

# **SYLLABUS**

FOR

TWO-YEAR FOUR-SEMESTER COURSE  
IN

**ENVIRONMENTAL  
SCIENCE**

2020

**RANI RASHMONI GREEN  
UNIVERSITY**

## SYLLABUS FOR TWO-YEAR M.Sc. COURSE IN ENVIRONMENTAL SCIENCE (WITH EFFECT FROM 2020-2022 ONWARDS)

### Semester wise distribution of Courses and Credits:

<b>SEMESTER-I</b>				
<b>Course Code</b>		<b>Title</b>	<b>Marks</b>	<b>Credits</b>
<b>GEST-11</b>	<b>Unit 1</b>	Introduction to Environmental science and Sustainable Development	50	4
	<b>Unit 2</b>	Principles of Ecology		
<b>GEST-12</b>	<b>Unit 1</b>	Biodiversity	50	4
	<b>Unit 2</b>	Conservational Biology and Wildlife Management		
<b>GEST-13</b>	<b>Unit 1</b>	Natural Resource Management and Environmental (Green) Movements	50	4
	<b>Unit 2</b>	Land-use, Resource mapping and Climatology		
<b>GEST-14A</b> <b>OR</b> <b>(Choice based)</b> <b>GEST-14 B</b>	<b>Unit 1</b>	Diversity of Lifeforms	50	4
	<b>Unit 2</b>	Evolutionary Biology		
	<b>Unit 1</b>	Sampling, Standardization, Calibration and Classical Methods of Analysis		
	<b>Unit 2</b>	Instrumentation and Environmental Applications		
<b>GESP-15</b>	<b>Practical &amp; Assignments</b>	Experiments and Analysis [ Marks – 90]	100	8
		Field study to a place of environmental importance –[Marks-10]		
<b>Total of Semester-I</b>			<b>300</b>	<b>24</b>
<b>SEMESTER-II</b>				
<b>GEST-21</b>	<b>Unit 1</b>	Introduction to Basic Microbiology	50	4
	<b>Unit 2</b>	Environmental Microbiology		
<b>GEST-22</b>	<b>Unit 1</b>	Environmental Pollution and Control Technologies	50	4
	<b>Unit 2</b>	Disaster management and Risk analysis		
<b>GEST-23</b>	<b>Unit 1</b>	Environmental Biotechnology and Waste management	50	4
	<b>Unit 2</b>	Environmental Chemistry		
<b>GEST-24A</b> <b>OR</b> <b>(Choice based)</b> <b>GEST-24B</b>	<b>Unit 1</b>	Epidemiology and Disease Ecology	50	4
	<b>Unit 2</b>	Immunology and Epigenomics		
	<b>Unit 1</b>	Basics of Oceanography		
	<b>Unit 2</b>	Marine Resources		
<b>GESP-25</b>	<b>Practical &amp; Assignments</b>	Experiments and Analysis [Marks-90]	100	8
		Environmental status report and documentation [Marks-10]		
<b>Total of Semester-II</b>			<b>300</b>	<b>24</b>
<b>SEMESTER-III</b>				
<b>GEST-31</b>	<b>Unit 1</b>	Environmental and Public health management	50	4
	<b>Unit 2</b>	Toxicology and Occupational hazards		
<b>GEST-32</b>	<b>Unit 1</b>	Energy and Environment	50	4
	<b>Unit 2</b>	Environmental Geo-science and Meteorology		
<b>GEST-33A</b> <b>(Choice Based)</b> <b>OR</b> <b>GEST-33B</b>	<b>Unit 1</b>	Rural Technology	50	4
	<b>Unit 2</b>	Economic Applications of Bioresources		
	<b>Unit 1</b>	Forest management		
	<b>Unit 2</b>	GIS and Remote Sensing		
<b>GESP00-34</b>	<b>Practical &amp; Assignments</b>	Experiments and analysis [ Marks-60]Term paper/ Review article/ Dissertation [Marks-30] Industrial visit/ Laboratory visit/ Vermi-compost unit/ Horticulture unit/Sericulture unit/ Bee keeping unit/visit to any place of environmental importance [ Marks-10]	100	8
<b>Total of Semester-III</b>			<b>250</b>	<b>20</b>
<b>SEMESTER-IV</b>				
<b>GEST-41</b>	<b>Unit1</b>	Environmental Impact Assessment(EIA) and Environmental Legislations	50	4
	<b>Unit 2</b>	Environmental Economics and Environmental Audit		

<b>GEST-42</b>	<b>Unit 1</b> <b>Unit 2</b>	Environmental Statistics and Environmental Modeling Molecular Biology and Bioinformatics	50	4
<b>GEST-43</b>	<b>Unit 1</b> <b>Unit 2</b>	Environmental Biochemistry Dietary care and Disease Management	50	4
<b>GEST-44</b>	<b>Practical &amp; Assignments</b>	Grant and Project proposal writing and Term Paper/ Review Paper/ Project work and Dissertation	25+25 = 50	8
		Seminar Presentation and Grand Viva	40 + 10 = 50	
<b>Total of Semester-IV</b>			<b>250</b>	<b>20</b>

## SEMESTER-I

### COURSE CODE: GEST-11

#### UNIT-1: INTRODUCTION TO ENVIRONMENTAL SCIENCE AND SUSTAINABLE DEVELOPMENT

##### *Introduction to environment*

Atmosphere: Structure and composition, acquisition, transformation and utilization of energy, the geochemical, biogeochemical and hydrological cycles

##### *Components of environment*

Lithosphere, hydrosphere, atmosphere and biosphere; physical and biological environments, Biomes types; forest, grassland, tundra, desert, aquatic, marine biomes

##### *Air, water and soil*

Air pollutants and their emission sources, Air quality standards, Air pollution in Indian cities.

Water quantity and quality, Water parameters and standards

Soil genesis and provenance, Soil organic matter: sources, composition, microbial decomposition of organic matter

Humus formation, Taxonomy and biology of soil organisms

Role of terrestrial and aquatic fauna, flora and microbes.

##### *Sustainable development*

Sustainability indices; Strategies and debates on sustainable development;

Environmental health indicators, minimum data set of environmental health.

Concept of Sustainable Agriculture; India's environment action programme: issues, approaches and initiatives towards Sustainability

Sustainable development in practice; Urbanization: Basic Urban process, Causes of Urbanization, Urban Landscaping, Urban sprawling and urban growth, Concept of Green building and Green architecture, Concept and characteristics of smart city; Urban resources and environmental problems

Carrying capacity analysis; Concept of ecological footprints.

#### UNIT-2: PRINCIPLES OF ECOLOGY

##### *The Ecosystem*

Concept of ecosystem, Structure and function of ecosystem, Stability of ecosystem, Gaia hypothesis

***Productivity and flow of energy***

Energy flow and mineral cycling (C,N,P)

Primary production and decomposition

***Structure and function of some Indian ecosystems***

Terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine).

***Population Ecology***

Characteristics of a population, Population growth curves

Factors affecting the shape of survivorship curve, Factors regulating population density

Life history strategies (*r* and *K* selection)

Population interaction (Neutralism, Amensalism, Competition, Parasitism, Predation, Commensalism, Protoco-operation, Mutualism).

