

SYLLABUS FOR TIER-I & TIER-II COMBINED EXAMINATION FOR THE POST OF JUNIOR ENGINEER (ELECTRICAL)/SECTION OFFICER (ELECTRICAL)

GENERAL TOPICS- TIER-I – SECTION-A

- (I) **GENERAL AWARENESS:** QUESTIONS WILL BE DESIGNED TO TEST THE ABILITY OF THE CANDIDATE'S GENERAL AWARENESS OF THE ENVIRONMENT AROUND HIM/HER AND ITS APPLICATION TO SOCIETY. THE QUESTIONS WILL BE DESIGNED TO TEST KNOWLEDGE OF CURRENT EVENTS AND OF SUCH MATTER OF EVERYDAY OBSERVATION AS MAY BE EXPECTED OF AN EDUCATED PERSON. THE TEST WILL ALSO INCLUDE QUESTIONS RELATING TO HISTORY, POLITY, CONSTITUTION, SPORTS, ART & CULTURE, GEOGRAPHY, ECONOMICS, EVERYDAY SCIENCE, SCIENTIFIC RESEARCH, NATIONAL/INTERNATIONAL ORGANIZATIONS /INSTITUTIONS ETC.
- (II) **GENERAL INTELLIGENCE & REASONING ABILITY:** THE SYLLABUS OF GENERAL INTELLIGENCE & REASONING ABILITY INCLUDES QUESTIONS OF BOTH VERBAL AND NON-VERBAL TYPES. TEST MAY INCLUDE QUESTIONS ON ANALOGIES, SIMILARITIES, DIFFERENCES, SPACE VISUALIZATION, PROBLEM SOLVING, ANALYSIS, JUDGMENT, DECISION MAKING, VISUAL MEMORY, DISCRIMINATION, OBSERVATION, RELATIONSHIP, CONCEPTS, ARITHMETICAL REASONING, VERBAL AND FIGURE CLASSIFICATION, ARITHMETICAL NUMBER SERIES ETC.
- (III) **ARITHMETICAL & NUMERICAL ABILITY:**THE TEST OF ARITHMETICAL AND NUMERICAL ABILITIES WILL COVER NUMBER SYSTEMS INCLUDING QUESTIONS ON SIMPLIFICATION, DECIMALS, DATA INTERPRETATION, FRACTIONS, L.C.M., H.C.F., RATIO & PROPORTION, PERCENTAGE, AVERAGE, PROFIT & LOSS, DISCOUNT, SIMPLE & COMPOUND INTEREST, MENSURATION, TIME & WORK, TIME & DISTANCE, TABLES & GRAPHS ETC.
- (IV) **HINDI LANGUAGE & COMPREHENSION:** TESTING OF CANDIDATE'S UNDERSTANDING AND COMPREHENSION OF THE HINDI LANGUAGE. IN ADDITION TO THIS, QUESTIONS ON ITS VOCABULARY, GRAMMAR, SENTENCE STRUCTURE, SYNONYMS, ANTONYMS AND ITS CORRECT USAGE ETC. WOULD ALSO BE COVERED.
- (V) **ENGLISH LANGUAGE & COMPREHENSION:** TESTING OF CANDIDATE'S UNDERSTANDING AND COMPREHENSION OF THE ENGLISH LANGUAGE. IN ADDITION TO THIS, QUESTIONS ON ITS VOCABULARY, GRAMMAR, SENTENCE STRUCTURE, SYNONYMS, ANTONYMS AND ITS CORRECT USAGE ETC. WOULD ALSO BE COVERED.

SUBJECT SPECIFIC TOPICS FOR THE POST OF JUNIOR ENGINEER
(ELECTRICAL)/SECTION OFFICER (ELECTRICAL)
TIER-I-SECTION B & TIER-II-PART-I&II

APPLIED CHEMISTRY

- ❖ PROBLEM BASED ON VOLUMETRIC GRAVIMETRIC ANALYSIS
- ❖ ANALYSIS AND TREATMENT OF WATER
- ❖ FUEL AND COMBUSTION
- ❖ CORROSION AND LUBRICANT
- ❖ ATOMIC STRUCTURE AND BONDING

APPLIED PHYSICS

- ❖ ELECTROSTATICS
- ❖ CAPACITORS
- ❖ DC CIRCUITS
- ❖ ELECTROMAGNETISM
- ❖ SEMI-CONDUCTOR PHYSICS
- ❖ MODERN PHYSICS

APPLIED MATHEMATICS

- ❖ ALGEBRA
- ❖ DETERMINANTS
- ❖ MATRICES
- ❖ CO-ORDINATE GEOMETRY OF TWO DIMENSIONS
- ❖ VECTORS
- ❖ DIFFERENTIAL CALCULUS
- ❖ INTEGRAL CALCULUS
- ❖ DIFFERENTIAL EQUATIONS
- ❖ COMPLEX NUMBERS

