variance, Two Way Analysis of Variance
- Non-Parametric Tests: Mann Whitney U test, Wilcoxon Signed Rank Sum Test, Kruskal Wallis Analysis of Variance, Chi square and Kendall Rank Correlation

UNIT-D 9 hours

- Use of Staistical softwares in analysis and interpretation of biological

data with special emphasis on SPSS.

Reference books

1. Dunn, OJ. *Basic Statistics*: *A primer for the Biomedical Sciences*. John Wiley, 1977.
2. Bancroft, Holdon. *Introduction to Bio-Statistics*. New York: P.B. Hoebar Inc., 1962.
3. Daniel, W. *Bio-statistics: A Foundation for Analysis in the Health Sciences*. John Wiley, 2005.

DAV UNIVERSITY, JALANDHAR

Course Title: Biostatistics Lab

Course Code: Zoo 518

L	T	P	Credits	Marks
0	0	4	2	50

- Recording of data by using any material such as fish or mollusks or insect.
- Calculation of standard deviation on the basis of recorded data.
- Calculation of correlation coefficient (between X & Y variables) on the basis of material provided.
- Setting up of regression equation and the calculation of the value of Y of unknown X on the basis of equation Y = a+bX.
- Construction of graphs.

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Engineering and Mitigation of Water Pollution

L	T	P	Credits	Marks
4	1	0	4	100

Paper Code: EVS 601

Course Objective: To acquaint the students with latest Engineering technology on how to combat with environmental problems.

Possible outcome: This will assist the students for analyzing water parameters in industries.

Unit 1: Water Chemistry

Chemistry of water and chemical reactions in aquatic environment; Chemistry of water, dissolution/precipitation reactions; complexation reactions; Concept of DO, BOD, COD; Concept of salinity; Composition of seawater and physic-chemical speciation in oceans; Suspended particles; Concept of sedimentation, coagulation and filtration; BOD test procedure: Determination of BOD5 and modelling of BOD5; Interrelationship between BOD, COD and TOC; Box model; Oxygen sag curve.

(12 Lectures)

Unit 2: Water Pollution control technologies

Water as a resource; Sewage and waste water treatments systems: Primary, secondary and tertiary treatments; Biological treatments: aerobic and anaerobic treatments; Design of screening, sedimentation, filtration, softening, break point, chlorination; Treatment plant operation and maintenance for screens, grit chamber, sedimentation tank, aeration tank, trickling filters, sludge digestion tanks, sludge drying beds and stabilization ponds.

(12 Lectures)

Unit 3: Sampling Methods

Physico-chemical and bacteriological sampling: MPN test and Membrane filter Technique; Standards for water quality and wastewater discharge; Methods of sampling**:** Grab, composite and integrated; Sample volumes; Selection of sampling points; Tests performed in the laboratory for raw sewage, primary sedimentation tank, aeration tank, secondary settling tank, sludge digester and stabilization ponds. (12 Lectures)

Unit 4: Treatment for potable Water

Procedures; Flocculation; Settling; Filtration; Reverse sand filter; Chlorination; Methods of Cleaning Potable Water:Filtration, Electro-dialysis, principle & theory of chemical oxidation; Disinfection mechanism: Ozone, permanganate, chlorination. Reverse osmosis, Ultra filtration; Water quality standards. (12 Lectures)

Practical:

1. To study the different methods of water sampling.

2. Determination of optimum coagulant dose by Jar test apparatus.
3. Determination of water transparency by Secchi disc method.
4. Determination of total solids of water samples.
5. Determination of DO of water sample.
6. Determination of BOD of water sample.
7. Determination of COD of water sample.
8. Determination of Chlorides in water sample.
9. A visit to nearby Sewage Treatment Plant.
10. A visit to nearby Effluent Treatment Plant.

References:

1. Benefield, LD, Jedkins, JF, and Weand BL. *Process chemistry for Water and Wastewater Treatment.* New York: Prentice Hall Inc., 1985.
2. Cornwell, DA, and Davis M. *Introduction to Environmental Engineering*. New York: McGraw-Hill, 1999.
3. Eckenfelder, WW. *Industrial Water Pollution Control*. New York: McGraw-Hill Book Company, 1989.
4. Elangovan, R, and Saseetharan MK. *Unit Operations in Environmental Engineering*. New Delhi: New Age International, 1995.
5. Fair, GM, Geyer, JC, and Okun K. *Water and Wastewater Engineering*. Vol. 2. New York: John Wiley, 1979.
6. Garg, S K. *Sewage Disposal and Air Pollution Engineering*. Delhi: Khanna Publishers, 2003.
7. Khandpur, RS. *Handbook of Analytical Instruments.* New Delhi: Tata McGraw-Hill, 1989.
8. Modi, PN. *Water Supply Engineering and Wastewater Engineering.* Volume I & II. Delhi: Standard Book House, 2003.
9. Pelczar, M , Chan, ECS, and Kreig NR. *Microbiology.* New Delhi: Tata McGraw Hill, 1993.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Natural Resource Conservation
Paper Code: EVS 602

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To provide the students with information on importance of natural resources and how to manage these resources.

Possible outcome: This will assist the students in resource management research.

Unit 1: Wildlife Resources and Management

Classification of natural resources, Introduction to Wildlife: Approaches and management; Wildlife extinction: Eroding the earth's Biological Diversity, understanding population dynamics, causes of extinction, methods of preventing extinction, legislation and policy for species conservation; Wildlife management: Wildlife, types of animal movements, mortality factors, waterfowl sickness, wildlife management, regulating population, non game management.

(12 Lectures)

Unit 2: Energy Resources and Management

Introduction to energy sources: Energy consumption as a measure of prosperity; World energy future; Energy sources and their availability; New energy technologies; Prospects of renewable non-conventional energy; Applications of solar energy: Solar water heating, solar heating of buildings, solar cooling of buildings, solar photo-voltaics, agriculture and industrial process heat, solar distillation, solar cooking and solar green house; Wind energy: Basic components of wind energy conversion system, applications of wind energy; Generation of hydropower, Tidal energy; Ocean thermal energy conversion; Geothermal energy. (12 Lectures)

Unit 3: Biomass Resources and Management

Biomass as a source of energy: Energy plantation; Biomass conversion technologies: Wet processes and Dry processes; Biogas generation and factors affecting bio digestion or generation of gas; Biogas plants: Classification of biogas plants, advantages and disadvantages of floating drum plant, advantages and disadvantages of fixed drum plant, types of biogas plants, constructional details of some main digesters, biogas from plant wastes, community biogas plants, material used for biogas generation, selection of site for a biogas plant, problems related to biogas plants, starting a biogas plant.