***Community Ecology***

Biotic community: Major and minor community, Pioneer and climax community, Nature of communities

Community structure and attributes

Relationship between species and number (Abundance, Density, Frequency, Relative, Abundance, Dominance, Dominance index)

Levels of species diversity and its measurement, Edges and ecotones

***Ecological Succession***

Types, Mechanisms, Changes involved in succession, Concept of climax.

***Habitat and Niche***

Concept of habitat and niche, Niche width and overlap, Fundamental and realized niche

***Landscape ecology***

**COURSE CODE: GEST-12**

**UNIT-1: BIODIVERSITY**

***Biodiversity as Bio-resource***

Biodiversity as a source of food and improved varieties, Source of drugs and medicines

Aesthetics and cultural benefits

***Levels of Biodiversity***

Community diversity (alpha, beta and gamma biodiversity; metaomics analysis), Gradients of Biodiversity (latitudinal, insular)

Ecosystems diversity: biomes, mangroves, coral reefs, wetlands and terrestrial diversity (equilibrium mix of G and W).

***Species diversity***

Richness and evenness (analysis through conventional and metagenomics techniques); magnitude of biodiversity (Global and Indian)

Global biodiversity hot spots; geography of species

***Genetic diversity***

Sub species, breeds, race, varieties and forms. Variation in genes and alleles at genomic/DNA levels (selected case studies)

***Ecosystem diversity***

***Microbial diversity and useful prokaryotic genes***

Methods of Taxonomy of Bacteria and Viruses, Usefulness of Bioresource microbes.

***Biodiversity Hot spots***

Concepts, distribution and importance.

***Threats to Biodiversity***

Species extinctions and their drivers – deforestation, land use changes, overexploitation, biological invasions; habitat loss

Projection of species extinction using species area relationship model

### ***Bioprospecting***

Concept of Bio-prospecting, Biodiversity informatics, International efforts and issues of Sustainability.

## **UNIT-2: CONSERVATIONAL BIOLOGY AND WILDLIFE MANAGEMENT**

### ***Wildlife habitat ecology***

Biomes of the world – an overview

Biome types of India: alpine, tundra, grassland, forest, desert, aquatic, marine and wetlands (unique features, distribution, vegetation, faunal make up and adaptations)

Forest types of India

### ***Protected area concept***

Protected area network in India

Wildlife distribution in India

Design and management of nature reserve; concept of corridor; joint forest management.

In situ conservation- problems and prospects; Sanctuaries, National parks

Community Reserves and Conservation Reserves

Biosphere Reserve, Case studies - Sundarbans Biosphere Reserve.

Wildlife values and Eco-tourism

Problems in wildlife protection, role of WWF, WCU, CITES, TRAFFIC.

### ***Conservation biology of important wild animals***

Conservation status, habit & habitat, behavioural biology, threats and conservation management of the following animals:

Himalayan salamander / Olive ridley turtles / Great Indian bustard / Himalayan musk deer / Greater one-horned rhinoceros / Fishing cat / Ganges river dolphin.

### ***Basic Concept of Wildlife Biology***

Definition and importance of wildlife; Wildlife wealth of India

Threatened wildlife and IUCN status - Concept of Extinct, Critically Endangered,

Endangered, Vulnerable and rare species; Red data book

### ***Wildlife conservation Indian perspective***

Aims & Objectives of wildlife conservation

A brief idea about Indian wildlife, causes for depletion of Indian wildlife

Wildlife conservation in India- through age, post-independence initiatives.

Different approaches for conservation – in-situ and ex-situ, Conservation breeding

Threats to wildlife conservation in India.

## **COURSE CODE:GEST -13**

## **UNIT-1: NATURAL RESOURCE MANAGEMENT AND ENVIRONMENTAL (GREEN) MOVEMENTS**

### ***Introduction and Mineral resources***

#### ***Natural resources:***

Concept of resource, classification of natural resources.

#### ***Mineral resources:***

Use of minerals, resources and reserves. Mineral exploration and extraction, Ocean as new area for exploration of mineral resources.

Ocean ore and recycling of resources, Environmental impacts of mineral extraction

### ***Energy resources***

Energy sources, Prospects of alternate energy sources.

Principal of generation of renewable energy: Solar energy (Photovoltaic and thermal conservation)

Wind, Geothermal energy, Nuclear energy: fusion and fission, Magneto hydrodynamic power, Bio-energy.

### ***Bio Energy***

Biomass conversion processes; Biodiesel; Environmental consequences of biomass resource harnessing

### ***Groundwater Management:***

Human use of surface and ground water

Recharge and discharge areas; Safe yield and overdraft

Land subsidence; Rainwater harvesting and artificial recharge

Consumptive and conjunctive use of water

Watershed management

### ***National environmental movements***

Silent Valley movement,

Chipko movement, Narmada movement and Appiko movement

Tehri & Garwal Dam movement, Uttar Kanda movement and Almatti dispute

Human resource manpower development and environmental education system in India and other countries.

## **UNIT-2: LAND-USE AND RESOURCE MAPPING AND CLIMATOLOGY**

### ***Land resources & management***

Land resources, land degradation cycle, land-use pattern, land reform, land use plan

Soil surveys in relation to land use planning; methods of site selection and evaluation

### ***Water resources management and its environment***

World water balance, hydrogeology and geochemistry of surface and groundwater

Water quality, use of water, conservation of water resources

Climate change impacts on water resource management

### ***Mineral resources and environment***

Mineral resources in relation to plate tectonics and geology, geology of mineral resources

Distribution of mineral resources in India, environmental impact of mineral development, recycling of mineral resources

### ***Climatology***

Fundamental principles

Earth's radiation balance

Latitudinal and seasonal variation of insolation, temperature, pressure, wind belts and humidity

Cloud formation and precipitation

Climatic change in of recent times

Climate and human comfort.

Water balance; air masses; monsoon system; jet streams; tropical cyclones; El-Nino and ENSO.

## **COURSE CODE:14A**

### **UNIT-1: DIVERSITY OF LIFEFORMS**

#### ***Basic classification of plants and animals***

##### ***Taxonomy***

Definition and basic concepts of biosystematics and taxonomy

History of taxonomy

Importance and applications of biosystematics in biology

##### ***General concepts:***

Micro- and Macro-taxonomy

Levels of taxonomic study

##### ***Concepts of species:***

Types –Typological, Biological and Evolutionary

Kinds of species

##### ***Kinds of Type Specimens***

Holotype, Paratype, Lectotype, Neotype, Allotype, Metatype,

Monotype

##### ***Rules of Nomenclature***

##### ***Modern trends in Polyphasic taxonomy:***

Numerical taxonomy concept and prospects

Phenotypic (cultural, physiological and biochemical) taxonomy

Biochemical techniques used in taxonomy

Significance of molecular taxonomy

Molecular techniques used in taxonomy

Molecular determinants used in taxonomy

##### ***Concept of Phenetics and Cladistics***

### **UNIT-2: EVOLUTIONARY BIOLOGY**

#### ***Theories of Origin of Life***

Theory of spontaneous generation, Theory of special creation, theory of catastrophism,

Cosmozoic Theory, Modern Synthetic Theory

#### ***Evolution and Speciation***

Classification and types of evolution, Evidences of Evolution.

