

**DETAILED SYLLABUS FOR THE POST OF  
STATION OFFICER (TRAINEE) IN FIRE AND RESCUE SERVICES**

*(Category Nos: 93/2020)*

(TOTAL MARKS ±100)

**Part I : Physics ( 12 Marks)**

**Module 1. Properties of Matter (3 marks)**

Elasticity-Modulus of elasticity, the three elastic moduli, Surface tension-shapes of drops, concept of excess of pressure, capillary rise, variation of surface tension with temperature, Fluid Dynamics- Streamline and turbulent flow, equation of continuity, Bernoulli's theorem and its applications, Viscosity-coefficient of viscosity, Stoke's formula, variation of viscosity with temperature.

**Module 2. Thermal Physics (2 marks)**

Thermal conductivity, coefficient of thermal conductivity, Weidman-Franz law, Radiation of heat, Stefan's law, Zeroth Law and First law of Thermodynamics, differential form of first law, different thermodynamic processes, specific heat capacities, Carnot's heat engine, entropy.

**Module 3. Optics (3 marks)**

Interference of light- The principle of superposition, coherent sources, Double slit interference, interference in thin films, Newton's Rings, Diffraction-Fresnel diffraction, Half-period zones, Fraunhofer diffraction-diffraction at a single slit, diffraction grating, LASER-Basic principle, He-Ne laser, optical fibre-step, index fibre, graded index fibre , numerical aperture.

**Module 4. Modern Physics (4 marks)**

Black body radiation curve, photoelectric effect, Compton effect, Bohr model- hydrogen atom, wave nature of particles, uncertainty principle, wave function, Vector atom model-quantum numbers associated with vector atom model, L-S and J-J couplings, Zeeman effect, Anomalous Zeeman effect, Paschen-Back effect, Stark effect, Solids-Amorphous and Crystalline Materials,

Unit Cell, Types of Lattices, Miller Indices, Nucleus-Constituents of nucleus and their intrinsic properties, binding energy, Nuclear fission and nuclear fusion processes.

## Part II : Chemistry ( 12 Marks)

### **Module 1. Inorganic chemistry (4 marks)**

Atomic structure- Bohr's atom model, Hydrogen spectrum, Heisenberg's uncertainty principle, de Broglie hypothesis, Quantum numbers. periodicity- atomic radius, ionisation energy, electron affinity, electronegativity, classification of elements into s, p, d, f blocks.

Preparation, properties and uses of hydrogen and hydrides. Hardness of water- Types, causes and consequences.

Chemical bonding- Ionic, covalent, coordinate and metallic bonds, hydrogen bonding.

Theories of acids and bases, effects of solvents on ionic strength, levelling effect. Solubility product, common ion effect and their applications.

Theory of titration- acid-base, redox, precipitation and complexometric titrations. Indicators, Gravimetric analysis.

Metallurgy- Various steps involved in metallurgical processes.

Sources, effects and consequences of air, water, soil, noise, thermal and radioactive pollution.

### **Module 2. Organic chemistry ( 4 marks)**

Nomenclature, basic concepts of reaction mechanism- addition, substitution and elimination reactions. Preparation and properties of alkanes, alkenes, alkynes, aromatic hydrocarbons, cycloalkanes, alcohols, phenols, ethers, epoxides, aldehydes, ketones, carboxylic acids, amines and nitro compounds.

Petroleum- Refining of crude oil, knocking, octane number, cetane number, cracking.

Polymers-Classification, Thermoplastics and thermosetting plastics, Rubber.

### **Module3. Physical chemistry ( 4 marks)**

Gaseous state- Gas laws, Kinetic gas equation, Ideal and real gases.

Thermodynamics- first, second and third laws of thermodynamics. Enthalpies of formation, combustion, neutralisation, solution and hydration, heat capacities.

Chemical kinetics±integrated rate laws and half-lives of zero, first, second and third order reactions. Arrhenius equation, chain reactions. Theories of catalysis, industrial application of catalysis. Photochemistry- Laws of photochemistry, Quantum yield.

Physical and chemical adsorption, applications of adsorption.

Chemical and ionic equilibria- Factors affecting equilibrium, Le-Chatelier's principle and its applications. Hydrolysis of salts and its effects. pH and pOH, Buffer action.

Electrochemistry- Conductance, Kohlrausch's law and its applications, transport number, Types of electrodes, primary and secondary cells, Fuel cells.

