

General English (Full Marks : 100)

- (a) Essay Writing (*Not more than 300 words*) 20 Marks
- (b) Idioms & Phrases (*Objective Type/MCQ*) 16 Marks
- (c) Comprehension of given passages 12 Marks
(*Objective Type/MCQ*)
- (d) Grammar: (*Objective Type/MCQ*)
Parts of Speech : Nouns, Adjective, Verb, Adverb, Preposition, etc. 20 Marks
- (e) Composition (*Objective Type/MCQ*) 16 Marks
(i) *Analysis of complex and compound sentences.*
(ii) *Transformation of sentences.*
(iii) *Synthesis of sentences.*
- (f) Correct usage and vocabularies (*Objective Type/MCQ*) 16 Marks

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ELECTRICAL ENGG. (Objective Type/MCQ) Paper-I (Full Marks : 150)

1. Power System – I (50 Marks)

I. Generation of Electrical Power

(1) Thermal Power Plants:-

- i. Detail layout of thermal power station
- ii. Site selection and furnish the list of thermal power plants
- iii. Generating capacity of the thermal power plants
- iv. Working principle of the following (a) Coal handling Plant (b) Alternators (c) Condensing plant (d) Water treatment plant (e) Ash handling system (f) Station auxiliaries (g) Pulverising system (h) Steam system (i) Turbine system

(2) Hydro Electric Generation Unit :-

- i. Developing a Hydro Electric reasons for developing a Hydro Electric Project
- ii. Type of hydro electric project
- iii. List of hydro electric projects and their capacities
- iv. Detail layout of the hydro electric project
- v. The Alternator, the Computing system and turbine of the hydro-electric project
- vi. The station auxiliaries of the hydro electric projects.

II. Power Planning Economic and Tariff.

- i. To define –
(a) Demand (b) Load Curve (c) Maximum Demand or Peak Load (d) Connected Load
(e) Demand factors (f) Load factor (g) Diversity factor (h) Plant factor

III. Sub-Station

- i. To define sub-station
- ii. To prepare the list of equipment of a sub-station
- iii. To design the layout of a transmitting sub-station

2. Power System – I (50 Marks)

I. Principle of Distribution System/Principles of Transmission and Distribution

- i. The transmission system and Distribution system
- ii. Transmission efficiency with the variation of system voltage/The principle of choice of voltages in generation, transmission & distribution
- iii. Compare the overhead and underground distribution
- iv. To describe (a) 2 Wire DC System (b) 3 wire DC system (c) Single phase AC
(d) Three phase AC system

II. Material of Overhead Lines

- i. Characteristics and their application of (a) Poles and wood poles (b) Treatment of wood poles (c) Concrete Poles (d) Steel tubular poles (e) Rail poles (f) Steel towers with cross arms brackets (g) Stays struts and other line accessories like arcing Home etc. suspension clamp, strain clamp, snail clamp, tubular compression dead end etc and binding wires dampers etc.
- ii. Characteristics & field of application of (a) Shackle Insulators (b) Pin Insulators (c) Post Insulators (d) Distributors (e) String Insulators

III. Concept on Line Design, Construction and L.A.

- i. To describe the rules & practices on (a) Selection of conductors size (b) Arrangement and spacing of conductor (c) Selection of height of poles or Towers (d) Clearances between power lines (e) Selection of span (f) Maintaining the clearance from building (vertical & Horizontal) (g) Earthing and counterpoise of transmission and distribution line.

IV. Detail of Service Connection

- i. Layout of the low and Medium voltage Distribution System
- ii. The detail of service connection of overhead line (low and medium voltage)
- iii. The relevant IE Rules IS specification regarding the tests before giving service connections
- iv. Insulation testing & earth testing

V. Construction Details of Underground cable

- i. Types of cables
- ii. Standard size of cables & their field of applications (To write the specification of underground cable)
- iii. The method of cable laying
- iv. To describe the method of cable joints for (a) PILC cable (b) XLPE cable (c) PVC cable
- v. Type of tests for commissioning of cables

VI. I.E. Rules

- i. To state the IE Rules related to (a) Overhead lines (b) Conductors at different voltages on same supports (c) Erection of or alternation to building structure flood banks and elevation of roads (d) Clearance (e) Routes (f) Maximum intervals between supports (g) Same structure carrying the Telecommunication lines (h) Lines crossing or approaching each other (i) Guarding (j) Service from OH Line (k) Earthing (l) Metallic bearer wire used for supporting insulated cables (m) Protection against.

