CHENNAI PORT AUTHORITY

TECHNICAL ASSISTANT (POLLUTION CONTROL)

EXAMINATION SYLLABUS

1. MARINE POLLUTION AND TOXICOLOGY

A. Fundamentals of Marine Pollution

Definition and Classification

- GESAMP framework for marine pollution
- Sources: Point and non-point sources
- Land-based vs. ocean-based pollution
- Transport and fate of pollutants in marine systems

Types of Marine Pollutants

- Sewage pollution: Domestic and municipal wastewater
- Industrial effluents: Chemical manufacturing, refineries
- Agricultural runoff: Fertilizers, pesticides
- Plastic pollution and microplastics
- Thermal pollution from power plants
- Radioactive pollution: Sources and impacts
- Aquatic noise pollution: Shipping, construction

B. Heavy Metal Pollution

- Sources: Industrial discharge, mining, shipping activities
- Common heavy metals: Mercury (Hg), Lead (Pb), Cadmium (Cd), Chromium (Cr), Arsenic (As)
- Distribution in marine environment
- Bioaccumulation in marine organisms
- Biomagnification through food chains
- Heavy metal binding to clay minerals and organic matter
- Toxicity to marine organisms and humans
- Minamata disease and other case studies

C. Oil Pollution

- Composition of crude oil and refined products
- Sources: Tanker accidents, operational discharge, offshore drilling
- Oil spill behavior: Spreading, evaporation, emulsification, weathering
- Impact on marine ecosystems: Plankton, fish larvae, benthos, seabirds
- Oil dispersants: Types, application, effectiveness
- Bioremediation: Oil-degrading bacteria, bioaugmentation
- Bioremediation of oil-contaminated coastal soils
- Oil spill response and cleanup methods
- MARPOL Annex I provisions

D. Pesticides and Persistent Organic Pollutants (POPs)

- Organochlorine pesticides: DDT, Aldrin, Endrin
- Organophosphate and carbamate pesticides
- PCBs (Polychlorinated Biphenyls) and dioxins
- Persistence and bioaccumulation

- Endocrine disrupting chemicals in marine organisms
- Stockholm Convention on POPs

E. Eutrophication and Nutrient Pollution

- Nutrient sources: Agricultural runoff, sewage, detergents
- Nitrogen and phosphorus enrichment
- Eutrophication process and impacts
- Algal blooms and oxygen depletion
- Hypoxia and dead zones
- Detergent pollution: Phosphates and surfactants
- Nutrient flux from sediments

F. Marine Toxicology

Toxic Algal Blooms

- Harmful Algal Blooms (HABs): Causes and conditions
- Red Tides: Dinoflagellates and toxin production
- Phycotoxins: Paralytic Shellfish Poisoning (PSP), Diarrhetic Shellfish Poisoning (DSP)
- Ciguatera Fish Poisoning
- Monitoring and management of HABs

Pathogenic Microorganisms

- Pathogenic bacteria in seafood: Vibrio, Salmonella, E. coli
- Seafood safety and human health risk
- Antibiotic residues and antimicrobial resistance
- Viral contamination: Hepatitis A, Norovirus

Toxicity Pathways

- Trophic transfer of contaminants: Sediment → Benthos → Fish → Humans
- Radiation effects on marine biota
- Ecotoxicological testing and bioassays

G. Ballast Water and Invasive Species

- Ballast water management: IMO BWM Convention
- Bio-invasion and ecosystem disturbance
- Invasive species: Case studies
- Ballast water treatment technologies

H. Marine Microbiology and Pollution

- Fecal and total coliforms as water quality indicators
- Microbial indicators of sewage contamination
- Biodegradation of hydrocarbons and xenobiotics
- Biomineralization processes
- Microbial biofilms and biofouling
- Metal corrosion by microbes

2. CHEMICAL OCEANOGRAPHY

- Trace metals and toxic elements in seawater
- Major and minor elements in seawater
- Carbon cycle and ocean acidification
- pH changes and impact on marine life
- Dissolved oxygen and anoxic conditions
- Methane hydrates in marine environments

- Geochemistry of marine sediments
- Diagenesis and pore-water chemistry
- Isotope chemistry for pollution tracing
- Radio-nuclides as environmental tracers
- Environmental forensics using isotopes

3. MARINE AND COASTAL SEDIMENT DYNAMICS

A. Physical Oceanography and Sediment Transport

- Ocean bottom topography: Continental shelf, slope, abyssal plain
- Submarine canyons and trenches
- Sediment transport by waves, tides and currents
- Turbidity currents and sediment deposition
- Coastal erosion and accretion
- Sea level change and coastal stability
- Storm surges and sediment resuspension

