

# KERALA PUBLIC SERVICE COMMISSION

## SYLLABUS FOR THE POST OF RANGE FOREST OFFICER IN KERALA FOREST & WILDLIFE DEPARTMENT

### **Optional subject- Environmental Science**

#### **Module 1**

**10 Marks**

Fundamentals of Environmental Science - Definition, Scope and Importance of Environmental Science; Multidisciplinary nature of environmental Science. The atmosphere or the air: Layers of Atmosphere, Composition of air; importance of atmosphere, meteorological conditions and air circulation. The hydrosphere or water: Importance of water, distribution of water at global, national and state level. Hydrological cycle. Lithosphere or the rock and the soil: Elementary composition of rocks in the earth crust. Types of rocks; Process of soil formation: Physical weathering, Chemical and biological weathering of rocks; Role of soil in shaping the biosphere.

#### **Module 2**

**10 Marks**

Environmental Factors: Climatic Factors - Light, Temperature of Air (atmospheric temperature), Rainfall (precipitation), Humidity of air, atmosphere (gases and wind), fire. Topographic Factors: height of mountains, direction of mountains and valleys, steepness of slope and exposure of slope. Edaphic factors: Soil - soil formation, soil profile, soil erosion, soil conservation. Biotic factors: Intraspecific interactions; Interspecific interactions: Neutralism, Commensalism, Mutualism, Proto co-operation, Parasitism, Predation.

#### **Module 3**

**20 Marks**

Ecosystem Definition; Components of ecosystem; Abiotic components: Light, Temperature, Pressure, Water, Wind, Soil; Biotic components; Energy flow in an ecosystem: Primary production, Secondary production; Food chain: Grazing food chain, Detritus food chain; Ecological pyramids: Pyramid of number, Pyramid of biomass, Pyramid of energy; Food web; Ecological indicators. Biogeochemical cycles: a)

Gaseous cycles: Oxygen cycle, Carbon cycle and Nitrogen cycle. b) Sedimentary cycles: Phosphorus cycle, Sulphur cycle.

#### **Module 4**

**10 Marks**

Population Ecology and Community Ecology: Population characteristics- Population growth and its dynamics; natality, mortality, growth patterns; Age distribution, Malthus theory; Community structure, Species diversity, Ecological dominance, Ecotone, Edge effect, Ecological equivalence, Succession and Climax; Ecological adaptations. Types of biodiversity; genetic, Species and ecosystem biodiversity; Cultural values, importance of biodiversity; hot spots of biodiversity; India as a megadiversity centre; threats to biodiversity: rare, endangered, threatened and endemic species ; biogeographical distribution of species; biodiversity conservation – *in-situ* , *ex-situ* and agrobiodiversity conservation, national parks and sanctuaries; wildlife conservation ; Red data book ; medicine ; sustainability , Intellectual Property Right (IPR). National Biodiversity Act

#### **Module 5**

**20 Marks**

Sun-Earth System: planetary motion and seasons; Solar radiation, effect of atmosphere - scattering, absorption and reflection, greenhouse effect; Structure of atmosphere and atmospheric circulation; General circulation of the atmosphere and Indian monsoons; General circulation of Oceans. Thermodynamics, Atmospheric stability: Composition of dry air and atmospheric water vapor content; Potential temperature, virtual temperature, isothermal and adiabatic processes; Stable, unstable and neutral equilibriums, Inversions; Atmospheric boundary layer - depth, structure, diurnal variations and their significance in pollutant dispersion. Clouds and precipitation. Weather and climate - Climatic zones, continental & maritime climates; Climate change and variability, Natural and anthropogenic causes of climate change, El Nino and ENSO events. Earth's geological history and development and evolution of the earth systems; Gaia Hypothesis; Introductions to various systems - Atmosphere, Hydrosphere, Lithosphere, Biosphere and their linkages. Properties and Structure of the Earth: crust, mantle, core, earth's magnetic field; Recycling of the lithosphere - the rock cycle, weathering and erosion, sedimentation, metamorphism; Rock types; Concept of plate tectonics and continental drift; Geological time-scales. Global water balance: hydrological cycle, relationship of surface, groundwater and stream-flow, Stream hydrograph; Groundwater - aquifers; Groundwater exploitation and management.

#### **Module 6**

**20 Marks**

Energy basics: Laws of thermodynamics; Forms and types of energy; Energy resources classification -; conventional and non- conventional; secondary energy sources; sun as source of energy, nature of its radiation, thermal dynamics of earth system, solar constant, distribution of solar radiation across various atmospheric levels, ecologically

important radiations, energy flow in Ecosystems. Non-renewable energy resources: Coal, oil, natural gas, heavy radioactive elements; India's non-renewable energy reserves and usage pattern; world's energy reserves and consumption; Non-renewable energy usage and limitations, role of fossil fuels in modern economy, Environmental impacts of fossil fuels exploitation and utilization. Renewable energy resources: Biomass, wind, hydroelectric, ocean, geothermal; Secondary energy resources - electricity, hydrogen; Alternate energy resources; Renewable energy usage, limitations and scope; modern techniques for energy resource recovery using microbes, solar collectors, photovoltaics, solar ponds, nuclear-fission and fusion, Magneto-Hydrodynamic Power (MHD) and biomass gasification. Nuclear energy generation and environmental safety. Energy production and impacts on environment: degradation of air, water and land; Important multipurpose power projects and environmental issues in India; Energy use pattern in different parts of the world and its impact on the environment; energy utilization in urban and rural contexts; Sustainable energy management, problems and solutions; Energy crisis and challenges of energy transformation; Energy conservation measures for sustainable development.