(14 Lectures)

Unit 4: Range land and Forest Management

The growth characteristics of range grasses; Rangeland Abuse; Range condition, range management and desertification; Forest management: Forest ecology, forest management, harvest methods, reforestation, monoculture controversy, developing genetically superior trees, the logging plan, the logging operation, control of forest pests; Fire control, use of controlled fires, forest conservation by efficient utilization, meeting future timber demands, Removal of tropical rain forests; Causes and effect of deforestation.

(10 Lectures)

Practical:

1. Study of solar energy devices.
2. Techniques of vegetative propagation of forestry trees.
3. Preparation of report on Energy Plantation.
4. Demonstration on the use of wind-mills.
5. Demonstration of Biogas plant.
6. Visit to a monoculture field.
7. To determine the biomass content of the given plant material.
8. Forest ecosystem studies: vegetation mapping.
9. Mapping of forests of world and India.
10. Mapping of rangelands of world and India.

References:

1. Oliver, SO, and Daniel DC. *Natural Resource Conservation: Management for a Sustainable future.* New Jersey: Prentice Hall International, 1990.
2. Rai, GD. *Non-Conventional Energy Sources.* Delhi: Khanna Publishers, 1993.
3. Ramijhan, S K. *Agro Industrial by Products and Non-Conventional Feed for Live Stock.* New Delhi: Indian Council for Agriculture Research, 1990.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Climatology
Paper Code: EVS603

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To provide the students with information on various atmospheric phenomenon and effect of climate change on living organisms and environment.

Possible outcome: The perspective for research of students will increase in field of climatic studies.

Unit 1: Climate and Environment

The boundary layer; Radiations: Radiation laws, short wave and long wave radiations; Albedo, Emissivity; Greenhouse effect; Radiation balance; Relief convection and mechanical turbulence; Laminar boundary layer; Friction layer; Spiral layer: convection, Precipitation, Local microclimate, surface conditions, energy balances; Atmospheric movements: Controlling factors of general circulations, Distribution of radiation, Rotation of earth, Coriolis acceleration, angular momentum; General meridonial circulations: Hadley cells; Middle latitudes; Circulation of water in atmosphere. Circulation of energy in atmosphere; Energy content and energy transport.

(12 Lectures)

Unit 2: Equatorial and Tropical climate

Equatorial climates: The tropical atmosphere, radiation and temperature, air masses, subtropical anticyclones; Trade winds; Equatorial trough; Easterly waves; Tropical storms and cyclones; Contour models; Zonal flow; Factors determining weather; Circulation systems: radiation and temperature, rainfall, evapotranspiration and water balance; Tropical arid and semiarid climates: Arid climates, deserts, ocean temperatures, aridity, radiation and temperature, rainfall variability; Alice springs; Southern Sahara; North Africa and Middle east.

(14 Lectures)

Unit 3: Middle latitude and Temperate climate

Middle and high latitude atmosphere: Long waves, thermal patterns and their development, index cycles; Southern hemisphere, Quasi-stationary anticyclones, meridonial temperature gradients, continentality, topography, air masses; Temperate maritime climates: Seasonal variation, weather types, singularities, Southern Europe, Synoptic conditions. (10 Lectures)

Unit 4: Polar climates

Climates of continental interiors and eastern coasts: Contrasting air masses, Tornadoes, land water modifications; Tundra vegetation, Forests, grasslands, Theoratical yields, Precipitation, snow and hail fall. Polar climates: Distribution, radiation and temperature, cloud effect, inversions, surface temperature, snow cover, precipitation and water balance.

(12 Lectures)

Practical / Assignments:

1. Handling of meteorological data recording equipment (Rain gauge, Anemometer, Dry and wet bulb thermometer, Barometer) and description of uses.
2. Climate classification on the basis of climographs.
3. To study energy Budget on earth.
4. To study highest rainfall regions of India and world.
5. To study highest snowfall regions of India and world.
6. Study of tundra vegetation in world.
7. Study of major deserts of world.
8. Presentation and interpretation of temperature data.
9. Study of major grasslands of world.

References:

1. Lockwood, JG. *World climatology: An environmental approach*. Kent: WhitstableLitho Ltd. Whit stable, 1979.
2. Menon, PA. *Our weather.* India: National Trust, 1993.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Biotechnology
Paper Code: EVS604

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective:To provide the students with information on various biotechnological methods that use to control pollution.

Possible outcome: The perspective for research of students will increase in field of biotechnology and assist the students for various techniques used in biotechnological industries.

Unit 1: Bioremediation and its applications

Bioremediation: Types of bioremediation, Use of fungi, algae and bacteria in biosorption, cautions for using bioremediations; Biodegradation of oil spills, TNT wastes, dye stuff wastes, pesticides and xenobiotics; Waste water treatment with aquatic macrophytes: Introduction, Concepts of aquatic macrophyte based waste water treatment systems, economics; Thin film techniques for waste water treatment using aquatic plants. (12 Lectures)

Unit 2: Polymers and plastic degradation

Polymers and plastic degradation:Introduction, polymer synthesis, polymer degradation; Photochemical degradation; Biodegradation of naturally occurring polymeric substances, disposable synthetic polymers, polymer recycling; Carry bag - A menace; Role of microorganisms in degradation of polymers and plastic. (11 Lectures)

Unit 3: Phytoremediation andTissue Culture Technology

Micropropagation; Somatic hybridization; Clonal propagation; Production of genetically variable plants; Production of useful biochemicals through tissue culture technology; Preservation of plant gene transfer : Resistance to drought and flooding; Importance of tissue culture technology in environmental metal ion toxicity and increased photosynthetic efficiency. GM Foods, Problems of GM Foods.