3. Switch Gear and Protection – I (20 Marks)

I. Protective Relays

- i. To describe the following (a) causes of faults (b) consequences of faults (c) relay protection (d) zones of protections

II. Relay Application and characteristics

- i. To describe the functions and operating principle of (a) over current relays (b) instantaneous over current relay (c) application of time current relays (d) time-graded protection with over current relays (e) directional relays (f) directional over current relays and their connections (g) distance relays (h) Impedance relay (i) Ohm relay (j) differential relays

III. Feeder Protection

- i. To describe the protection and their selection
- ii. To explain the principle of over current protection in respect of (a) non-directional time and current grading (b) directional time and current grading (c) over current earth fault protection (d) directional earth fault relays (e) Earth-fault detection in systems earth through A.C. suppression oil

- iii. Apparatus protection
 - (i) Transformer protection
 - (ii) To describe (a) the nature of transformer faults (b) faults in auxiliary equipment (c) winding faults (d) overloads and external start-circuits (e) differential protection of transformers (f) problems encountered in differential protection of transformers.

IV. Generator Protection

- i. To describe type of generator faults e.g. (a) stator fault (b) Rotor fault (c) Abnormal running conditions
- ii. To describe (a) the stator protection systems (b) the rotor protection systems (c) the field feature protection (d) unbalanced load up protection (e) over load protection (f) prime mover protection (g) over speed protection (h) over voltage protection
- iii. To describe (a) the protection of generator transformer unit (b) relay tripping functions

V. Motor Protection

- i. To describe different type of motor faults
- ii. To describe the protection systems of (a) stator (b) Rotor (c) over load (d) unbalance and single phasing (e) under-voltage (f) Reverse phase protection (g) loss of synchronism

VI. Circuit breakers

- i. Theory of circuit interruption
- ii. To state the rating of a circuit breaker
- iii. To define the effect of re-striking voltage transients
- iv. To describe this interaction between the breaker and circuit
- v. To classify (a) current dropping (b) duties of switch gear
- vi. To describe (a) automatic switch (b) air circuit breakers (c) oil circuit breakers (single break and multi-break construction) (d) Air blast circuit breaker (e) performance of circuit breakers and system requirements (f) terminal start air unit and R.R.R.V. (g) interruption of small inductive and capacitive currents (h) modification of circuit breaker duty by shunt resistors
- vii. To state the recent developments in circuit breakers

4. Instrumentation and Control – I (20 Marks)

I. Overview of Instrumentation and control system

- i. To list the basic components of instrumentation system such as
 - (a) Measurement system
 - (b) Information signals and system
 - (c) Intelligent versus dumb instrumentation
- ii. To discuss the basic idea of the control systems such as
 - (a) Automatic control systems
 - (b) Types of control system
 - (c) Definition of controller

II. Pressure Measurement

- i. To describe the concepts of pressure measurement in (a) mechanics (b) mechanics (b) hydraulics (c) kinetics (d) thermodynamics

III. Transducers

- i. To describe the characteristics of Electrical Transducers
- ii. To describe the criterion for the selection of Transducers
- iii. To describe (a) the principles of different type of resistive transducer (b) different type of inductive transducer (c) capacitive transducer (d) photoelectric transducers (e) thermoelectric transducers (f) ultrasonic temperature transducers (g) magnetic flow meters (i) measurement of thickness by beta gauge.

IV. Signal Conditioning

- i. To describe the basic principle (a) D.C. (b) A.C. signal conditioning (c) Data Acquisition and conversion system
- ii. To describe the basic instrumentation Amplifier

5. High Voltage Engineering (E) – I (10 Marks)

I Over view of the power generation, transmission and Distribution

- i. To describe the generation & Transmission of Electrical Energy
- ii. Define (a) voltage stresses (b) Testing voltages

II Measurement of High Voltages

- i. Type of voltages to be measured & their wave shapes
- ii. The measurement of (a) peak voltage by spark gap (b) state the effect of nearby earthed objects (c) state the effect of humidity (d) effect of radiation & of polarity (e) influence of dust particles (f) effect of rod gaps
- iii. The working principle of Electrostatic Voltmeters
- iv. High voltage measurement by ammeter in series with high resistance method
- v. The generating or rotating voltmeters
- vi. Suppression of disturbances
- vii. Calibration of PD – Detectors in a Test Arrangement