**Basic principle and applications of UV-Vis, IR, NMR and ESR spectroscopy, mass spectrometry.**

### **Part III : Zoology (12 Marks)**

#### **Module 1 (3 marks)**

Balanced diet, PEM, vitamins, minerals and their deficiencies.

Blood - composition and functions, blood groups, blood clotting, anticoagulants. Heart- conducting system and pace maker, heartbeat, pulse and blood pressure, cardio vascular diseases -arteriosclerosis, myocardial infarction, electrocardiogram, angiogram, angioplasty.

Structure of haemoglobin, transport of oxygen, oxyhaemoglobin curve, Bohr effect, transport of carbondioxide, apnoea, dyspnoea, hypoxia, asphyxia, carbon monoxide poisoning, bronchitis, asthma. Physiological effects of smoking.

#### **Module 2 (3 marks)**

Types of muscles, red and white muscles. Ultra structure of striated muscle fibre, muscle proteins, muscle twitch, all or none law, summation, tetanus, tonus, fatigue, oxygen debt, rigor mortis. Physiological and biochemical events in muscle contraction.

Structure of brain. Neurons - structure, types of neurons, nerve impulse propagation. Synapses and synaptic transmission, neurotransmitters. Reflex action, electroencephalogram.

Endocrine glands in man, hormones and disorders.

#### **Module 3 (3 marks)**

Cell theory, prokaryotic cells and eukaryotic cells, structure and functions of Mitochondria, Golgi bodies, Lysosomes, Ribosomes and Nucleus.

Chromatin - euchromatin and heterochromatin, nucleosomes, Watson - Crick model of DNA. Chromosome structure, giant chromosomes- polytene and lamp brush chromosomes.

Human karyotype, pedigree analysis, DNA fingerprinting, chromosomal anomalies in man- autosomal (Down's syndrome, Edward's syndrome), allosomal (Klinefelter's syndrome, Turner's syndrome). Inborn errors of metabolism- Phenylketonuria, Alkaptonuria, Albinism.

#### **Module 4 (3 marks)**

Types of immunity- innate, acquired, active, passive, humoral and cell mediated. Cells of immune system - T cells, B cells and plasma cells. Primary and secondary lymphoid organs. Antigens, haptens, epitopes, antibodies - general structure, different classes of antibodies. Hypersensitivity, immunodeficiency diseases, immunization-passive and active, vaccination.

### **Part IV : BOTANY (12 Marks)**

#### **Module-1 The plant Kingdom (2 marks)**

Plant cell- structure, cell wall and organelles, totipotency, diversity of cells and tissues (types)

Plant groups- algae, bryophytes, pteridophytes, gymnosperms and angiosperms- diversity of thallus structure and modes of reproduction

Mesophytes, hydrophytes, epiphytes and halophytes- adaptations- morphological, anatomical and physiological

#### **Module-2 Plant morphology and anatomy (3 marks)**

Modifications- Root, stem and leaf modifications with examples

Inflorescence- Major Types (racemose and cymose) with examples

Fruits- kinds of fruits (simple fleshy, simple dry, multiple and aggregate fruits) with suitable examples

Primary structures of dicot and monocot stem and roots; structure of dicot and monocot leaves

Secondary growth- normal secondary growth in dicot stem and root; anomalous secondary growth (examples only)

### **Module ±3 Plant Physiology (3 marks)**

Absorption of water- Transpiration pull theory only

Translocation- Munch's hypothesis and bidirectional transport only

Photosynthesis- cyclic and noncyclic electron flow for trapping solar energy by green plants-  $\text{CO}_2$  fixation by Calvin cycle, Warburg effect

Growth and Phytohormones- growth curve and major physiological effects of hormones like auxins, gibberellins, cytokinins, abscisic acid and ethylene

### **Module-4 Economic Botany (2 marks)**

Major pulses, cereals and millets

Sugar yielding and fibre yielding plants- sugar cane, *Beta vulgaris*, cotton and hemp

Oil yielding plants- mustard, sunflower, oil palm and coconut

Morphology of useful parts in jack fruit, pine apple and coconut

### **Module -5 Plant Biodiversity and conservation (2 marks)**

Biodiversity hotspots, environment protection laws, deforestation and impacts, forest fires and biodiversity depletion, anthropogenic factors

Conservation strategies- exsitu and insitu- wild life sanctuaries, National parks, Botanic Gardens; Major Wild life sanctuaries, National Parks and Botanic Gardens of India and Kerala.