(12 Lectures)

Unit 4: Biotechnology for Management of Resources

Bio-transformation of heavy metals; Oil field microbiology; Improved oil recovery; Role of environmental biotechnology in management of resources; Reclamation of wasteland; Biomass production; Biogas and biofuel production; Microorganisms in mineral and energy recovery, Nanotechnology for control of pollution; Biofertilizer: Bacteria, bacterization, mass cultivation of microbial inoculants, green manuring, the blue green algae, algalization, Azolla, present status and improvements; Biological nitrogen fixation: The range of nitrogen fixing organisms.

(13 Lectures)

Practical:

1. To study various instruments used in biotechnological laboratory.
2. Preparation of basic liquid (e.g., Nutrient broth or McConkey Broth) media /solid (Nutrient agar or McConkey agar) media for culture of bacteria.
3. Preparation of media for tissue culture.
4. Isolation of root nodule bacteria.
5. Isolation of bacteria by Streak plate, Pour plate, Spread plate method.
6. Tissue culture techniques: Anther culture and stem culture.
7. Analysis of pesticides residues using TLC.
8. Qualitative/Quantitative detection of pesticides from waste water.
9. Effect of Heavy metals of seed germination.
10. Assignment by teacher.

References:

1. Abbasi, SA, and Ramasami E. *Biotechnological Methods of Pollution Control*. Hyderabad Universities Press, 1999.
2. Alexander, M. *Biodegradation and Bioremediation*. San Diego: Acadamic Press, 1999.
3. Manahan, SE. *Environmental Science and Technology.* New York: Lewis Publishers, 2000.
4. Rittmann, DE, and McCarty PL. *Environmental Biotechnology*: *Principles and Applications*. New York: McGraw Hill, 2001.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Laws and Policy
Paper Code: EVS 608

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To aware the students about environmental laws that are constituted in India to control pollution and protect flora, fauna, forests and environment.

Possible outcome: The perspective for research of students will increase in environmental law related studies.

Unit 1: Introduction to Laws and Policy

Meaning; Definition and historical development of Environment Law; Environment and constitution of India, environmental legislative machinery; Fundamental rights; Directive principles of State policy and Fundamental duties. (10 Lectures)

Unit 2: Environmental Acts

Environment Protection Act, 1986; The Factories Act, 1948; Water (Prevention and Control of Pollution) Act, 1974; Water (Prevention and Control of Pollution) Cess Act, 1977; Air (Prevention and Control of Pollution) Act 1981 and Rules; Motor Vehicles Act, 1939; Forest Conservation Act 1980; Wildlife (Protection) Act 1972; Indian Boiler's Act, 1923.

(14 Lectures)

Unit 3: Judgments

Rural Litigation and Entitlement Kendra, Dehradun V. State of U.P. AIR 1988 SC 2187; Ram Rattan V. MunnaLal AIR Pb. 217; M/s. Delhi Bottling Co. Pvt. Ltd. V. Central Board for the Prevention and Control of Water Pollution AIR 1986; M.C. Mehta, V. Union of India AIR 1988 SC 1037; ChaitanayPulverising Industries V. Karnataka State Pollution Control Board AIR 1987 Kart; M.C. Mehta, V. Union of India AIR 1987 SC 965; The Goa Foundation V. Konkan Railway Construction Corp. AIR.; BanwasiSewa Ashram V. State of U.P. AIR 1987 SC 374; BanduaMuktiMorcha V. Union of India AIR 1984 SC802.; Ratlam Municipality V. Vardhichand AIR 1980 SC1622. (10 Lectures)

Unit 4: Environmental Policy

Stockholm Conference on Human Environment,1972; Ramsar Convention on Wetlands, 1971; Montreal Protocol, 1987; Basel Convention (1989,1992); Earth Summit at RiodeJaneiro,1992; Kyoto Protocol, 1997; Earth Summit at Johannesburg, 2002; Brundtland report 1987; Environmental Regulatory Framework in India; Role of International Environmental Agencies - UNEP, GEF, UNFCC and IPCC. (13 Lectures)

Practical:

1. To study judgments as directed by teacher.
2. To study animals given in Schedule I to IV in Wildlife protection Act.
3. To study Summits and Reports assigned by teacher.

References:

1. Divan, S, and Rosencranz A. *Environmental Law and Policy in India.* New Delhi: Oxford University Press, 2005.
2. Gurdip, S. *Environmental Law in India*. Mcmillan & Co., 2004.
3. Jaswal, PS, and Jaswal N. *Environmental Law*. Delhi: Pioneer Publications, 2003.
4. Leelakrishnan, P. *Environmental Law Case Book*. Butterworths: Lexis Nexis, 2008.
5. Mohanty, S K. *Environment and Pollution Law*. Universal Law Publishing Co. Pvt. Ltd., 2011.
6. Shastri, SC. *Environmental Law*. (2nd Ed). Lucknow: Eastern Book Company, 2008.
7. Singh, PP, and Sharma S. *Environment and Pollution Education*. New Delhi: Deep and Deep Publication pvt. Ltd., 2004.
8. Smith, K. *Environmental Hazards*. Routledge, 1996.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Wastewater Treatment Plant Design
Paper Code: EVS 609

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To understand the students about specification to design various wastewater treatment equipment's used in industries to treat water.

Possible outcome: This will assist the students for designing of effluent treatment plants (ETP) in industries.

Unit 1: Characteristics of wastewater

Quantity & Quality of sewage generated; Organic impurities of wastewater; Types of Biological processes for wastewater treatment: Suspended and attached growth processes; Oxygen transfer: Oxygen transfer coefficient, Oxygen transfer in clean water and wastewater, Effect of temperature on oxygen transfer, Alpha and Beta correction factor, Application of correction factors; Aeration system: Diffused air systems, Mechanical aerators and High purity oxygen system; Energy requirements for mixing in aeration systems.