III Over voltage

- i. The lightning mechanism
- ii. To state the (a) Energy in Lightning (b) Nature of Danger
- iii. The simulated lightning surges for testing
- iv. The switching surges test voltage characteristics

ELECTRICAL ENGG. (Objective Type/MCQ) Paper-II (Full Marks : 150)

1 Electrical Machine – II (40 marks)

(a) Transformer :-

- i. Basic principle
- ii. Classification of transformer based on
- iii. Application
- iv. Construction
- v. Construction of transformer
- vi. List of components used
- vii. Type and nature of cooling of transformer
- viii. Working principle of transformer

- ix. Describe transformer on (a) no-load (b) full load
- x. Derive the emf equation of transformer
- xi. Effect of leakage flux and leakage reactance of transformer
- xii. Phase and diagram on no load (specify whether ideal or actual)
- xiii. Percentage resistance, reactance and impedance of transformer
- xiv. Different type of losses in transformer
- xv. Calculate the losses and efficiencies of transformer
- xvi. Condition for maximum efficiency of transformer
- xvii. Procedure for testing of transformer
- xviii. Open circuit test and short circuit test
- xix. The voltage regulation of a transformer
- xx. Construction of Auto transformer
- xxi. Working principle of Auto transformer

(b) Storage Batteries :-

- i. Type of storage batteries
- ii. Construction of Lead Acid battery
- iii. Working principle of Lead Acid battery
- iv. Special feature of maintenance free battery
- v. Defects in storage batteries
- vi. The method of battery maintenance
- vii. Different method of battery charging
- viii. Different battery charging circuit for (a) Constant voltage (b) Constant current charging
- ix. Method of testing, fault diagnosis and repair of batteries
- x. Safety procedure for battery
- xi. Method for prevention of environmental pollution

2. Electrical Machine – II (30 Marks)

I. Induction Motor

- i. Explain the constructional features of three phase induction motor
- ii. Explain the method of the production of rotating magnetic fields produced in a three phase stator winding when three phase supply is applied in it.
- iii. To define slip, synchronous speed
- iv. Working principle of an three phase induction motor
- v. To develop an expression for torque in three phase induction motor
- vi. Method of achieving high starting torque of an three phase induction motor
- vii. Explain various methods starting induction motor
- viii. The modern techniques of starting different types of induction motor
- ix. Explain different method of speed control in three phase induction motor (conventional method)
- x. The modern method of speed control of three phase induction motor
- xi. State and enumerate different losses in three phase induction motor
- xii. To determine the efficiency of three phase induction motor considering the losses in the motor
- xiii. The various methods for testing of induction motor
- xiv. The various components in Test Report
- xv. State various factors involved in installation of a three phase induction motor

- xvi. The various step for the maintenance of induction motor
- xvii. The working principle of single & three phase induction regulator

II. Three phase synchronous Machine

- i. Constructional detail of three phase synchronous machine
- ii. Basic principle of developing three phase armature windings
- iii. Voltage regulation by synchronous impedance method
- iv. Method of synchronise the incoming alternator with three phase bus bar
- v. Local sharing between two alternators in synchronized mode
- vi. Why synchronous motor is not self-starting
- vii. Change in excitation of a synchronous motor on armature current
- viii. Application of synchronous machine
- ix. Condition/factors for the application of synchronous machine
- x. Testing the synchronous machines and to determine their performance characteristics

III. Single

- i. Type of single phase motors
- ii. Construction of various type of induction motor (split phase type)
- iii. Construction & working principles of single phase synchronous motor
- iv. Construction & working principles of single phase commutator motor
- v. Testing procedure of single phase induction motor measurement of
 - (i) speed (2) power consumption (3) torque
- vi. Selecting a specific type of single phase induction motor for a particular purpose.