### **Environmental Science**

1. Environmental Pollutions:- Air pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution.

2. Solid Waste Management:- Waste Minimization, Recycling and Re-use, Consuming environment friendly products. E-waste Management.
3. Environmental Issues:- Climate Changes, Global Warming, Acid Rain, Ozone layer depletion

### Part V : Mathematics ( 12 Marks)

**Module 1 :- Linear Algebra:** Matrix - multiplication - determinants - transpose - symmetric matrix - Hermitian matrix - rank - characteristic roots-Cayley's theorem  
(2 Marks)

**Module 2 :- Complex numbers:** Basic definitions-basic operations with complex numbers-Real and imaginary part - polar form of a complex number-products- quotients - powers - modulus - roots of complex number-  $n^{\text{th}}$  root of unity  
(2 Mark)

**Module 3: - Analytic Geometry:** distance formula - straight line - angle between lines - general second degree equation to represent circle - ellipse - parabola- hyperbola- polar coordinate - cylindrical coordinate - spherical coordinates.  
(1 Mark)

**Module 4 :- Calculus:** limit of a function - indeterminate form - L'Hospital's rule - continuous function - derivatives - increasing and decreasing function - critical points - stationary points - maxima and minima - concave up and concave down - point of inflexions  
( 2 Mark)

**Module 5:- First Order Differential Equation:** Order - degree - separable equation - linear equation - exact equation - homogeneous equation with constant coefficients.  
( 1 Mark)

**Module 6 : -Vector calculus:** Position vector of a point - magnitude - dot product - projection of vector - angle between vectors - cross product - scalar triple products - gradient - divergent - curl- solenoidal vector - irrotational vector.  
(2 Marks)

**Module 7 : - Abstract Algebra:** Group  $\pm$  properties and examples  $\pm$  subgroup- cyclic groups  $\pm$  Permutations  $\pm$  rings  $\pm$  integral domains  $\pm$  ideals  $\pm$  fields.

( 2 Marks )

**Part VI : Job Related Topics (20 Marks)**

- I. Basics of Fire (2 Marks)
- a. Fire triangle
  - b. Basics of fire extinguishment
  - c. Spread of fire
  - d. Fire Extinguishers
  - e. Properties of Water
- II. Heat and Combustion (4 Marks)
- a. Flash Point
  - b. Fire Point
  - c. Range of flammability
  - d. Critical Temperature
  - e. Critical Pressure
  - f. Types of Combustion
  - g. Smoke and Ventilation
  - h. Modes of Heat Transfer
- III. Electricity (2 Marks)
- a. Ohm's Law
  - b. Conductor and Insulator – Properties
  - c. Joule's Law
  - d. Static Electricity
  - e. Earthing, Bonding and Grounding
  - f. Lightning protection
  - g. Electro static spark & Electric Arc
  - h. Transformer
- IV. Basic Life Support (First Aid) (3 Marks)
- a. Concept of First Aid

- b. CPR
- c. Bleeding
- d. Fractures
- e. Burns
- f. Chocking
- g. Drowning
- h. Snake Bite

V. Fluid Mechanics (1 Mark)

- a. Bernoulli's Theorem and Venturi effect
- b. Pascal's Law
- c. Velocity and flow
- d. Flow of water through pipes
- e. Jet Reaction

VI. Pumps (2 Marks)

- a. Different types of Pumps
- b. Efficiency of Pump
- c. Priming System
- d. Cooling System for pumps

VII. Hazardous Chemicals (2 Marks)

- a. Hazardous Substances
- b. Acids Alkalis
- c. Explosives
- d. Water Reactive Chemicals
- e. Radio Active Materials – chances of emergency, handling and History of emergencies
- f. Storage, Handling and Transportation Emergencies – History



VIII. Liquid and Gaseous Fuels (2 Marks)

- a. Petroleum products
- b. LPG, LNG and CNG
- c. Cryogenic Gases
- d. UVCE
- e. BLEVE

IX. Building Construction (2 Mark)

- a. Structural Fire Protection
- b. Elements of structure
- c. Elements of Construction
- d. Behavior of different construction materials in fire
- e. **Fire Resistance**

**Part VII : Renaissance in Kerala & General Knowledge,**

**Current Affairs**

**(10 Marks)**

**I RENAISSANCE IN KERALA AND FREEDOM MOVEMENT**

**Towards A New Society**

Introduction to English education - various missionary organisations and their functioning- founding of educational institutions, factories, printing press – CMS Press etc.