(12 Lectures)

Unit 2: Activated sludge process

Mathematical modelling; Kinetic relationships and formulation of continuous biological reactor; Biokinetic parameters for aerobic biological reactors: Y, Y, kd, a and b. Basic concepts of HRT, SRT, F/M, MLSS and, recycling ratio; Material balance for determination of oxygen utilization and net yield of biomass and recycle ratio; Concepts of mean solids residence time and sludge age; Relationship between recycle ratio and sludge age. (13 Lectures)

Unit 3: Designing of treatment plant

Michaelis-Menten relationship: Derivation, Corollaries, Relationship in terms of specific growth rate; Comparison of Plug Flow reactor and Continuous Flow Stirred Tank Reactor; Wastewater engineering for Biological Treatment: Principal, role of microorganisms, ecosystem & designing of following biological Unit Operation in waste water treatment: Trickling filters, Rotating Biological Contactor, Stabilization pond and Aerated lagoon.

(11 Lectures)

Unit 4: Anaerobic treatment of wastewater

Membrane bioreactors: Moving bed biological reactors; Biotowers; Up flow anaerobic sludge blanket reactor (UASB); Anaerobic baffled reactor; Nutrient removal: Nitrification, Denitrification; Conversion process in anaerobic systems: Hydrolysis, Acidogenesis, Methanogenesis; Design of anaerobic suspended growth process. Design of up flow Anaerobic Sludge Blanket Reactor: Design consideration, Start up, Operational problems; Attached growth anaerobic processes.

(12 Lectures)

Practical:

1. Determination of pH of provided sewage sample.
2. Determination of Turbidity of provided sewage sample by turbidity meter method.
3. Determination of Total dissolved solids from the sewage sample.
4. Determination of Conductivity of sewage sample.
5. Determination of dissolved oxygen from sewage sample.
6. Determination of Oil & Grease from Sewage sample.
7. Estimation of Biochemical oxygen demand of wastewater.
8. Estimation of Chemical oxygen demand waste water.
9. Determination of Nitrates from sewage sample.
10. Determination of Carbon dioxide from sewage sample.

References:

1. Benefield, LD, and Randoll D. *Biological Treatment Processes*. New York: Prentice Hall Inc., 1988.
2. Benefield, LD, Jedkins, JF Jr, and Weand BL. *Process chemistry for water and wastewater treatment.* New Jersey: Prentice Hall Inc., 1990.
3. Eckenfelder, WW, and O'Conner DJ. *Biological Waste Treatment.* New York: John Wiley & Sons, 1980.
4. Eckenfelder, WW Jr. *Biological Waste Treatment*. New York: Pergamon Press, 1961.
5. Eckenfelder, WW Jr. *Industrial Water Pollution Control*. New York : McGraw-Hill Book Company, 1989.
6. Eckenfelder, WWJr. *Developing Industrial Water Pollution Control Programs: A Primer.* New York: CRC Press, 1997.
7. Haandel, A C, and Lettinga G. *Anaerobic Sewage Treatment*. Chichester: John Wiley and Sons, 1994.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Solid Waste Management Techniques
Paper Code: EVS 610

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To understands the students with the common municipal solid wastes techniques to manage solid wastes.

Possible outcome: This will assist the students for designing of solid waste treatment technologies to manage the waste.

Unit 1: Introduction to solid waste

Sources, generation, classification & composition of solid wastes; Need for management and planning; Solid waste types; Types of solid waste; Special wastes: Types, household hazardous wastes, demolition waste, domestic waste; Sewage sludge and municipal waste; Slaughterhouse waste; Agricultural waste; Mining waste; Integrated Solid waste Management; Solid waste characterization: ultimate and proximate analysis; Waste reduction at source, volume reduction and collection techniques. (14 Lectures)

Unit 2: Recycling and Landfilling

Need of materials recovery/recycling; Recycling of Aluminum, glass, plastic and paper; Treatment and disposal techniques: Burning, Open dumping; Landfill: Landfilling methods and operation, Landfill liners: clay, Geo-membrane, HDPE, Geonet, Geotextile; Landfill emissions: Leachate and Landfill gas, Leachate collection & analysis. (11 Lectures)

Unit 3: Waste treatment methods

Composting; Vermicomposting; Incineration; Pyrolysis; Gasification; Refuse derived fuels; Biogas: Method and applications; Merits and demerits of waste disposal methods; Biomass gasification: Classification of biomass gasifiers, chemistry of gasification process, applications of the gasifier, problems in development of gasifier, advantages and disadvantages.

(12 Lectures)

Unit 4: Solid waste management rules

Municipal Waste (Management and Handling) Rules 2000; Recycled Plastics (Manufacture and usage) Rules; Role of GIS in Waste Management; Hospital Waste Management; Hazardous Waste Management & Handling rules, 1989 & 2000 (amendments); Pollution abatements and public participation- cleaning river like Ganga and Yamuna.

(10 Lectures)

Practical / Assignments:

1. A visit to Composting/Vermicomposting Unit.
2. Ultimate analysis of Solid waste.
3. Practical knowledge and working of incinerators.
4. Practical knowledge and working of Pyrolysis.
5. To prepare a list of materials from municipal waste stream that can be reused or recycled.
6. A visit to the RDF plant.

7. Practice exercises on computer related to handling of data.
8. Visit to local landfill site.
9. Survey of different machine's used in solid waste management.

References:

1. Evans, G. *Biowaste and Biological Waste Treatment.* UK: James and James, Science Publishers Ltd., 2005.
2. Hammer, MJ, and Hammer Jr MJ. *Water and Wastewater Technology.* 3rd ed. Delhi: Prentice Hall of India, 2000.
3. Jaswal, PS, and Jaswal N. *Environmental Law*. Delhi: Pioneer Publications, 2003.
4. Kreith, F. *Handbook of Solid Waste Management*. USA: McGraw Hill Publishers, 1999.
5. Kumar, R, and Singh RN. *Municipal Water and Wastewater Treatment.* New Delhi: Capitol Pub Co., 2006.
6. Noble, G. *Sanitary Landfill Design Handbook*. USA: Technomic Westport Connecticut, 1976.
7. Peavey, HS, Rowe, DR, and Tchobanoglous G. *Environmental Engineering*. New York: McGraw-Hill, 1985.
8. Shah, K.L. *Basics of Solid and Hazardous Waste Management Technology*. USA: McGraw Hill, 1999.
9. Tchobanogloas, G. *Integrated Solid Waste Management: Engineering, Principle and Management.* USA: McGraw Hill, 1993.
10. White, P, Frank, M, and Hindle P. *Integrated Solid Waste Management*- A *Life Cycle Inventory.* USA: Chapman & Hall, 1999.