## **Module 7**

**20 Marks**

Environmental pollution: Pollution - physical, chemical and biological; radio nuclides, Electromagnetic radiations, Electro-smog, noise and light pollution; sources . History of evolution of the earth's atmosphere. Air pollution: Particulate matter - Respirable and irrespirable, inorganic and organic species in PM; gaseous pollutants; Green-house gases, Ozone layer , Photochemical smog , Acid rain; Meteorological factors affecting air pollutants; Effects of pollutants on life forms; Ambient air quality standards. Pollution monitoring methods and pollution abatement. Water pollution: pollution of water resources, types and sources. Pollution monitoring methods and pollution abatement: Water, soil and biological sample analysis . Wastewater and its treatment. Soil-weathering and pedogenesis, classification of types of soil (Reference to India and Kerala),soil quality parameters and assessment. Soil pollution. Solid wastes: definition, types, source, categories, generation rates; Waste management approaches ; Hazardous wastes; Biomedical wastes; Nuclear wastes; Environmental impacts of wastes; recycling of wastes and waste minimization techniques; solid waste processing technologies, biological and chemical techniques for energy and other resource recovery; Waste biomass resources, utilization of organic manure; waste and earthworms, vermicomposting .

## **Module 8**

**20 Marks**

Major classes of environmental pollutants - routes of entry into ecosystems - surface waters, land, atmosphere; long-range movement and global transport of pollutants; Fate of pollutants in ecosystems - biotransformation, bioaccumulation and biomagnification. Toxicity testing . Biochemical effects of environmental contaminants. Environmental health and safety- Diseases through pollution. Management to control diseases;

Occupational health, health and safety considerations; Environmental health and human society, Health problems in different types of industries. Environmental health and occupational hygiene; Occupational health & safety management system, OHSAS – 18000.

## **Module 9**

**20 Marks**

Environmental Microbiology: - characteristics, classification, identification and morphology of microorganisms. Physiological status of microorganisms in the environment. Microbes in air, water and soil. Microorganisms in extreme environments, genetically engineered microorganisms. The aquatic microorganisms. Nature of marine and fresh water environments, Water and disease transmission, Microbial analysis of water quality. Soil microorganisms, Microbial diversity in soil, biogeochemical role of soil microorganisms. Soil microorganisms associated with plants. Soil microorganism's interactions with the atmosphere, the role and importance of microbial ecosystems, biogeochemical transformation. Environment Biotechnology–Role of biotechnology in Environmental Protection, biotechnology in industrial pollution control – Agro – biotechnology – Bio- pesticides and Bio-fertilizers; Ecological Engineering-Aquatic macrophyte based wastewater treatment systems (AMATS)-constructed/artificial wetlands, Nutrient film techniques (NFT), Municipal solid waste management, Role of composting and vermicomposting; Biodegradable plastics – Biopolymers-PHBs and PHAs, Phyto – reactors-Plants used to produce genetically engineered products. Biotechnological Methods in Pollution Control – Air pollution control: Bio scrubbers, biofilters and membrane bioreactors. Bio-desulphurization of coal. Green belts. Bioremediation: Soil/ land contaminated with oil spills, and synthetic organic compounds (xenobiotics) such as PCBs, PAHs. Bioremediation technology, bioremediation of marine oil spills. Phytoremediation. Biosensors. -Concept, principle, and development of biosensors. Biosensor's for environmental monitoring-BOD, ammonia, and nitrite.

## **Module 10**

**10 Marks**

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community – based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

**Module 11****20 Marks**

Basics of Environment Impact Assessment (EIA) and Risk Assessment (RA): EIA practice in India, EIA Notifications 1994, 1997 2009; Other related notifications. Types of EIA: Rapid EIA, comprehensive EIA, strategic EIA, data collection, ecological impacts, environmental impacts (Air, water, land and noise), socioeconomic and cultural impacts, health impacts, prediction of impacts; methodologies, cost benefit analysis, Environmental Management Plan (EMP). Environmental Impact Statements (EIS); Reviewing EIA/EIS

**Module 12****20 Marks**

Environmental ethics: concepts, ethical theories. Major Indian environment / conservation related acts: Introduction to Water (Prevention and Control of Pollution) Act - 1974, Water (Prevention and Control of Pollution) Cess Act -1974, Wildlife (Protection) Act -1972, Forest (Conservation) Act -1980, Air (Prevention and Control of Pollution) Act -1981. The Environment (Protection) Act -1986, The Public Liability Insurance Act – 1991. Laws on water and air pollution control: Powers of Central and State Pollution Control Boards, Prevention and control of Water Pollution. Air Pollution Control Areas, pollution control strategies, Prohibition of Emission of Air Pollutants. Environment (Protection) Act - 1986, Hazardous Wastes (Management and Handling) Rules - 1989, The Natural Environment Tribunal Act - 1995, Legal Measures to Control Noise Pollution, Solid waste management and handling rules-2000; Biomedical wastes (Management and Handling) Rules - 1999; Coastal Regulation Zone Notification – 1991, Biodiversity Act - 2002. International environmental treaties and conventions: Montreal Protocol, Earth Summit, Agenda 21, Convention on Biological Diversity (CBD) , Kyoto Protocol, Paris convention, Copenhagen Summit - 2009, Millennium Development Goals, Basel convention. International Organisations: United Nations Environment Programme (UNEP), International Union for Conservation of Nature and Natural Resources (IUCN), International Panel on Climate Change (IPCC), International Panel on Oceans (IPO)

**NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the questionpaper. There is no undertaking that all the topics above may be covered in the question paper.**