Types of speciation: Allopatric, Parapatric, Peripatric And Sympatric Speciation

#### ***Basic concept on***

Natural selection, Fitness, Evolution, adaptation, Directional selection

Stabilizing selection, Disruptive selection, Mutation

#### ***Natural Selection***

Conditions necessary for natural selection

Adaptations as products of natural selection

Genes as the units of inheritance

The phenotype and the genotype

Interaction of environment on the phenotypic traits

#### ***Concept of Population genetics***

Basic approach to evolutionary biology and behavioral ecology

Evolutionary principles and stable strategies

## **COURSE CODE: 14B**

### **UNIT-1: SAMPLING, STANDARDIZATION, CALIBRATION AND CLASSICAL METHODS OF ANALYSIS**

#### ***Sampling; Standardization, calibration***

Comparison with standards, external standard calibration, Errors in external standard calibration, Minimizing errors in analytical procedures; Internal standard methods; Standard addition methods; Sensitivity and detection limit, Linear dynamic range, Quality assurance of analytical results, Validation.

#### ***Classical Method of Analysis***

Principle and Applications of Titrmetry-Acid-Base, Redox, Complexometry and Gravimetry

### **UNIT 2- INSTRUMENTATION AND ENVIRONMENTAL APPLICATIONS**

#### ***Spectral Techniques***

Colorimetry; Spectrophotometry; Flame photometry; Atomic absorption spectrophotometry; Molecular Fluorescence; X-Ray fluorescence; Inductive coupled plasma

#### ***Electro Analytical techniques***

Electrogravimetry, Coulometry, Voltammetry: Polarography, Differential Pulse Voltammetry, Stripping Voltammetry, Cyclic Voltammetry,

#### ***Other analytical techniques***

Electron microscopy; Microtomy; Infrared spectroscopy; X-ray diffraction; Flow Cytometry; Fluorescence microscopy

#### ***Separation techniques***

Chromatography; membrane filtration; adsorption

## **COURSE CODE: GESP-15 [PRACTICAL]**

1. Quantitative estimation of some physico-chemical parameters in the aquatic ecosystem: Temperature, pH, dissolved oxygen, carbon dioxide and chloride contents, Eh, CEC
2. Quantitative estimation of some factors of soil and the sediment:  
Soil moisture, pH, nitrates, phosphates, organic matter, Eh, CEC, macronutrients
3. The study of aquatic and terrestrial habitats:  
Identification and characterization of zooplanktons, phytoplanktons and mosquito larvae
4. Study of rocks, fossils and geological structures; Interpretation of geological and topographical maps
5. Identification of prokaryotic & eukaryotic specimens following taxonomic methods and Principles
6. Problems related to ground water assessment, development and management;  
Hydrogeological map interpretation; Water table and piezometric surface measurement.
7. Application of advanced instruments for monitoring, measurement of pollutants and related studies: Study includes visits to laboratories with state of art facilities
8. Report submission for the Field study to a place of environmental importance
9. Laboratory notebook submission
10. Viva-voce



## **SEMESTER-II**

### **COURSE CODE -GEST-21**

#### **UNIT 1: INTRODUCTION TO BASIC MICROBIOLOGY**

##### ***History and development of Microbiology:***

Contributions of Leeuwenhoek, Koch, Pasteur, Jenner and Flemming

##### ***Microbial Taxonomy***

Concepts of taxonomy and nomenclature of microbes.

Polyphasic taxonomy: classical, numerical and molecular taxonomy

Species concept Bacteriology

##### ***Bacteriology and virology***

Types and structure of bacteria, structure and function of capsule, pili, flagella, cell wall, cell membrane

Bacterial reserve materials, cytoplasmic inclusions, plasmid and bacterial chromosome

Structure and properties of bacterial endospore, spore –formation and germination

Nutrition and nutritional types of bacteria,

Structural organization of viruses, prions, viroids, virions

Lytic cycle of bacteriophages with reference to *E. coli* and T4

Lysogeny, lysogenic conversion, induction and significance

##### ***Microbial growth:***

Fundamentals of microbial growth and multiplication

Growth requirements, growth kinetics, energy metabolic types

Culture media and composition:

Simple, Complex, Synthetic and Semisynthetic media; Differential and Selective media

Pure culture techniques

##### ***Microbial genetics:***

Microbial genome and plasmid structure and replication

Gene transfer in Bacteria: transformation, conjugation and transduction.

Transcription and translation in *E. coli*

Structure and life-cycle of  $\lambda$  Phage virus and control mechanism of lysogeny

Auxotroph, Prototroph, Replica plating and Ames test

##### ***Control of microorganisms:***

Physical and chemical agents for control of microorganisms

##### ***Antibiotic and chemotherapeutic agents:***

Sulfur drugs, Antibiotics and their classification, Mode of action, antibiotic assay and sensitivity test

##### ***General accounts of Mycoplasma, Actinomycetes and Rickettsias***

#### **UNIT 2: ENVIRONMENTAL MICROBIOLOGY**

##### ***Environmental factors influencing growth***

Temperature, pH, osmotic/salt, oxygen and moisture status effect on bacteria.

##### ***Microbiology of Air***

Factors affecting the survival of microorganisms in air; Sources of microorganisms

Air-borne pathogens and its role on public health; Sampling techniques for microbiological air quality.

### ***Microbiology of Water***

Common microorganisms encountered in freshwater sources

Common sources of microbial pollution in water

Assessment of microbiological quality of water

Characteristics of pollution indicator microorganisms

Selection and quantification of indicator organism in freshwater

Freshwater quality standard; purification of water for human use.

### ***Microbiology of Soil***

Beneficial and pathogenic microbes in agriculture; Soil as a microbial growth medium

Characteristics of soil microenvironment for microbes; Interaction of microorganisms and plant in soil

Role of microorganism in maintaining the soil fertility

Concepts of Chemoorganotroph and Chemolithotroph.

### ***Elements of Food Microbiology***

Different fermented food (eg. Cheese, curd, wine etc)

Harmful food borne microorganisms

Detection of food borne pathogens in raw and canned foods

Bacteriology of milk

Outline of the processes of food preservation (Pasteurization, Sterilization, Canning and Blanching).

Bacterial food infections (Salmonellosis, Shigellosis and Listeriosis).

Symptoms, mode of transmission and methods of prevention of Staphylococcal food poisoning and Botulism

Concept of aflatoxin intoxication

### ***Medical Microbiology***

Microbial virulence, Mode of transmission, pathogenicity and prevention of microbial diseases:

Air-borne (Tuberculosis and Influenza)

Food and waterborne (Typhoid and Cholera)

Arthropod borne (Dengue, JE and Yellow fever)

## **COURSE CODE- GEST-22**

### **UNIT-1: ENVIRONMENTAL POLLUTION AND CONTROL TECHNOLOGIES**

#### ***Air Pollution***

Natural and anthropogenic sources of pollution; inorganic pollutants, ozone, SPM, photochemical smog, acid rain; organic pollutants, bio-pollutants

Effects of air pollutants on human, plants, materials and climate

Status of air pollution in Indian cities

Different control measures and air quality standard; Control devices and systems, control of stationary and mobile sources; Principle and application of mechanical collectors, Fabric Filters, Gas & Venturi Scrubbers, Electro-static precipitators

#### ***Water pollution***

Sources, types and consequences

Inorganic and organic pollutants

Concept of eutrophication, DO, BOD, COD

Sewage and groundwater pollution

Status of water pollution in different water bodies with reference to Indian context

Thermal pollution

**Noise pollution**

Sources of noise, types of noise; noise and health; sonic boom

Sound pressure and intensity level; decibels; noise measurement

Control of noise pollution; noise mapping

**Radiation pollution**

Radioactivity in the environment; biological effects of radiations

Pollution from nuclear weapons' explosions, from electric power generation plant and nuclear reactors

**Soil pollution**

Sources, effect of soil pollution on biota, surface water and groundwater regimes; fate and behavior of soil pollutants

Impact of different pesticides (herbicides, insecticides, fungicides, nematicides, rodenticides etc.) on soil

Different kinds of synthetic fertilizer (NP&K) and their interactions with different components of soil

Management of agricultural pollution in India.