This syllabus has been designed as per national syllabus suggested by UGC and cover 20% extra syllabus as per requisite of honour degree.

DAV UNIVERSITY, JALANDHAR

Course Title: Computer Programming in Ecology
Paper Code: CSA651

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: The objective of this course is to help the students in finding solutions to various real lifeproblems and converting the solutions into computer program using C language(structured programming). Students will learn to write algorithm for solutions to variousreal-life problems. Converting the algorithms into computer programs using C language.

UNIT-A

Logic Development and Program Development Tools

- Data Representation, Flowcharts, Problem Analysis
- Decision Trees/Tables, Pseudo Code and Algorithms,
- Program Debugging, Compilation and Execution.

Fundamentals

- Character Set, Identifiers and Key Words, Data Types
- Constants, Variables, Expressions, Statements, Symbolic Constants.

Operations and Expressions

- Arithmetic Operators, Unary Operators, Relational Operators,
- Logical Operators, Assignment and Conditional Operators, Library functions.

12 hours

UNIT-B

Data Input and Output

- Single Character Input, Single Character Output, Entering Input Data
- More About Scan Functions, Writing Output Data, More About Print Functions
- Gets and Puts Functions, Interactive Programming.

Control Structures

- Introduction, Decision Making with If – Statement, If Else and Nested If,
- While And Do-While, For Loop.
- Jump Statements: Break, Continue, Goto, Switch Statement.

Functions

- Introduction To Functions, Function Declaration, Function Categories
- Standard Functions, Parameters And Parameter Passing, Pass – By Value/Reference
- Recursion, Global and Local Variables, Storage Classes.

12 hours

UNIT-C

Arrays

- Introduction to Arrays, Array Declaration, Single and Multidimensional Array, Memory Representation, Matrices, Strings, String Handling Functions.

Structure and Union

- Declaration of Structure, Accessing Structure Members, Structure Initialization, Arrays of Structure, Nested Structures, Unions. 10 hours

UNIT-D

Pointers

- Introduction To Pointers, Address Operator And Pointers, Declaring and Initializing Pointers,
- Assignment through Pointers, Pointers and Arrays.

Files

- Introduction, Creating a Data File, Opening and Closing a Data File, Processing a Data File. 9 hours

Reference Books

1. Gottfried and Byron S. *Programming with C*. New Delhi: Tata McGraw Hill, 1992.
2. E. Balagurusamy, *Programming in ANSI C*. New Delhi: McGrawHill, 2011.
3 .HanlyR, Jeri, and Koffman Elliot P. *Problem Solving and Program Design in C*. India: Addison Wesley, 2011.
4. Yashwant, Kanetker. *Let us C*. New Delhi: BPB Publications, 2011.

DAV UNIVERSITY, JALANDHAR

Course Title: Scientific Writing and Research Methodology

Paper Code: BOT601

L	T	P	Credits	Marks
2	0	0	2	50

Objective:

To make the students learn how to design an experiment and what are the various research strategies?

Teaching Methodology:

Class room Lectures, practicals, models, charts, power point presentations.

Learning outcomes

This course will impart the comprehensive knowledge of designing a research experiment, how to write a research paper, the relevant ethics, copy right, impact factor etc.

UNIT-I

Basic principles and significance of research design

Experimental set-up

Randomized Block Designs (RBD), completely randomized designs (CRD); Latin square design and Factorial design **(5 Lectures)**

UNIT-II

Data collection, organization and interpretation.

Research articles, research papers, popular research articles and reviews;

Difference between periodicals; journals; monographs, magazines; proceedings.

How to write a research paper, reference styles. **(8 Lectures)**

DAV UNIVERSITY, JALANDHAR

UNIT-III

Process of proof reading of a research manuscript.

Process of reviewing.

Process of submission of a paper.

Important journals in plant sciences. **(6 Lectures)**

UNIT-IV

An introduction to Science citation index; H-index, Impact factor of a journal; Eigen factor

Copyright act; Academic frauds; Plagiarism; Softwares to check plagiarism. **(5 Lectures)**

Suggested Readings

1. Kothari, CR. *Research Methodology – Methods and Techniques*. 2nd revised ed. New Delhi: New Age International (P) Ltd. Publishers, 2007.

2. McKillup, S. *Statistics Explained. An Introductory Guide for Life Scientists*. Cambridge, UK: Cambridge University Press, 2006.

3. Selvin, S. *Biostatistics – How it Works.* New Delhi: Pearson Education Inc., 2007.

DAV UNIVERSITY, JALANDHAR

Course Title: Computer Programming in Ecology Laboratory

L	T	P	Credits	Marks
0	0	4	2	50

Paper Code: CSA652

Implementation of C programming concepts:

- Control Structures, Loops, Arrays, Strings
- Functions, Structures, Union, Files, etc.

DAV UNIVERSITY, JALANDHAR

List of Elective Courses

S. no	Course Code	Course	Credits			Total Credits
			L	T	P	
1	EVS 651	Urban Planning and Development	3	-	-	3
2	EVS 652	Dynamics of Biogeography	3	-	-	3
3	EVS 653	Environmental Challenges	3	-	-	3
4	EVS 654	Energy and Environment	3	-	-	3
5	EVS 655	Pollution Control Technology	3	-	-	3
6	EVS656	Green Technology	3	-	-	3
7	EVS657	Environmental Toxicology	3	-	-	3

DAV UNIVERSITY, JALANDHAR

ELECTIVE COURSES

Course Title: Urban Planning and Development
Paper Code: EVS 651

L	T	P	Credits	Marks
3	0	0	3	100

Course Objective: To understands the students the importance of planning of cities for healthy environment.