APPLIED MECHANICS

- ❖ **INTRODUCTION:** CONCEPT OF ENGINEERING MECHANICS, ITS IMPORTANCE AND NECESSITY. GIVING SUITABLE EXAMPLES ON BODIES AT REST AND MOTION, CONCEPT OF RIGID BODIES.
- ❖ LAWS OF FORCES
- ❖ MOMENTS
- ❖ CENTRE OF GRAVITY
- ❖ LAWS OF MOTION
- ❖ FRICTION
- ❖ SIMPLE LIFTING MACHINES

FUNDAMENTALS OF ELECTRICAL ENGINEERING

- ❖ D C CIRCUITS
- ❖ ELECTROMAGNETISM
- ❖ MAGNETIC CIRCUITS
- ❖ ELECTROMAGNETIC INDUCTION
- ❖ D C TRANSIENTS

ENGINEERING DRAWING

- ❖ INTRODUCTION
- ❖ LETTERING TECHNIQUES AND PRACTICE
- ❖ DIMENSIONING
- ❖ SCALES
- ❖ CONSTRUCTION OF CURVES

ELECTRICAL ENGINEERING MATERIALS

- ❖ CONDUCTING MATERIALS
- ❖ SEMICONDUCTING MATERIALS
- ❖ INSULATING MATERIALS
- ❖ MAGNETIC MATERIALS

BASICS OF ELECTRICAL ENGINEERING

- ❖ FUNDAMENTALS OF ELECTRIC CIRCUITS, KIRCHHOFF'S LAWS, MESH ANALYSIS, NODE ANALYSIS, CLASSIFICATION OF NETWORK ELEMENTS, THEVENIN'S THEOREM, NORTAN'S THEOREM MAXIMUM POWER TRANSFER THEOREM, SUPERPOSITION THEOREM.

- ❖ SINGLE PHASE AC CIRCUITS, AVERAGE AND EFFECTIVE VALUES OF SINUSOIDS, SOLUTION OF R,L,C SERIES CIRCUITS, THE J OPERATOR, COMPLEX REPRESENTATION OF IMPEDANCES, PHASOR DIAGRAM, CONCEPT OF POWER FACTOR, POWER FACTOR IMPROVEMENT, POWER IN COMPLEX NOTATION, SOLUTION OF PARALLEL AND SERIES-PARALLEL CIRCUITS, RESONANCE. INTRODUCTION TO BALANCE THREE PHASE AC CIRCUITS.

- ❖ AMPERE'S CIRCUITAL LAW, B-H CURVE, SOLUTION OF MAGNETIC CIRCUITS, HYSTERESIS AND EDDY CURRENT LOSSES. RELAYS AS AN APPLICATION OF MAGNETIC FORCE. TRANSFORMERS- CONSTRUCTION, E.M.F. EQUATION, RATINGS, PHASOR DIAGRAM FOR NO LOAD AND FULL LOAD, EQUIVALENT CIRCUIT, REGULATION AND EFFICIENCY CALCULATIONS, OPEN CIRCUIT AND SHORT CIRCUIT TESTS, INTRODUCTION TO AUTO-TRANSFORMER.

- ❖ INTRODUCTION TO ELECTROMECHANICAL ENERGY CONVERSION, DC MOTORS- CONSTRUCTION, E.M.F. AND TORQUE EQUATIONS, CHARACTERISTICS OF DC GENERATORS AND MOTORS, SPEED CONTROL OF DC MOTORS. DC MOTOR STARTER- WORKING PRINCIPLE, RATINGS. INTRODUCTION TO THREE PHASE INDUCTION MOTOR, INTRODUCTION TO ALTERNATOR AND SYNCHRONOUS MOTOR AND THEIR APPLICATIONS.

- ❖ PMMC INSTRUMENTS, SHUNTS AND MULTIPLIERS, MULTI-METERS, MOVING IRON AMMETERS AND VOLTMETERS, DYNAMOMETER WATTMETER, AC WATT-HOUR METERS, EXTENSION OF INSTRUMENT RANGES.

