

GATE SYLLABUS Part I - ENGINEERING SCIENCE (XE) Section-XE-H Atmospheric & Ocean Science





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SECTION – XE-H: ATMOSPHERIC & OCEAN SCIENCE

Course Syllabus

Unit 1: Atmospheric Science

- > Fundamental of Meteorology:
 - Thermal structure of the atmosphere and its composition
 - Radiation Balance and Laws
 - Wind Belts
 - Monsoon
 - Climate
- > Atmospheric Thermodynamics
- > Hydrostatic equilibrium:
 - Hydrostatic equation
 - · variation of pressure with height
 - geopotential
 - Tropical convection
- > Atmospheric Electricity
- Cloud Physics
- > Observation Techniques of the Atmospheric Properties
- > Fundamental equations
- Pressure, gravity, centripetal and Corolis forces, continuity equation in Cartesian and isobaric coordinates, Scale analysis, inertial flow, geostrophic and gradient winds, thermal wind, vorticity
- > Atmospheric turbulence, Baroclinic instability
- Atmospheric Waves
- > Tropical Meteorology:
 - Trade wind inversion
 - ITCZ
 - Monsoon trough tropical cyclones, their structure and development theory
 - Monsoon depressions
 - Climate variability and forcing
 - Madden-Julian oscillation(MJO)
 - ENSO
 - QBO (quasi-biennial oscillation)
 - Sunspot cycles
- Primitive equations of Numerical Weather Prediction
- General Circulation and Climate Modelling
- > Synoptic weather forecasting
 - Prediction of weather elements such as rain, maximum and minimum temperature and fog
- Data Assimilation



Unit 2: Ocean Science

- Seawater Properties
- > T-S diagrams
- Ocean Observations
- Ocean Tide and Waves and their properties
- Coastal processes and Estuary Dynamics
- Coastal zone management
- Wind Driven Circulation:
 - Ekman
 - Sverdrup
 - Stommel and Munk theories
 - Inertial currents
 - Geostrophic motion
 - Barotropic and Baroclinic conditions
 - Oceanic eddies
- Global conveyor belt circulation
- Subtropical gyres:
 - Western boundary currents
 - Equatorial current systems
- Current System in the Indian Ocean
- > Momentum equation, mass conservation, vorticity
- > Ocean and Wave Modeling, Ocean State Forecasting
- Data Assimilation
- Ocean Turbulence
- > Seawater:
 - Chemical property of seawater
 - Major and minor elements, their behavior and chemical exchanges across interfaces and residence times in seawater
 - Element chemistry in atypical conditions-estuaries
 - Biochemical cycling of nutrients
 - Trace metals and organic matter
 - Air-sea exchange of important biogenic dissolved gases
 - Carbon dioxide-carbonate system
 - Alkalinity and control of pH
 - Biological pump
- Marine Pollution
- Primary and secondary production:
 - Factors controlling phytoplankton and zooplankton abundance and diversity
 - Nekton and fisheries oceanography