Unit 1: Urban systems models

Historical perspectives:The roots of planning, Classic planning, Islamic planning, medieval planning, *Indian* Indus valley, Later planning theories: Haussman's Boulevards, Sitte's artistic planning, Howard's garden city. Economy in Urban systems models**:** Causes and effects in urban development, Growth models: economic base-multiplier model, input-out model, trend model, gravity model, intervening opportunity model, land market model. (8 Lectures)

Unit 2: City planning and Housing

City planning:Principles of city planning, types of cities & towns, Model building byelaws, eco-city concept. Housing: Concept of housing, housing typology, housing standards, housing infrastructure, housing policies, housing programs in India, self-help housing. Environmental Studies in Building Science: Climate responsive design, energy efficient building design, thermal comfort, solar architecture, principles of lighting and styles for illumination.

(11 Lectures)

Unit 3: Building Services

Water supply, sewerage and drainage systems, principles of electrification of buildings, intelligent buildings, elevators & escalators: their standards and uses, building safety and security systems. Materials and Structural Systems: Characteristics of all types of building materials: mud, timber, bamboo, brick, concrete, steel, glass, FRP, different polymers, composites.

(8 Lectures)

Unit 4: Traffic and Transportation Planning

Principles of traffic engineering and transportation planning, traffic survey methods: roads, intersections, grade separators and parking areas, traffic and transport management in urban areas, intelligent transportation system, mass transportation planning, para-transits and other modes of transportation, pedestrian & slow moving traffic planning. (8 Lectures)

References:

1. Broadbent, G. *Emerging concepts in urban space design*. London: Van Nostrnd Reinhold International, 1990.

2. Helly, W. Urban system models. New York: Academic Press, 1975.

3. Hambleton, R. *Policy Planning and Local Government*. London: Hutchinson, 1978.

4. Sain, M. *Urban planning in third world*. London: Mansell P Publishing Limited, 1982.

DAV UNIVERSITY, JALANDHAR

Course Title: Dynamics of Biogeography
Paper Code: EVS 652

L	T	P	Credits	Marks
3	0	0	3	100

Course Objective: To understands the students about earth's processes and effect of topography on distribution of species on earth.

Unit 1: Geological history of the earth

Biogeography and its history:Basic principles, its relationship to physiography and other modern sciences, biology, geography, biodiversity, and landscape ecology, age of exploration, biogeography of 18th , 19th and 20th centuries, biogeographic distribution of globe., vegetation types and classification of floristic regions.The geological time scale, Wegner's theory of continental drift, tectonic history of the planet, patterns of continents. (9 Lectures)

Unit 2: Climate and environment

Physical setting of the planet, climatic zones of the world, ombrothermic and climate diagrams, solar energy and temperature regimes, winds and rainfall, soils and successions, formation of major soil types, aquatic environments, stratification and oceanic circulation. Island biogeography:Types of islands, islands as model systems, MacArthur-Wilson theory of island biogeography, Effects of size and distance, equilibrium equation, modifications caused by selective nature of immigration and extinction and interspecific interactions; Endemic species. (8 Lectures)

Unit 3: Distributions of species

The geographic range projections and geographic coordinate systems, mapping and measuring range, distribution of individuals, populations and ecosystems, Hutchinson's multidimensional niche concept, relationship between distribution and abundance. (8 Lectures)

Unit 4: Dispersal and immigration

Mechanisms of active and passive dispersal, Physiological, ecological and psychological barriers, biotics, exchange and dispersal routes: corridors, filters, sweepstakes routes, dispersal curves within and among species, establishment of colony and habitat selection, ecosystem theories (Wedge effect, Bergmann's rule, Allen's rule, Gloger's rule, Jordon's rule and Merriam's classification). (10 Lectures)

References:

1. Brown, JH, and Lomolino MV. *Biogeography*. Sunderland, Massachusetts: Sinauer Associates Inc., 1998.

2. Cox, CB, and Moore PD. *Biogeography – An Ecological and Evolutionary Approach*. London Blackwell Scientific Ltd., 2000.

3. Fahrig, L, and K Freemark. *Landscape-scale effects of toxic events for ecological risk assessment.* In J, Cairns and BR, Niederlehner (eds.), Ecological Toxicity Testing, Scale, Complexity, and Relevance. Lewis Publishers, Boca Raton, FL., 1994.

4. Weinstein, DA, and Shugart HH. *Ecological modeling of landscape dynamics*. In: HA, Mooney and M, Godron (eds.), Disturbance and Ecosystems. New York: Springer-Verlag, 1983.

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Challenges
Paper Code: EVS 653

L	T	P	Credits	Marks
3	0	0	3	100

Course Objective: To provide assessments of the current status of environmental issues at the national and international levels.

Unit 1: Atmospheric issues

Greenhouse effect - Greenhouse gases its sources, impacts,consequences and remedial measures; Global warming. Global climate change,Concept, History, Milankovitch's theory of climate change, GHGs, Role ofhumans, Climatic feedback mechanism, Possible impacts of climate change, Control andconsequences, World and Indian scenario, Conventions. Acid rain; Brown haze,Photochemical smog, Nuclear winter; Ozone depletion-sources, effects, impacts andconsequences; Conventions and protocols. (10 Lectures)

Unit 2: Resource depletion and pollution

Natural resource depletion, Human resources –population explosion, urbanization, industrialization, slums, poverty, Forest resources,Mineral resources, Marine resources, Nuclear resources, Water resources – usage andexploitation; Water crisis and conservation, Biodiversity and its conservation, Wastelandand its reclamation, Wetlands conservation, Urban air quality and vehicular pollution,Bhopal gas tragedy, Chernobyl disaster, Love canal tragedy, Minimata bay.
(10 Lectures)

Unit 3: Ecological degradation

Ecological conflicts, Soil erosion and conservation, Formationand reclamation of Usar, Alkaline and saline soil; Desertification and its control;Deforestation; Ecological restoration. Eutrophication; Restoration of Lakes; Rivercleaning, River action plans - Ganga and Yamuna action plan, Interlinking of rivers. (8 Lectures)

Unit 4: Energy crisis and ethics

Energy crisis and conservation - India and world scenario, CNG andpollution in various cities in India. Clean development mechanism, Carbon emissions,Carbon sequestration, Carbon credit hours, Carbon sinks. Environmental ethics:Role of education in solving environmental issues.
(8 Lectures)

References:

1. Chapman, JL, and Reiss MJ. *Ecology: principles and applications*. UK: Cambridge university press, 1999.
2. Dhar. *Environmental science and ethics*. New Delhi: Vayu Education of India, 2010.
3. Dutta, A, Dutta, S, and Pandey PN. *Environmental issues and challenges*. New Delhi: APH publishing corporation, 2009.
4. Jerath, N, Boojh, R, and Singh G. *Climate change, biodiversity and food security in the South Asian region.* New Delhi: Macmillan Publishers, 2010.