**Efforts To Reform The Society**

**(A) Socio-Religious reform Movements**

SNDP Yogam, Nair Service Society, Yogakshema Sabha, Sadhu Jana Paripalana Sangham, Vaala Samudaya Parishkarani Sabha, Samathwa Samajam, Islam Dharma Paripalana Sangham, Prathyaksha Raksha Daiva Sabha, Sahodara Prasthanam etc.

**(B) Struggles and Social Revolts**

Upper cloth revolts. Channar agitation, Vaikom Sathyagraha, Guruvayoor Sathyagraha, Paliyam Sathyagraha. Kuttamkulam Sathyagraha, Temple Entry Proclamation, Temple Entry Act .Malyalee Memorial, Ezhava Memorial etc.

Malabar riots, Civil Disobedience Movement, Abstention movement etc.

## **Role Of Press In Renaissance**

*Malayalee, Swadeshabhimani, Vivekodayam, Mithavadi, Swaraj, Malayala Manorama, Bhashaposhini, Mathrubhoomi, Kerala Kaumudi, Samadarsi, Kesari, Al-Ameen, Prabhatham, Yukthivadi, Deepika – Nasrani Deepika, etc*

## **Awakening Through Literature**

Novel, Drama, Poetry, *Purogamana Sahithya Prasthanam, Nataka Prashtanam*, Library movement etc

## **Women And Social Change**

Parvathi Nenmenimangalam, Arya Pallam, A V Kuttimalu Amma, Lalitha Prabhu. Akkamma Cheriyan, Anna Chandi, Lalithambika Antharjanam and others

## **Leaders Of Renaissance**

Thycaud Ayya Vaikundar, Sree Narayana Guru, Ayyan Kali. Chattampi Swamikal, Brahmananda Sivayogi, Vagbhadananda, Poikayil Yohannan (Kumara Guru) Dr Palpu, Palakkunnath Abraham Malpan, Mampuram Thangal, Sahodaran Ayyappan, Pandit K P Karuppan, Pampadi John Joseph, Mannathu Padmanabhan, V T Bhattathirippad, Vakkom Abdul Khadar Maulavi, Makthi Thangal, Blessed Elias Kuriakose Chaavra, Barrister G P Pillai, TK Madhavan, Moorkoth Kumaran, C. Krishnan, K P Kesava Menon, Dr. Ayyathan Gopalan, C V Kunjuraman, Kuroor Neelakantan Namboothiripad, Velukkutty Arayan, K P Vellon, P K Chathan Master, K Kelappan, P. Krishna Pillai, A K Gopalan, T R Krishnaswami Iyer, C Kesavan. Swami Ananda Theerthan, M C Joseph, Kuttippuzha Krishnapillai, Nidheerikkal Manikathanar and others

## **Literary Figures**

Kodungallur Kunhikkuttan Thampuran, KeralaVarma Valiyakoyi Thampuran, Kandathil Varghese Mappila. Kumaran Asan, Vallathol Narayana Menon, Ulloor S Parameswara Iyer, G Sankara Kurup, Changampuzha Krishna Pillai, Chandu Menon, Vaikom Muhammad Basheer. Kesav Dev, Thakazhi Sivasankara Pillai, Ponkunnam Varky, S K Pottakkad and others

## **General Knowledge and Current Affairs**

## **Part VIII : COMPUTER SCIENCE (10 Marks)**

### **Basics of Computer**

#### **1. Hardware**

- Input Devices (Names and uses)
- Output Devices (Names and uses/features)
- Memory devices - Primary and Secondary (Examples, Features)
- Evolution of the Computing Machines
- Generation of Computers

## 2. Software

- Different types of Programming Languages
- Types of Errors
- Classification – System software and Application software
- Operating System – Functions and examples
- Popular Application software packages – Word processors, Spreadsheets, Database packages, Presentation, Image editors (Uses, features and fundamental concepts of each)
- Basics of programming – Types of instructions (Input, Output, Store, Control, Transfer) (*Languages need not be considered*)

## 3. Computer Networks

- Types of networks – LAN, WAN, MAN (Features and application area)
- Network Devices – Media, Switch, Hub, Router, Bridge, Gateway (Uses of each)

## 4. Internet

- Services – WWW, E-mail, Search engines (Examples and purposes)
- Social Media (Examples and features)
- Web Designing – Browser, HTML (Basics only)

## 5. Cyber Crimes and Cyber Laws

- Types of Cyber Crimes (Awareness level)
- *Information Technology Act and Other Laws (Awareness level)*

**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 question paper. There is no undertaking that all the topics above may be covered in the question paper**