**Industry and Environmental degradation**

Industrial development and environmental degradation,

Use of resources like water, energy, mineral consumption by industries

Industrial pollution, viz., air pollution, water pollution, industrial solid wastes, hazardous wastes, toxic chemicals

**UNIT -2: DISASTER MANAGEMENT AND RISK ANALYSIS**

**Disasters**

Definition, nature, scale and types of disasters

Causes and impacts of natural disasters: Flood, Drought, Landslides, Coastal Hazards, Earthquake, Volcanic eruption and Avalanche

Earthquake hazard zoning; Environment management of earthquake hazards

Slope failure, landslides and subsidence

Landslide hazard management

Tropical cyclones

Anthropogenic Disasters: industrial disasters, mine disasters, war and fire disasters

Few case studies: Chernobyl, Bhopal, Exxon-Valdez, Minamata, Nepal earthquake, Aila, Amphan etc.

**Disaster management:**

Prediction and forecasting of natural disaster

Brief outline of their management with special references to social and economic impacts of natural disaster

Protection against climate extremities

Role of Information systems and Technology in disaster management

Assessment of disaster vulnerability; Principles of disaster management, preparation of disaster management plans

Mitigation of different natural and anthropogenic disaster

Post Disaster Relief & Logistic Management

Community Participation at various stages of disaster management.

**Risk analysis:**

Concept of Risk; Risk assessment methodologies

Hazard-risk evaluation and management  
Environmental Safety measurements (on site and off site).

## **COURSE CODE- GEST-23**

### **UNIT-1: ENVIRONMENTAL BIOTECHNOLOGY & WASTE MANAGEMENT**

#### **Concept of Environmental biotechnology**

Broad outlines of various application areas - waste treatment  
Biodegradation of xenobiotic compounds, hydrocarbon degradation  
Bio-fertilizer, bio-pesticides production, bioleaching and other areas

#### **Bioremediation**

Concept, role of bioremediation in controlling various pollution problems:  
Solid water, sewage water, industrial effluents, heavy metals, radioactive substances, oil spillage etc.

#### ***Phytoremediation***

Abatement of different types of pollution using plants  
Types of phytoremediation, mechanism involved with case studies.

#### ***Techniques related to environmental Physicico-chemicals***

Ultrasound - characteristics, measurement and application; acoustic radar; laser application  
Environmental aspects of microwave radiation  
Electrical detection of airborne particles using surface ionization techniques.  
Trace element detection - various methods.

#### **Recombinant DNA technology**

Concept of Genetic Engineering, Genetically modified organism (GMO), General strategy for gene cloning

Genetically modified foods (GMO) and Therapeutic Products

#### ***Microorganisms and environmental pollutants:***

Environmental bio-monitoring and indicator microorganisms  
Biodegradation of organic pollutants  
Anaerobic biodegradation; In-situ and ex-situ bioremediation  
Case studies of microbial remediation; Lagoon and Vadose zone bioremediation  
Metal – microbial interaction and metal remediation  
Microbial transformation of pesticides.

#### ***Solid Waste Management***

Solid Waste  
Sources and types of Solid Wastes wrt Solid Waste Management Rules, 2016  
Characteristics of Solid Waste  
Steps of Solid Waste Management  
Waste collection and Transportation  
Solid Waste Recycling and Recovery  
Waste to Energy Concept  
Composition, Vermicomposting & Biomethanation of Solid Waste  
Disposal of Solid Waste

#### ***Hazardous Waste Management***

Hazardous waste definition and management, E-Waste, Fly-ash, Plastic wastes, Radioactive wastes

## **UNIT-2- ENVIRONMENTAL CHEMISTRY**

### ***Basic Concepts:***

Classification of elements (emphasis on heavy metals)  
Biogeochemical cycles; Saturated and unsaturated hydrocarbons in environment  
Stoichiometry; Gibb's energy  
Chemical Potential and Chemical equilibrium  
Mass and energy transfer across various interfaces;  
Material balance; Laws of thermodynamics, Heat transfer process, Acid - Base-reactions,  
Solubility products; Solubility of gases in water  
Chemistry of hydrocarbons and its decay.

### ***Environmental aspects of air-chemistry:***

Chemical composition of air  
Particles, ions and radicals in atmosphere  
Chemical processes for formation of inorganic and organic particulate matter  
Thermochemical and Photochemical reactions in Atmosphere, Photochemical smog  
Oxygen and ozone chemistry.

### ***Environmental aspects of water-chemistry:***

Fundamentals of water chemistry; Concept of DO, BOD, COD, Total hardness, Redox potential; Carbonate system.

### ***Environmental aspects of soil-chemistry:***

Soil formation, composition and classification; Soil profile; Soil erosion  
Inorganic and Organic components of soil -Nitrogen pathways in soil; NPK in soils.

### ***Principles of commonly used analytical methods in environmental quality assessment***

Titrimetry; Gravimetry; Colorimetry; Spectrophotometry; Flame photometry  
Atomic absorption spectrophotometry; Basic Chromatography; GC; GLC, HPLC  
Electrophoresis; X-Ray fluorescence, X-Ray diffraction; Inductive coupled plasma spectroscopy.

## **COURSE CODE: GEST-24A**

## **UNIT-1: EPIDEMIOLOGY AND DISEASE ECOLOGY**

### ***Principles of Epidemiology:***

Concept of disease: Endemic, Epidemic and Pandemic, Acute and Chronic  
Communicable and Non-Communicable; Infectious, Contagious, Sporadic and Zoonotic diseases  
Epizootic, Enzootic, Vector-Borne, Nosocomial, Opportunistic and Iatrogenic diseases  
Concept on: Surveillance and Eradication  
Rate of A Disease in a population: Attack Rate, Morbidity Rate, Mortality Rates and Ratios, Standardized Mortality Ratio, Proportion, Two By Two Tables, Dose Response, Diagnostic Or Screening Test, Evaluation  
Incidence and Prevalence  
Infectious disease epidemiology: Infection, Contamination, Infestation  
Factors that influence the epidemiology of a disease

### ***Epidemiological methods:***

Descriptive studies, analytical studies and experimental studies.