BASIC ELECTRONICS

- ❖ APPLICATIONS OF ELECTRONICS IN DIFFERENT FIELDS. ACTIVE AND PASSIVE COMPONENTS, VOLTAGE AND CURRENT SOURCE WITH NUMERICAL EXAMPLES.
- ❖ PN JUNCTION, BEHAVIOUR OF PN JUNCTION UNDER FORWARD AND REVERSE BIAS. SEMICONDUCTOR DIODE CHARACTERISTICS. STATIC AND DYNAMIC RESISTANCES. THEIR CALCULATION FROM DIODE CHARACTERISTICS. DIODE AS HALF WAVE, FULL WAVE, AND BRIDGE RECTIFIER, APPLICATIONS. RIPPLE FACTOR, AND ITS VALUE FOR HALF WAVE RECTIFIED OUTPUT. CALCULATION OF DC VOLTAGE, RMS VOLTAGE, AND EFFICIENCY.
- ❖ CAPACITOR INPUT FILTER, CHOKE INPUT FILTER, LC FILTER, RC FILTER, PIE FILTER. BRIEF IDEA AND APPLICATIONS OF POWER DIODE, ZENER DIODE, TUNNEL DIODE, VARACTOR DIODE, APPLICATION OF ZENER DIODE AS VOLTAGE REGULATOR, NUMERICAL EXAMPLES.
- ❖ CONCEPT OF BIPOLAR JUNCTION TRANSISTOR (BJT) AS TWO JUNCTIONS THREE TERMINAL DEVICE HAVING TWO KINDS OF CURRENT CARRIERS. PNP AND NPN TRANSISTORS THEIR SYMBOL AND MECHANISM OF CURRENT FLOW, EXPLANATION OF FUNDAMENTAL CURRENT RELATIONS. CONCEPT OF LEAKAGE CURRENT, CE, CB, CC CONFIGURATION. INPUT AND OUTPUT CHARACTERISTICS. DETERMINATION OF THE TRANSISTOR PARAMETERS. COMPARISON OF CE, CB, AND CC CONFIGURATION.
- ❖ TRANSISTOR AS AN AMPLIFIER IN CE CONFIGURATION. DC LOAD LINE, ITS EQUATION AND DRAWING IT ON THE OUTPUT CHARACTERISTICS. TRANSISTOR BIASING CIRCUIT, EFFECT OF TEMPERATURE ON OPERATING POINT. NEED FOR STABILIZATION OF OPERATING POINT, EFFECT OF FIXING OPERATING POINT IN CUT-OFF AND SATURATION REGION ON THE PERFORMANCE OF AMPLIFIER.
- ❖ DIODE CIRCUITS, BJT CIRCUITS, MOSFET CIRCUITS

DIGITAL ELECTRONICS AND MICROPROCESSOR

- ❖ NUMBER SYSTEMS
- ❖ LOGIC GATES
- ❖ COMBINATIONAL CIRCUITS
- ❖ INTRODUCTION TO MICROPROCESSORS

ELECTRICAL DESIGN DRAWING

- ❖ ELECTRICAL SYMBOLS AND SIMPLE LIGHT AND ALARM CIRCUITS
- ❖ ELECTRICAL INSTALLATION OF SMALL RESIDENTIAL BUILDINGS
- ❖ ELECTRICAL INSTALLATION OF COMMERCIAL BUILDINGS

GENERATION OF ELECTRICAL ENERGY

- ❖ IMPORTANCE OF ELECTRICAL POWER IN DAY TODAY LIFE, VARIOUS SOURCES OF ENERGY. COMPARISON OF SOURCES OF POWER. SELECTION OF SITE FOR THERMAL POWER STATIONS, BLOCK DIAGRAM OF THERMAL

POWER STATION, OPERATION OF BOILER, ECONOMIZER, AIR PREHEATER, SUPER HEATER, STEAM PRIME MOVERS, CONDENSERS, DRAFT FANS ETC.

- ❖ CLASSIFICATION OF HYDROELECTRIC PLANTS. GENERAL ARRANGEMENT AND OPERATION OF HYDROELECTRIC PLANT, LAYOUT DIAGRAMS, HYDRAULIC TURBINES, SELECTION OF TURBINES, DAMS, SPILLWAYS, PENSTOCK, SURGE TANK, FORE BAY, RESERVOIRS, CATCHMENT AREA.
- ❖ **NUCLEAR POWER PLANT, DIESEL POWER PLANT AND GAS POWER PLANT**
- ❖ PREDICTION OF LOAD, LOAD CURVES, PLANT CAPACITY FACTOR, UTILIZATION FACTOR, COMPONENTS FOR TOTAL COST OF GENERATION PER UNIT, METHODS FOR DEPRECIATION CALCULATION, EFFECT OF LOAD CURVES ON COST PER KWH.