5. Joshi, PC, and Joshi N. *A text book of environmental science.* New Delhi: APH Publishers, 2009.
6. Keller, DR. *Environmental ethics: The big questions*. UK: Wiley-blackwell, 2010.
7. Kelly, RA. *Energy supply and renewable resources*. New Delhi: Viva books, 2010.
8. Khan, S. *A Global warming and climate change*. New Delhi: Rvs Books, 2010.
9. Masters, GM, and Wendell PE. *Introduction to environmental engineering and science.* New Delhi: Phi Learning, 2009.
10. Odum, EP, and Barrett GW. *Fundamentals of ecology*. USA: Brooks/cole, 2008.

DAV UNIVERSITY, JALANDHAR

Course Title: Energy and Environment
Paper Code: EVS 654

L	T	P	Credits	Marks
3	0	0	3	100

Course Objective: To provide the students with information on how to manage the energy resources on a sustainable basis by using non-conventional resources.

Unit I: Introduction to energy resources

Energy scenario in world and India, Fundamental concepts of energy, Heatbudget of the earth, Earth's classification of energy resources-conventional and non-conventional, Environmental implications of energy resources. (7 Lectures)

Unit 2: Conventional energy sources

Fossil fuels (Coal, petroleum, LPG and natural gas) – origin,composition and physic chemical characteristics and energy content, sources, propertiesand production process; Nuclear energy– fission and fusion, technologies – Nuclearenrichment, Nuclear reactors, Nuclear waste disposal, Policies and regulations. (9 Lectures)

Unit 3: Non-Conventional energy sources

Types-solar energy, Wind energy, hydel, tidal andgeothermal energy, OTEC: introduction, principle, generation, distribution and itsapplication. **Bioenergy:** Biomass energy-sources, generation- biochemical and thermo chemicalconversion; Biofuels- types, importance, production, technologies and applications;Biodiesel, bioethanol, biogas, biohydrogen–sources, production, importance andapplications; Microbial fuel cell. (10 Lectures)

Unit 4: Energy conservation, efficiency and economics

Energy conservation – principles and approach, Energy conservation in buildings, Green buildings, Solar passive architecture, Eco-housing, Energy audit, National and international norms. (9 Lectures)

References:

1. Aswathanarayana, U, Harikrishnan, T, and ThayyibSahini, KM. *Green energy technology, Economics and Policy*. USA: CRC Press, 2010.
2. Boyle, G. *Renewable energy power for a sustainable future*. UK: Oxford University Press, 2010.
3. Coley. D. *Energy and climate change creating a sustainable future.* UK: John Wiley and Sons Ltd., 2008
4. Dian, P, and Yaqoot M. *Energy Management.* New Delhi: Pentagon Energy Press.
5. Rai, GD. *Non-conventional energy sources.* New Delhi: Khanna Publishers, 2010.
6. Soetaert, W, and Vandemme EJ. *Biofuels.* UK: John Wiley and Sons, 2009.

DAV UNIVERSITY, JALANDHAR

Course Title: Pollution Control Technology
Paper Code: EVS 655

L	T	P	Credits	Marks
3	0	0	3	100

Course Objective: To acquaint the students with latest pollution control technologies.

Unit 1: Water Pollution control technologies

Sewage and waste water treatments systems; Primary, secondary and tertiary treatments; Measurement of treatment efficiencies; Biological treatments - aerobic versus anaerobic treatments; Environmental pollution control- Bioremediation, Bioaugmentation and Biostimulation; Biofilms in treatment of waste water; Bioreactors for waste water treatments; Reactors types and design; Reactors in series; Development and optimization of membrane bioreactor process for use in sanitary and industrial sewage treatment. (8 Lectures)

Unit 2: Air pollution control technologies and devices

Methods to control air pollution in the environment, Limestone injection and fluidized bed combustion, Desulfurization; Catalytic converter and control of vehicular emission, Gravity settling chamber, Centrifugal collectors- cyclone collector and dynamic precipitators; Electrostatic precipitators; Fabric filters. (7 Lectures)

Unit 3: Solid, Toxic, and Hazardous waste management

Solid waste disposal methods – open dumps, ocean dumping, Landfills, Incineration; Recycling and reuse. Organic pollutants and Hazardous waste disposal and management. Management of Radiation, noise, thermal, oil and e-wastes: recycling of waste. Biosorption - Biotechnology and heavy metal pollution; Oil field microbiology; Improved oil recovery; Biotechnology and oil spills; Hydrocarbon degradation. (8 Lectures)

Unit 4: Biotechnological methods to control pollution

Bioremediation, Biotransformation Biodegradation and Phytoremediation: In situ and Ex situ bioremediation; Evaluating Bioremediation; Bioremediation of VOCs. Factors affecting process of biodegradation; Methods in determining biodegradability; Contaminant vailability for biodegradation.; Use of microbes(bacteria and fungi) and plants in biodegradation and Biotransformation; Phytoremediation: Waste water treatment using aquatic plants; Root zone treatment. (12 Lectures)

References:

1. Fulekar, MH. *Environmental Biotechnology.* Oxford IBH Publishing cooperation, 2005.
2. Fulekar, MH. *Bioremediation technology recent advances.* Springer, 2010.
3. Cheremisinoff, NP. *Biotechnology for Waste and Wastewater Treatment.* New York: William Andrew Publishing, 1996.
4. Rittman, B, and McCarty PL. *Environmental Biotechnology: Principles and Applications.*2nd edition, McGraw-Hill, 2000.