### ***Community water and its management***

Source of water, safe drinking water, Etiology and effects of toxic agents, Water-borne diseases (Cholera and Amoebiasis),

***Dynamics of Disease transmission***

Human reservoir, Animal reservoir, Reservoir of non-living things

***Modes of Transmission***

Direct, Indirect, Vehicle-borne, Vector-borne, Fomite-borne, Unclean hands and fingers

***Climate change and disease transmission***

Impact of climate change in disease transmission, Factors affecting the emergence and re-emergence of diseases

***Disease prevention and control***

Controlling reservoir: Early diagnosis Epidemiological investigation

Notification, Isolation, Treatment, Quarantine

Immunization: Active, Passive, Combined passive and active, Chemoprophylaxis,

Immunization Schedule

WHO epi schedule, Non-specific measures, Health advice to travellers: Individual, local, National and International

***Disinfection***

Definitions: Disinfectant, Disinfection, Sterilization, Antiseptic, Asepsis, Sanitizer, Sterile, Hospital Disinfectant, Germicide, Detergent, Cleaning, Deodorant, Properties of ideal disinfectant, Types of disinfection

***Epidemiology, mode of transmission, pathogenesis, clinical features, prevention and control of***

Viral diseases: Dengue, Rabies, Measles, Polio, AIDS, Corona virus disease [Covid-19], SARS

Bacterial diseases: Tetanus, botulism

Vector-borne: Malaria and Lymphatic filariasis

**UNIT-2 : IMMUNOLOGY AND EPIGENOMICS**

***Overview of Immune System***

Introduction – concept of health and disease; Cells and organs of the Immune system

***Innate and Adaptive Immunity***

Anatomical barriers, Inflammation, Cell and molecules involved in innate immunity, Adaptive

immunity (Cell mediated and humoral).

***Antigens***

Antigenicity and immunogenicity, Immunogens, Adjuvants and haptens, Factors influencing immunogenicity, B and T-Cell epitopes

***Immunoglobulins***

Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions,

Immunoassays (ELISA and RIA), Monoclonal antibody production

***Major Histocompatibility Complex***

Structure and functions of MHC molecules.

Structure of T cell Receptor and its signalling, T cell development & selection

***Cytokines***

Types, properties and functions of cytokines.

***Complement System***

Components and pathways of complement activation.

***Hypersensitivity***

Brief description of various types of hypersensitivities

***Vaccines***

Various types of vaccines. Active & passive immunization (Artificial and natural)

***Epigenomics***

Epigenetic modification and organization of nucleus

Genetic-Epigenetic Interaction

Dosage compensation

Genomic Imprinting and Epigenetic Imprinting

**COURSE CODE GEST-24B**

**UNIT-1: BASICS OF OCEANOGRAPHY**

***Introduction to Oceanography***

History of Physical oceanography

Origin of Oceans, Bottom topography

Abyssal hills-plains: submarine canyons-ocean trenches, Ocean sediments.

***Marine environment***

Ecological factors (light, temperature, salinity, pressure).

Classification of marine environment:

Pelagic environment: neritic, epipelagic, meso, bathyal and abyssal zone

Planktonic and nektonic adaptations

Benthic environment: intertidal, shelf, deep sea habitat

Hydrothermal vents.

Other coastal environments: estuaries, lagoons, mangroves, seagrass, coral reefs.

***Physical Properties of Seawater***

Density, conductivity, surface tension, viscosity

Sound in the sea, Light in the Sea, UV radiation, Temperature distribution in the sea

***Waves, Tides and Currents***

Theories of waves, tidal waves, formation of swells, internal and standing waves

Tsunami, tide generating forces, tidal currents, tidal effects in coastal areas

Importance of tide tables, tide and wave energy

***Chemical composition of seawater***

Ionic - major and minor constituents

Nitrogen - Phosphorus and Silicon in the sea

Salts, gluconite, petroleum, phosphorite, manganese nodules

Sources, classification and composition of dissolved organic matters

**UNIT-2: MARINE RESOURCES**

***Sea as biological environment***

Divisions of marine environment: pelagic, benthic, coastal, oceanic zones.

Marine diversity: plankton, nekton, benthos

***Marine Ecosystems***

Concepts and principal components

Marine food chains: trophic structure, food web, ecological pyramids, energy flow

## ***Marine Zoology***

Animal association in marine environment:

Endemism, inquilinism, phoresis, epizoism, mutualism, communalism, symbiosis and parasitism

### ***General idea about some marine animals***

Taxonomic characters and general features of Protista (Phyla- Ciliophora, Dinoflagellata, Stramenopila, Actinopoda, Granuloreticulosa), Phylum Porifera (Water current channels, sponge cell types, spicules, biology of sponges), Cnidaria (Structure, functional morphology of Polyp and Medusa, reproduction and development), Ctenophora, Annelida (Polychaeta and Oligochaeta), Arthropoda (Features of marine crustaceans), Phylum Mollusca (molluscan shell, torsion, locomotion, cephalopod colouration and ink, feeding - radula - types, sense organs), Phylum Echinodermata (water vascular system, support, locomotion, feeding, types of larvae)

General characteristics of marine vertebrates

Characteristic features and physiological adaptations of marine vertebrates:

Marine Fish: Shark and Electric Ray Fish

Marine Reptiles: Salt water crocodiles, Sea turtles and Sea snakes

Marine Birds: Albatross

Marine Mammals : Whales and Dolphins, Walrus

### ***Mangroves***

Special features of mangroves

Flora and Fauna of mangrove ecosystem.

Role of mangroves in Carbon sequestration.

## **COURSE CODE -GESP-25[PRACTICAL]**

1. Preparation of liquid media (broth) and solid media for routine cultivation of bacteria
2. Preparation of sanitizer
3. Preparation of slant and stab, Pure culture techniques: Spread plate, pour plate and streak plate
4. Isolation and enumeration of bacteria from natural sources: soil, air and water
5. Staining of bacteria and study of cell types: Gram staining, Endospore staining and acid-fast staining
6. Biochemical tests for characterization: Catalase, Nitrate reduction, Indole production, Methyl red and Voges–Proskauer test, Sugar fermentation test,
7. Antibiotic sensitivity test.
8. Microbiological examination of milk (Methylene blue reduction test).
9. Physico-chemical characterization: water and waste water, soil and sediment; Air quality Assessment
10. Agglutination reactions: Direct and indirect agglutination tests.
11. Environmental Status Report submission and documentation
12. Laboratory note book
13. Viva-voce



## SEMESTER-III

### COURSE CODE - GEST-31

#### UNIT 1: ENVIRONMENTAL AND PUBLIC HEALTH MANAGEMENT

##### **General idea on**

Parasitism, symbiosis, commensalism, mutualism, Parasites, vectors, carriers, mechanical-transmitters, hosts

##### **Proto-zoology**

General account, structure, life cycle, pathogenicity and control of :

*Plasmodium vivax* and *Plasmodium falciparum*, *Entamoebahistolytica*, *Giardialambliia*, *Trypanosomacruzi* and *Leishmaniadonovoni*

##### **Helminthology:**

Classification and General morphology of parasitic helminthes,

Life history, pathogenesis and control of:

*Wuchereriabancrofti*, *Paragonimuswestermani*, *Schistosomahaematobium*, *Taeniasaginata*, *Trichinellaspiralis*, *Dracunculusmedinensis*, *Ancylostomaduodenale*

##### **Medical Entomology and Vector Biology**

Introduction to arthropods of public health importance Arthropods

Diseases and epidemiological triad

Identifying characters, ecology, biology, medical importance and control of

Malarial vectors (*Anopheles stephensi*, *An.subpictus*, *An.sundaicus*, *An.culicifacies*),

Filarial vector (*Culexquinquefasciatus*) and Dengue vectors (*Aedesalbopictus* and *Ae.aegypti*) and vector of Kala-azar (Sand fly)

##### **Vector-microbe interaction:**

*Mosquito – Plasmodium* interaction, Symbiotic association of microbes with vectors

Role of microbes as controlling agents of vectors

##### **Public health and phytonic resources**

Perspectives of plants in public health medicine, environmental safety and pest management.