B. Sediment Characteristics and Processes

- Sediment structure and granulometry
- Grain size analysis: Clay, silt, sand, gravel
- Sediment classification and sorting
- Bioturbation and sediment stability
- Benthic-sediment interactions
- Meiofaunal and macrofaunal influence on sediment strength
- Bulk sediment processes

C. Contaminant Transport in Marine Sediments

- Sediment contamination sources: Industrial discharge, dredging
- Pollutant release due to erosion and resuspension
- Stability of contaminated sediments in ports and estuaries
- Sediment quality assessment
- Sediment toxicity testing

D. Dredging and Port Operations

- Dredging impacts on sediment geochemistry
- Dredging impacts on toxicity
- Dredge spoil disposal and management
- Soil bearing capacity for marine structures
- Geotechnical considerations in coastal development
- Offshore structure foundations
- Seabed mining and geotechnical stability

4. MARINE ECOLOGY AND ECOSYSTEM IMPACTS

A. Pollution Impact on Marine Ecosystems

Coral Reefs

- Coral bleaching: Causes and consequences
- Impact of sedimentation and turbidity
- Chemical pollution effects on coral health

Mangroves

- Oil spill impacts on mangrove ecosystems

- Heavy metal accumulation in mangrove sediments
- Mangrove restoration and conservation

Seagrass Ecosystems

- Eutrophication impacts on seagrass beds
- Physical disturbance from dredging and anchoring

B. Benthic Ecology

- Benthic community structure and function
- Benthic biotic indices: AMBI, Shannon-Wiener Index
- Benthic indicators for sediment quality
- Fouling and boring organisms
- Impact of pollution on benthic fauna

C. Marine Food Webs and Trophic Transfer

- Energy flow in marine ecosystems
- Trophic transfer of contaminants
- Food chain magnification of toxins

5. ENVIRONMENTAL MONITORING AND ASSESSMENT

A. Environmental Impact Assessment (EIA)

- EIA methodology and framework
- Coastal and marine EIA
- Port and harbour pollution assessment
- Scoping and baseline studies
- Impact prediction and mitigation measures
- Environmental Management Plans (EMP)
- Post-project monitoring and audit

B. Risk Assessment and Disaster Management

- Risk analysis methodology
- Risk assessment of contaminated coastal soils
- Disaster preparedness for oil spills
- Emergency response planning

C. Environmental Monitoring Techniques

- Water quality monitoring: Physical, chemical, biological parameters
- Sediment sampling and analysis
- Biological indicators and biomonitoring
- Remote sensing and GIS applications
- Real-time monitoring systems

6. ENVIRONMENTAL REGULATIONS AND POLICIES

A. International Conventions and Regulations

- MARPOL Convention: Annexes I-VI
- IMO Ballast Water Management Convention
- London Convention on Dumping of Wastes
- Stockholm Convention on POPs
- Basel Convention on Hazardous Wastes
- UNCLOS (United Nations Convention on the Law of the Sea)

B. Indian Environmental Legislation

- Environment Protection Act, 1986
- Water (Prevention and Control of Pollution) Act, 1974
- Air (Prevention and Control of Pollution) Act, 1981
- Coastal Regulation Zone (CRZ) Notification, 2019
- Island Coastal Regulation Zone (ICRZ) Notification
- EIA Notification, 2006 (and amendments)
- Hazardous Waste Management Rules, 2016
- E-Waste Management Rules, 2016
- Plastic Waste Management Rules, 2016

C. Coastal Zone Management

- Integrated Coastal Zone Management (ICZM)
- Marine Protected Areas (MPAs)
- Marine Spatial Planning
- Shoreline protection and erosion control
- Impact mitigation strategies

D. Port-Specific Environmental Requirements

- Port waste management regulations
- MARPOL reception facilities
- Cargo handling pollution prevention
- Ballast water discharge regulations
- Air emissions control from ships

7. POLLUTION CONTROL TECHNOLOGIES

A. Wastewater Treatment

- Primary, secondary, and tertiary treatment
- Biological treatment processes: Activated sludge, trickling filters
- Nutrient removal: Nitrogen and phosphorus
- Disinfection methods: Chlorination, UV, ozonation
- Marine outfall systems
- Effluent discharge standards

B. Industrial Effluent Treatment

- Chemical precipitation and coagulation
- Heavy metal removal technologies
- Membrane filtration: RO, UF, MF
- Adsorption: Activated carbon, ion exchange
- Advanced oxidation processes

C. Oil Spill Response Technologies

- Containment: Booms and barriers
- Recovery: Skimmers and vacuum systems
- Chemical dispersants: Application and limitations
- In-situ burning
- Sorbent materials

D. Air Pollution Control in Ports

- Ship emissions: SOx, NOx, Particulate Matter
- Emission Control Areas (ECAs)
- Shore power (Cold ironing)
- Dust suppression in cargo handling