NETWORK ANALYSIS

- ❖ NETWORK TERMINOLOGY
- ❖ AC FUNDAMENTALS
- ❖ NETWORK THEOREMS
- ❖ SUPERPOSITION THEOREM, THEVENIN'S THEOREM, NORTON'S THEOREM, MAXIMUM POWER TRANSFER THEOREM AND THEIR APPLICATIONS, CONVERSION OF CIRCUITS FROM STAR TO DELTA AND VICE VERSA, AND NUMERICAL PROBLEMS.

ELECTRICAL MACHINES

- ❖ DC GENERATOR
- ❖ DC MOTORS
- ❖ INTRODUCTION TO SINGLE PHASE TRANSFORMER
- ❖ EQUIVALENT CIRCUIT AND PHASOR DIAGRAM FOR 1-PHASE TRANSFORMER
- ❖ INTRODUCTION TO THREE- PHASE AC MACHINE
- ❖ THREE PHASE TRANSFORMERS
- ❖ THREE PHASE SYNCHRONOUS MOTORS
- ❖ SINGLE PHASE MOTORS (FKW MOTORS) SINGLE PHASE MOTORS

POWER ELECTRONICS

- ❖ INTRODUCTION TO SCR
- ❖ CONTROLLED RECTIFIERS
- ❖ INVERTERS
- ❖ CHOPPERS
- ❖ CYCLO-CONVERTERS

ELECTRICAL INSTRUMENTATION

- ❖ INTRODUCTION :IMPORTANT TERMS IN MEASUREMENT SYSTEM, ERRORS, TYPES OF ERROR, CLASSIFICATION OF ERRORS ADVANTAGES OF ELECTRICAL INSTRUMENTATION, DATA TRANSMISSION & THEIR CLASSIFICATION, PRINCIPLE OF TELEMETRY SYSTEM, CLASSIFICATION OF TELEMETRY SYSTEM.

- ❖ SENSORS AND TRANSDUCERS
- ❖ STRAIN GAUGE AND THERMOELECTRIC TRANSDUCERS
- ❖ MEASUREMENT OF NON-ELECTRIC PARAMETERS

POWER SYSTEM PROTECTION

- ❖ INTRODUCTION AND COMPONENTS OF A PROTECTION SYSTEM
- ❖ FAULT AND OVER-CURRENT PROTECTION EQUIPMENT PROTECTION SCHEMES
- ❖ SYSTEM PROTECTION

POWER QUALITY AND FACTS

- ❖ TRANSMISSION LINES AND SERIES/SHUNT REACTIVE POWER COMPENSATION
- ❖ VOLTAGE SOURCE CONVERTER BASED (FACTS) CONTROLLERS
- ❖ APPLICATION OF FACTS

ELECTRICAL ENERGY CONSERVATION AND AUDITING

- ❖ ENERGY SCENARIO
- ❖ BASICS OF ENERGY AND ITS VARIOUS FORMS
- ❖ ENERGY MANAGEMENT & AUDIT
- ❖ ENERGY EFFICIENCY IN INDUSTRIAL SYSTEMS

POWER SYSTEM DYNAMICS AND CONTROL

- ❖ INTRODUCTION TO POWER SYSTEM OPERATIONS
- ❖ MODELING OF SYNCHRONOUS MACHINES AND ASSOCIATED CONTROLLERS
- ❖ STABILITY ANALYSIS
- ❖ ENHANCING SYSTEM STABILITY

TRANSMISSION AND DISTRIBUTION

- ❖ TRANSMISSION LINES: INTRODUCTION TO OVERHEAD TRANSMISSION LINE, CLASSIFICATION AND COMPARISON OF AC/DC TRANSMISSION SYSTEMS. MAIN COMPONENTS OF TRANSMISSION LINE I.E. TOWER, CONDUCTORS, AND OVERHEAD LINE INSULATORS. POTENTIAL DISTRIBUTION OVER SUSPENSION INSULATOR STRING, STRING EFFICIENCY AND METHODS OF IMPROVING STRING EFFICIENCY, SAG CALCULATION OF EQUAL SUPPORTS, EFFECT OF TRANSMISSION VOLTAGE ON EFFICIENCY AND REGULATION OF LINE. KELVIN LAW.
- ❖ PERFORMANCE OF TRANSMISSION LINES
- ❖ DISTRIBUTION OF ELECTRICAL ENERGY