##### **Microbial diseases**

Mode of transmission, pathogenicity, prevention and control of:

Bacterial diseases (Typhoid, Anthrax, Diphtheria) and viral diseases (Herpes simplex virus, Common cold, Mumps, Rabies)

#### UNIT-2 TOXICOLOGY AND OCCUPATIONAL HAZARDS

##### **Concept of Xenobiotics:**

Toxic materials; Xenobiotic induced oxidative stress; Cell injury

Mode of action: Types of exposure, Absorption, Distribution

Metabolism and Excretion of toxicants (Phase I and Phase II reaction).

Toxicity assay: Acute and chronic toxicity

Dose- Response Relationship- Median lethal concentration (LD50 and LC50)

Sublethal concentration and safe concentration (NOEL, MATC)

Whole Effluent Toxicity (WET) test

Bioassay - types, methodologies and application

##### **Ecotoxicology:**

Biomarkers; Bioaccumulation; Biomagnification

Bioconcentration factor; Risk assessment; Effects on population and ecosystems

Damage process and action of toxicants

Toxicity of heavy metal (Pb, Cd, Hg and As)

Predictive toxicology and Quantitative Structured Activity Relationship (QSAR).

***Cytotoxicity and Genotoxicity:***

Molecular mechanism of cell death; chromosomal aberration; sister chromatid exchanges; Micronucleus and Nuclear abnormalities; DNA damage and repair mechanism.

***Carcinogenesis:***

Classification of carcinogens; Metastasis and metabolism of chemical carcinogens; cancer risk evaluation; Brief outline of cancer therapy.

***Reproductive toxicity***

Teratology, Invitro fertilization

***Occupational hazards***

Health consequences of different occupations- Anthracosis, Silicosis, Asbestosis

***Stress physiology***

Concept of stress, Stress related diseases, Stress management

Stress, strain and general adaptive syndrome

Industrial Environmental Psychology

Cardio-respiratory response during high altitude acclimatization; Effect of climate on performance.

**COURSE CODE - GEST-32**

**UNIT-1: ENERGY AND ENVIRONMENT**

***Energy as resources***

Concept of renewable, non-renewable, conventional and non-conventional energy resources  
Energy and heat budget of the earth; Global energy use pattern, energy use and prospects in India; Energy security.

***Conventional energy sources:***

Classification of Fossil fuels and their composition

Physio-chemical characteristics and energy values

Green house gas, Global warming, Climate change: Global and Indian perspectives

Energy conservation; Energy efficiency: global and Indian perspectives

***Solar energy:***

Sun as source of energy; Characteristics: irradiation, insulation etc.

Solar ponds; Theory & practice of solar power generation

Solar collectors, heliostats, PV cell, solar thermal, CSP; Energy phase change material and environmental impacts.

***Bio-energy***

Bio-mass characteristics

Different methods of extracting energy from bio-mass, their use, prospects and problems

Concept and use of bio-fuel and environmental impacts

Edible and non-edible biofuels, biological and abiological biofuel production technologies, conservation

Production of biofuel resource animals and plants of terrestrial and fresh water and saline aquatic ecologies.

***Alternative energy:***

Basic Principles, applications and environmental significance of

Wind energy, Hydal Energy, Tidal energy, Wave energy, Ocean thermal energy

Geothermal energy, Nuclear energy (fission and fusion)

Magneto hydrodynamic power, fuel cell and their techno-economic comparison.

***Environmental impacts of energy use***

Impacts of large-scale exploitation of energy on ecosystem, land use etc.

## **UNIT -2: ENVIRONMENTAL GEOSCIENCES AND METEOROLOGY**

### ***The Earth and its system:***

Geological Time Scale, Space and time scales of processes in the solid Earth  
Evolution, structure and composition of lithosphere, atmosphere hydrosphere and biosphere  
Basic principles of stratigraphy  
Fossil records; Earth's gravity and magnetic fields and its thermal structure: Geoid, spheroid;  
Isostasy.

### ***Rocks and minerals***

Gross composition, physical properties and distribution of important minerals and rocks  
Processes responsible for mineral concentrations  
Different Rock types – igneous, metamorphic and sedimentary  
Weathering of rocks - physical, chemical and biological

### ***Mineral deposits***

Geological characteristics in relation to mining  
Impact of mining on environment; Acid mine drainage  
Radioactive and stable isotope mining.

### ***Earth's geodynamic processes***

Elemental ideas of folds, faults, joints, foliation, lineation, cleavage and schistosity  
Physicochemical and seismic properties of Earth's interior, Paleomagnetism  
Continental drift, sea floor spreading, plate tectonics and mountain building processes.

### ***Physiography:***

Development of land forms, land use pattern, land use policy of India  
Glaciers: Physical and chemical aspects  
Mass balance; Recession of Himalayan glaciers  
Glaciers as index of climate change  
Physiographic features and river basins in India.

### ***Meteorology:***

Atmospheric stability  
Inversion and mixing height  
Wind roses  
Climate and weather  
Scales of meteorology, pressure, temperature, precipitation, humidity, radiation and wind.

## **COURSE CODE -GEST-33A [CHOICE BASED]**

### **UNIT-1: RURAL TECHNOLOGY**

#### ***Nature and Characteristics of Rural Resources:***

Definition and meaning of Resources, Types and characteristics of Rural Resources, Natural and Man-made

#### ***Horticulture:***

Scope of horticultural crops  
Soil and climatic requirements for fruits and vegetables, nursery raising and management  
Crop production technology for major fruit crops viz., mango, banana, sapota, aonla, pomegranate, guava, etc.

### ***Organic farming***

Introduction, concept, advantages and disadvantages, relevance in present context, organic production requirements.

Biological intensive nutrient management

### ***Organic manures:***

Vermin composting, Green manuring

Recycling of organic residue and bio fertilizers

### ***Soil improvement and amendments***

Integrated weed, disease and pest management

Uses of bio-control agents, bio-pesticides, pheromones, trap crops, bird perches, weed management.

Quality consideration, certification, labeling and accreditation process, marketing and exports.

### ***Rural Tourism***

Rural Tourism in India, its scope & importance, rural society of India, cultural aspects of India & tourism,

Models of sustainable tourism in India, Rural Tourism components & types of rural tourism.

### ***Integrated pest management***

Concept, technology involved in agriculture & forestry, Bio-pesticides application potential.

### ***Vector Control***

Integrated Vector-control strategies

Role of mosquito-larvicidal agents (*Bacillus thuringiensis*, *Bacillus sphaericus*)

## **UNIT-2: ECONOMIC APPLICATIONS OF BIO-RESOURCES**

### ***Apiculture***

Apis and Non-Apis Bee species and their identification.

General Morphology of Apis Honey Bees Social Organization of Bee Colony

Rearing of Bees: Artificial Bee rearing (Apiary)

Beehives – Newton and Langstroth box Bee

Methods of Extraction of Honey (Indigenous and Modern)

Bee Economy: Products of Apiculture Industry and its Uses – Honey, Bees Wax, Propolis, Pollen etc

### ***Sericulture:***

Definition, history and present status

Types of silkworms,

Distribution and Races Exotic and indigenous races Mulberry and non-mulberry Sericulture

Life cycle of *Bombyx-mori*; Structure of silk gland and secretion of silk

Selection of mulberry variety and establishment of mulberry garden Rearing house and rearing appliances.