5. Hurst, CJ, Crawford, RL, Knudsen, GR, and McInerney MJ. *Manual of Environmental Microbiology*. 2nd edition, ASM Press, 2001.

Course Title: Green Technology
Paper Code: EVS 656

L	T	P	Credits	Marks
3	0	0	3	100

Course Objective: To aware the student about green technology and its application in daily life.

Unit 1: Overview Green technology

Green chemistry, Chemistry of the atmosphere, principles of sustainable and green chemistry. Basic principles of green technology, concepts of atom economy and carbon trading, tools of green technology. Waste minimization and climate change, Zero waste technology, concept of environmentally balanced industrial complexing and industrial ecology, greenhouse effect, climate change, photochemical smog. (8 Lectures)

Unit 2: Green synthetic methods and designs

Catalytic methods in green synthesis, safer chemicals – different basic approaches; selection of auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements-use of microwaves, ultrasonic energy; selection of starting materials; use of blocking/protecting groups, catalytic reagents; Designing of biodegradable products. (8 Lectures)

Unit 3: Green Nanotechnology

Introduction to Nanomaterials and green nanotechnology, Fullerene, carbon nanotubes, Nanoparticles; Green nanoparticle production and characterization; Biocompatibility; Nanomedical applications of green nanotechnologies; use of nanotechnologies and materials impact on biodiversity, resource conservation, ecosystems and human. (8 Lectures)

Unit 4: Green technology applications

Biocatalysis, green chemistry in industries, fuel cell and electric vehicles, solar energy and hydrogen production, energy from alternate sources; Solar photovoltaic technology, Biofuel production (bio-ethanol and biodiesel), Biomass, prevention/minimization of hazardous/ toxic products. Agricultural related practices and food processing, Production of biodegradable materials, concept of green building, and Pollution free engineering processes.

(10 Lectures)

References:

1. Fulekar, M H. *Nanotechnology Importance and applications.* I K international publishing house Pvt. Ltd., 2010.
2. Matlack, AS. *Introduction to Green Chemistry*. New York: Marcel Dekker, 2001.
3. Anastas, P T, and Warner, JC. *Green Chemistry: Theory and Practice*. Oxford: Oxford University Press, 1998.
4. Lakhtakia, A. The *Handbook of Nanotechnology*. *Nanometer Structures: Theory, Modeling, and Simulation.* USA: SPIE Press, 2004.

DAV UNIVERSITY, JALANDHAR

Course Title: Environmental Toxicology
Paper Code: EVS 657

Course Objective: To aware the student about toxins in environment and their harmful effects.

Unit 1: Introduction

Toxicology: Definition, Classification of toxic substance i.e. Toxic gases, organic Poison, Inorganic poison, Toxins**;** Emergence as a science; concepts and definitions; Factors affecting toxicity;Evaluation of Toxicity**:** Evaluation of LC50, LD50, LCIC and IT; Toxic Chemical in the Environment: Metals and other inorganic contaminants; Organic contaminants; Fate of organic contaminants; Pesticides; Biochemical aspects of Arsenic, cadmium, lead, mercury, carbon monoxide, ozone and PAN. (8 Lectures)

Unit 2: Toxic substances and risk assessment

Introduction, Toxic substances, xenobiotics, Acceptable Daily Intake (ADI), Procedure for estimating ADI, Potential Daily Intake (PDI), Relationship between ADI and PDI, Models for estimating risk;Conventional toxicity studies: Acute toxicity studies, Short term and Long term toxicity studies, Importance of conventional toxicity studies, Examples for acute, short term and long term toxicity studies; Toxic effects: Spectrum of toxic effects: Quantal and graded effects, idiosynchratic and allergic effects, immediate and prolonged effects, Target organs: liver, kidney, intestine, central nervous system, Molecular targets: DNA, RNA, Proteins, Enzymes. (10 Lectures)

Unit 3: Mutagenicity and genotoxicity testing

Microbial: Ames *Salmonella* mutagenicity assay, Disc diffusion assay, Plant: *Allium cepa* root chromosomal aberration assay, *Allium cepa* chromosomal aberration and micronuclei assay in pollen mother cells, Tradescantia stamen hair mutation assay, *Tradescantia/ Vicia faba* micronuclei assay; Animal: Comet assay, Rattus micro nuclei assay. (9 Lectures)

UNIT-4: Indices of Toxicology

Detoxification; Ecological Monitoring and Tests; Ecological risk assessment of toxic chemicals. Symptoms, epidemiology and control of vector borne diseases: amoebiasis, trypanosomiasis, filariasis, leishmaniasis, schistosomiasis. Water borne diseases and their control-chlorea, diarrhea. Control of Malaria, Tuberculosis and AIDS. Carcinogenesis, Chemistry of Carcinogenic compound carcinogens, mutagens and teratogens, cancer causing agent Neoplasm. Drugs, Tobacco, Narcotic. (10 Lectures)

References:

1. Frank, CL, and Sam K. *Basic toxicology: Fundamentals, target organs and risk assessment.* 4th edition. London: Taylor and Francis, 2002.
2. Tambrell, J. *Introduction to Toxicology*. London: Taylor and Francis, 2002.
3. Casseret, LJ, and Doull J. *Toxicology. The basic science of Poisons*. New York: Macmillan publishers, 1982.
4. Stake, MY, Mido, M S, Sethi, S, Iqbal, A, Yasuhisa, H, and Taguchi S. *Environmental Toxicology.* New Delhi: Discovery publishing house, 1997.
5. De, AK. *Environmental Chemistry*. New Delhi: Willey Eastern Limited, 1986.
6. Botkin, DB, and Keller EA. *Environment Science: Earth as a Living Planet.* New York: JohnWiley & Sons Inc., 2004.
7. Levin, SA. *Ecotoxicology: Problems and Approaches*. New York: Springer-Verlag, 1989.
8. Manahan, SE. *Environmental Chemistry*. Seventh Edition. New York: Lewis Publishers, 2000.