8. ANALYTICAL TECHNIQUES AND LABORATORY METHODS

- Sample collection and preservation
- Water quality parameters: pH, DO, BOD, COD, turbidity, salinity
- Spectrophotometry and colorimetry
- Chromatography: GC, HPLC, GC-MS
- Atomic Absorption Spectroscopy (AAS)
- Inductively Coupled Plasma (ICP-MS, ICP-OES)
- Microbiological analysis: Culture methods, MPN technique
- Quality assurance and quality control (QA/QC)
- Standard methods: APHA, IS, EPA

9. REASONING ABILITY

- Logical and Analytical Reasoning
- Statement and Conclusions/Assumptions/Arguments
- Seating Arrangements: Linear, Circular
- Blood Relations and Coding-Decoding
- Direction Sense and Distance Calculations
- Data Sufficiency
- Puzzles and Pattern Recognition
- Syllogisms
- Series: Number, Letter, Alpha-numeric

10. QUANTITATIVE APTITUDE

Number Systems and Arithmetic

- Simplification, HCF, LCM
- Percentages, Ratio and Proportion
- Averages, Profit & Loss
- Simple and Compound Interest

Algebra and Mensuration

- Linear and Quadratic Equations
- Area, Volume, Perimeter calculations

Data Interpretation

- Tables, Bar Graphs, Line Graphs, Pie Charts
- Environmental data analysis

Statistics and Probability

- Mean, Median, Mode, Standard Deviation
- Probability and Risk Assessment

11. GENERAL AWARENESS

Current Affairs

- Environmental incidents and pollution events (last 6-12 months)
- Marine pollution case studies
- Climate change and ocean health
- Government environmental initiatives

Chennai Port Authority

- History, organizational structure, officials
- Port facilities and infrastructure
- Environmental management at Chennai Port
- Green port initiatives
- Pollution control measures in place

Major Ports of India

- 12 Major Ports: Location and features
- Environmental challenges at major ports

Maritime and Port Policies

- Sagarmala Project
- Maritime India Vision 2030/2047
- Blue Economy initiatives

Environmental Organizations

- Ministry of Environment, Forest and Climate Change (MoEFCC)
- Central Pollution Control Board (CPCB)
- State Pollution Control Boards
- National Green Tribunal (NGT)
- IMO, UNEP, GESAMP

Geography

- Indian coastline and coastal states
- Marine biodiversity hotspots
- Major rivers and estuaries

Science and Technology

- Environmental monitoring technologies
- Remote sensing and satellite monitoring
- Clean technology innovations

12. ENGLISH LANGUAGE

Reading Comprehension

- Passages on environmental topics (400-700 words)
- Scientific and technical passages

Grammar

- Error Detection and Sentence Correction
- Fill in the Blanks
- Tenses, Voice, Articles, Prepositions

Vocabulary

- Synonyms, Antonyms
- Technical environmental terminology
- Idioms and Phrases

Sentence Organization

- Para Jumbles
- Coherence and Logical Flow

Technical Writing

- Report writing format
- Environmental assessment reports
- Professional correspondence

EXAMINATION PATTERN

Section	Questions	Marks
Marine Pollution & Toxicology	60-70	60-70
Sediment Dynamics & Soil Mechanics	20-30	20-30
Marine Ecology & EIA	20-30	20-30
Reasoning Ability	30-40	30-40
Quantitative Aptitude	30-40	30-40
General Awareness	30-40	30-40
English Language	30-40	30-40
Total	**200-250**	**200-250**

- Duration: 2.5-3 hours
- Type: Multiple Choice Questions (MCQ)
- Marking: 1 mark per question
- Negative Marking: 0.25 marks deduction per wrong answer

PREPARATION STRATEGY

- Master marine pollution fundamentals and toxicology concepts
- Study MARPOL Convention and Indian environmental laws thoroughly
- Focus on practical applications: EIA, monitoring, pollution control
- Understand sediment dynamics and coastal processes
- Stay updated on environmental incidents and Chennai Port developments
- Practice analytical techniques and data interpretation
- Review case studies of marine pollution incidents
- Take timed mock tests regularly

KEY REFERENCE AREAS

- Marine Biology and Oceanography textbooks
- Environmental chemistry and toxicology references
- GESAMP reports on marine pollution
- IMO conventions and guidelines
- CPCB and MoEFCC publications
- Standard Methods for Water and Wastewater Analysis (APHA)
- CRZ Notification 2019 and amendments
- Scientific journals: Marine Pollution Bulletin, Environmental Science & Technology

Note: Candidates must refer to the official notification from Chennai Port Authority for exact pattern and details.

BEST WISHES FOR YOUR EXAMINATION!