Silkworm rearing technology: Early age and Late age rearing, Spinning, harvesting and storage of cocoons

Pests of silkworm: Uzi fly, dermestid beetles and vertebrates

Pathogenesis of silkworm diseases: Protozoan, viral, fungal and bacterial

Prevention of pests and diseases

### ***Ornamental fish culture***

The potential scope of Aquarium Fish Industry as a Cottage Industry, Exotic and Endemic species of Aquarium Fishes

Common characters of Fresh water and Marine Aquarium fishes such as Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish and Butterfly fish

Use of live fish feed organisms. Preparation and composition of formulated fish feeds,  
Aquarium fish as larval predator  
Live fish transport - Fish handling, packing and forwarding techniques  
General Aquarium maintenance – budget for setting up an Aquarium Fish Farm as a Cottage  
Industry

*Commercial & Economic Utilization of Plants and Microbial Resources*

**OR**

**COURSE CODE -GEST-33B [CHOICE BASED]**

### **UNIT-1: FOREST MANAGEMENT**

#### *General Silvicultural Principles*

Ecological and physiological factors influencing vegetation, natural and artificial  
regeneration of forests

Methods of propagation, grafting techniques

Nursery and planting techniques

#### *Forest Soils, soil Conservation and Watershed Management:*

Forests Soils: Classification, factors affecting soil formation; physical, chemical and  
biological properties.

Soil conservation– definition, causes for erosion

Types–wind and water erosion

Conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes

Reclamation of saline and alkaline soils, water logged and other waste lands.

Forest leaf litter and composting

Role of micro-organisms in ameliorating soils; N and C cycles

#### *Forest Management and Management Systems*

Objective and principles; techniques; stand structure and dynamics, sustained yield relation;  
rotation, normal forest, growing stock; regulation of yield; management of forest plantations,  
commercial forests, forest cover monitoring.

Approaches viz., (i) site-specific planning, (ii) strategic planning, (iii) Approval, sanction and  
expenditure, (iv)Monitoring (v) Reporting and governance.

Details of steps involved such as formation of Village Forest Committees

Joint Forest Participatory Management

#### *Major forest types in India*

#### *Ethnobotany*

Role of Ethnobotany in Indian Systems of Medicine

Nomenclature, habitat, distribution and botanical features of medicinal and aromatic plants

Factors affecting action and toxicity of drug plants and their chemical constituents.

### **UNIT-2: GEOGRAPHIC INFORMATION SYSTEM AND REMOTE SENSING**

Historical development of GIS

Objective, components and elements of GIS

An overview of application of geoinformatics in ecological studies

Application of Remote sensing and GIS in land cover/land use planning and management  
(urban sprawling, vegetation study, forestry, natural resource)

Ecological studies using LiDAR

Biodiversity assessment with geoinformatics  
Biodiversity informatics and citizen science  
Satellite telemetry for wildlife studies  
Geostatistical analysis in ecological studies  
Soil mapping; Land use/Land cover mapping  
Spatial data Analysis (Vector-based)  
Spatial data Analysis (Raster-based)  
Waste management and climate change.

### **COURSE CODE -GESP-34 [PRACTICAL]**

1. Fixation, staining and permanent preparation of Protozoan and Helminth parasites
2. Demonstration of mouth parts and wings of medically important insects
3. Identification of Protozoan and helminth parasites, mosquito vectors  
(*Culexquinquefasciatus*, *Cx. tritaeniorhynchus*, *Anopheles stephensi*, *Anopheles subpictus*, *Aedesaegypti*, *Ae. albopictus*, *Mansoniaannulifera*, *Ma. uniformis*) and sand fly (*Phlebotomussp*)
4. Water quality analysis, Analysis of field water for important physical and chemical parameters
5. Microbiological analysis of drinking water
6. Physicochemical analysis of soil / solid waste materials
7. Handling of meteorological data recording equipment
8. Study of rocks, fossils and geological structures, Interpretation of geological and topographical maps
9. Experiments on eco-toxicocity, genotoxicity and cytotoxicity, Invitro toxicity assay.
10. Presentation and interpretation of wind data (wind rose); Satellite image interpretation
11. Application of global positioning system; Land use and land cover study
12. Term paper/ Review article/ Dissertation
13. Report submission for Industrial visit/ Laboratory visit/ Vermi-compost unit/ Horticulture unit/Sericulture unit/ Bee keeping unit/visit to any place of environmental importance
14. Laboratory note book
15. Viva-voce

### **SEMESTER-IV**

#### **COURSE CODE -GEST-41**

#### **UNIT-1: ENVIRONMENTAL IMPACT ASSESSMENT (EIA) AND ENVIRONMENTAL LEGISLATIONS**

##### ***Environmental Impact Assessment***

Concept & scope of EIA, principle and salient features

EIA processes, methodologies, MOEF guidelines

Basic steps of overall appraisal of development projects - base line data collection & generation from the field

Identification & prediction of impacts of development project

Evaluation of impacts - different methods (checklist, adhoc, overlays, matrix, network and Battle Environmental Evaluation Systems)

Preparation Environmental & Management plan (EMP) for mitigation

Environmental impact statement; post project monitoring and Environmental.

Case studies of EIA/EMP and environmental auditing system.

***Environmental laws, treaty, regulation and movements:***

Environmental protection - issues and problems

Statutory requirement for environmental clearance from state and central government of any developmental projects

Concept of environmental laws, pollution control acts, rules, notifications in India

Environmental policy resolution, Legislations, Public policy strategies in pollution control

Wildlife protection Act 1972

The Water (Prevention and control of pollution) Act, 1974

Forest Conservation Act 1980, Air (Prevention and control of pollution) Act, 1981

Biodiversity Act, 2002

The Environmental (Protection) Act, 1986

Public Liability Insurance Act, 1991

Sanction and enforcement bodies of environmental laws - roles of Supreme Court and Green Bench of High Court on environmental protection in India

National Environmental policy; public awareness and participation in environmental protection movement in the worlds and India,

International treaty, global and national environmental summits.

Role of NGOs in environmental protection in India and other countries

**UNIT-2: ENVIRONMENTAL ECONOMICS AND AUDIT**

***Environmental Economics***

Economics and Development

Economic efficiency and Cost benefit analysis

Concept of Consumerism; Poverty and globalization

Monitoring economic and environmental progress

Application of economics to improve environmental quality

Rural planning and development

Environmental valuation (Hedonic pricing, Contingent valuation and Travel cost method) and decision making

Theory of externalities and public good

International negotiations on climate change and North South debate

Environment Kuznet Curve (EKC).

***Dimensions of natural resources***

Basic services of natural resources; Natural resource as national capital

Natural resource potential of India

Natural resources and sustainable development

Resource economics

Issues and challenges of SEZ and EEZ in India

***Environmental audit***

Concept of environmental audit; Guidelines of environmental audit

Methodologies adopted along with some industrial case studies

Environmental standards: ISO 14000 series

Scheme of labelling of environment friendly products (Ecomark)

Life cycle analysis

Concept of energy and green audit.

## **COURSE CODE-GEST-42**

### **UNIT-1: ENVIRONMENTAL STATISTICS AND MODELING**

#### **Attributes and Variables:**

Types of variables, scales of measurement

#### ***Descriptive statistics***

Measurement of central tendency and dispersion

Standard error

Moments – measure of skewness and kurtosis

#### ***Standard Univariate Distributions***

Standard univariate discrete and continuous distributions- uniform; binomial; Poisson; geometric; negative binomial and hyper-geometric distributions

Chi-square test for goodness of fit

Correlation, Regression, tests of hypothesis (t-test and ANOVA)

Significance and confidence limits.

Approaches to development of environmental models

Linear, simple and multiple regression models, validation and forecasting.

Models of population growth and interactions: Lotka-Volterra model, Leslie's matrix model.

### **UNIT-2: MOLECULAR BIOLOGY AND BIOINFORMATICS**

#### ***Nucleic Acids***

Salient features of DNA, Chargaff's Rule, Hypo and Hyperchromic shift. Watson and Crick Model of DNA. RNA types & Function.

#### ***DNA Replication***

Mechanism of DNA Replication in Prokaryotes, Prove that replication is Semi-conservative, bidirectional and discontinuous, RNA priming, Replication of telomeres.

#### ***Transcription***

Mechanism of Transcription in prokaryotes and eukaryotes

Transcription factors, Difference between prokaryotic and eukaryotic transcription.

#### ***Translation***

Genetic code, Degeneracy of the genetic code and Wobble Hypothesis

Mechanism of protein synthesis in prokaryotes.

#### ***Basic concept on Bioinformatics***

Objectives, applications and challenges in Bioinformatics,

Major databases & tools

Current status of Bioinformatics in India.

#### ***Tools in Bioinformatics***

Web based Bioinformatics Applications,

Desktop based softwares,

Online Analysis Tools & Servers, PDB, SWISS-PROT

Homology Tools –BLAST, FASTA

Multiple Alignment-CLUSTALW

#### ***Genomics***

Basic concept on genomics

Data Mining –ORF, Pubmed, MSA, Gen BANK, COG Cluster, OMIM, Gene Mapping

Retrieval of gene sequence, sequence alignment and annotation



Comparative genomics  
Phylogenetic tree analysis and recovering evolutionary history.

***Proteomics***

Visualization & prediction of Protein Structure  
Methods used in protein structure prediction  
Applications of PROSITE, DNA Micro array (DNA chip).

**COURSE CODE-GEST-43**

**UNIT-1: ENVIRONMENTAL BIOCHEMISTRY AND NUTRITION**

***Basics of Biomolecules***

Structure and Chemistry of Carbohydrates, Amino acids, Proteins, Lipids and Nucleic acids of physiological significance.

Structure and function of proteins, enzymes and membranes: Amino acids and peptides; Determination of primary structure and higher order structures; Enzyme- mechanism of action, enzyme kinetics, regulation and activities.

***Environment and Nutrition Connection***

Interrelation between Environment and Nutrition

***Environmental Nutrition Model (ENM)***

Healthy diets as a climate change mitigation strategy Sustainable Diets for a food secure future

***The diet, health and environment trilemma***

Concept and definition of terms, Nutrition, Undernutrition, Malnutrition, Underweight and Health. Scope of Nutrition.

Protein energy malnutrition (Kwashiorkor, Marasmus), Nutritional anaemia, Pernicious anaemia,

Balanced diet, Nutrition during pregnancy and lactation, Nutrition in infancy, Nutrition of pre-school children, and school-children, Nutrition during adolescence, Nutrition during old-age

Sports Nutrition

***Nutritive value of food-commodities***

Cereals and cereal products, pulses, vegetables, Fruits, meat, fish and eggs

Spices and condiments

Fats and oils

Beverages, sweetening agents

Dietary fiber: Classification and nutritional significance

Milk and milk-products, Host resistance factors of human milk

Types of processed milk, Milk products (butter, curd, paneer and cheese), Pasteurization of milk

***Assessment of Nutritional Status***

**Anthropometric assessment**

**Clinical examination**

Biophysical and Biochemical assessment

Dietary assessment

Vital health statistics

Study of Clinical signs: Identifying signs of PEM, Vit A, Vit B complex, Vit D,

Vit C deficiency, Iron and Iodine deficiency.

***Food sanitation and Hygiene***

Freshness of foods (Fruits, Berries, citrus, salad plants), Selection of foods (Eggs, meat, fish, milk, fats, cereals and cereal products)

Food poisoning, prevention of food poisoning

***Food adulterants***

Common adulterants in food and their effects on health; Common household methods to detect adulterants in food.

**UNIT-2: DIETARY CARE AND DISEASE MANAGEMENT**

***Dietary care and disease management***

Classification of therapeutic diets.

Hospital basic diets, Nutritional adequacy of hospital diets

Basic concept and methods of

(i) Oral feeding (ii) Tube feeding (iii) Parenteral feeding

Etiology, symptoms, diagnostic tests and dietary management of:

Gastro-intestinal tract diseases (Diarrhoea, Constipation, Irritable Bowel Syndrome, Peptic ulcer, Ulcerative Colitis)

Liver diseases (Viral hepatitis and Cirrhosis of liver).

Cardiovascular diseases(Ischemic heart disease, Hypertension)

Diabetes (Diabetes mellitus and Diabetes insipidus)

Renal diseases(Nephritis, Glomerulonephritis, Uremia, Kidney failure, Nephrosis)

Risk factors and dietary management of obesity

***Role of International and National agencies in combating malnutrition***

World Health Organisation, Food and Agricultural organization, United Nations Children`s Fund, Care, Indian Council of Medical Research, National Institute of Nutrition

***Nutritional Programmes***

Special Nutrition Programme (SNP)

Integrated Child Development Services (ICDS)

Mid-day Meal Programme

***Nutrigenomics:***

Concepts and applications, Interaction between nutrient and gene

Tools of nutrigenomics

Chronic disease and nutritional genomics

Role of nutrigenomics in coronary heart disease

**COURSE CODE-GESP-44 [PRACTICAL]**

1. Anthropometric measurement: Height, weight, circumference of: chest, upper arm, waist, hip; waist - hip ratio, measurement of fat using skin-fold thickness
2. Determination of BMI and comments on results
3. Detection of Vanaspati in Ghee/Butter, Khesari flour in besan, Argemone oil in edible oil and Metanil yellow in turmeric/coloured sweet products.
4. Blood analysis: T.C., D.C, Haemoglobin level, estimation of Cholesterol and Sugar from mammalian blood / milk
5. Estimation of Blood Pressure by Sphygmomanometer (Auscultatory method.)

6. Clinical assessment and sign of nutrient deficiency disorders: Protein energy malnutrition (PEM), Anaemia, Rickets, Goiter, Vitamin A, Vitamin C and Vitamin Bcomplex (Slide/Photography).
7. Demonstration of plasmid DNA isolation, amplification of DNA by PCR and Agarose Gel electrophoresis; Demonstration of SDS-PAGE
8. Retrieval of nucleic acid/protein sequence from data bases, Storing of sequence and conversion of one sequence format to another, Sequence alignment (pair-wise alignment and multiple sequence alignment). Retrieval of protein structure from Protein Data Bank, Protein structure visualization.
9. Grant and Project proposal writing and Term Paper/ Review Paper/ Project work and Dissertation
10. Seminar Presentation
11. Grand Viva