3. Power Electronics / Electronic Devices & Circuits – II (30 Marks)

I. The Thyristor and their characteristics

- i. The construction, working principle, characteristics and rating of (a) Power diode (b) Silicon controlled rectifier (c) Power Transistor (d) Gate turn off Thyristor (GTC) (e) Triac (f) Disc
- ii. To classify thyristors
- iii. To explain the basic principle of selection of Thyristors
 - a) Overloads & fault current b) Voltage rating c) Di/dt behavior of thyristor d) Series parallel operation e) Current sharing during switching

II. Power Diodes & Power Transistors

- i. To classify power diodes & state their characteristics and field of application
- ii. To describe (a) forward recovery (b) Reverse recovery characteristics of power diode
- iii. To describe (a) the static characteristics of transistor (b) Turn-n & Turn off times of transistor (c) Second break down in transistor (d) Breakdown voltage of transistor (e) Base drive circuit of transistor

III. Line Cumulated Converters

- i. To define (a) Converter (b) Inverter
- ii. Line commutated converter in terms of quadrant of conversion
- iii. The equation for output voltage (a) Three phase half wave converter (b) Three phase semi-converters (c) Three phase full controller (d) Three phase dual converter
- iv. The method of power factor improvement for phase controller converters
- v. Basic considerations for designing converter circuits

IV. A.C. Voltage Controllers

- i. The principle of AC voltage control
- ii. Describe the principle of (a) ON OFF control and (b) Phase control for single phase loads (Star/Delta connected loads)
- iii. Single phase tap changer circuits

V. D.C. Chopper and Switch Mode Power Supply

- i. Define the DC Chopper and their field of application
- ii. The principle of step down and step up operation
- iii. Voltage control in single phase inverters

VI. Power supplies

- i. Purpose for developing AC & DC power supply (in industries)
- ii. The principle of operation of
 - a) Switched mode DC power supply
 - b) AC power supplies & VPS configuration

VII. A.C. Drivers

- i. To list different method of AC motor control
- ii. To draw the schematic diagram of (a) Stator voltage control (b) Rotor voltage control (c) Frequent control (d) Stator voltage and frequency control (e) Stator current control (f) Voltage current and frequency control

VIII. A.C. Voltage Control

- i. To list Describe operating principle of (a) constant voltage transformer (b) Servo controlled voltage stabilizer.
- ii. Describe the working principles of different type of Electro Magnetic Interface suppressor.
- iii. Dielectric and induction heating.

4. Repairing of Household Equipment – II (14 Marks)

I. Ceiling fan/Exhaust Fan

- i. To describe and draw the diagram of a ceiling/exhaust fan
- ii. To describe the electrical circuits of ceiling/exhaust fan
- iii. To describe the fastening of the components of ceiling/exhaust fan
- iv. To describe the dismantling procedure of a ceiling/exhaust fan
- v. To state the precautions required to dismantle the ceiling/exhaust/fan
- vi. To state the procedure for repair of the ceiling/exhaust fan
- vii. To describe the process of preventive maintenance

II. Fluorescent Lamp/Sodium Vapour Lamp

- i. To draw and describe the circuit of the lamp fitting
- ii. To explain the function of each components
- iii. To state the procedure for dismantling
- iv. To enlist the probable faults in the fitting
- v. To state the procedure for repair of the circuit
- vi. To perform the repair work
- vii. To state the assembly procedure
- viii. To suggest testing procedure

III. Split type/Window Air-conditioning

- i. The function of control terminals on the remote control unit
- ii. The electrical (in some cases block diagram/functional diagram) for checking the operation
- iii. The procedure for testing without dismantling for detecting or isolating the fault.
- iv. The procedure for testing after dismantling for detecting or isolating the fault
- v. To describe the procedure for the repair replacement of defective components
- vi. The testing procedure for the compressor or costing unit/without dismantling
- vii. The procedure for commissioning of the Air Conditioner of the repair

5. Non-Conventional Sources of Energy (E) – II (16 Marks)

I. Solar radiation

- i. To describe (a) Global, direct and diffused radiation (b) Spectral distribution of direct solar radiation through four types of curves (c) Radiation measuring Instruments (d) Data from a radiation measurement network
- ii. Water & Air heating application – To describe the construction and uses of water heating system through – (a) flat plate collector (b) ..spiral or ‘sea shell’ collector (c) heat pipe collector (d) Cylindrical heater/storage system
- iii. To describe three types of air heaters used to dry crop in lower latitude or space heating in higher latitude
- iv. To describe the integration of an air collector into a heating and cooling system
- v. To know some storage units
- vi. Space heating application: To describe the utilization of air heater and thermal energy storage in space heating application
- vii. Thermal Power & other applications (a) Head Engine (b) Large scale power Generation (c) Furnaces (d) cookers (e) refrigeration & cooling (f) Heat pumps (g) solar ponds (h) distillation (i) industrial application of process heat and transport.
- viii. Photovoltaic Technology: (a) Principle of solar cells (b) Solar cells & modules (c) Applications of photovoltaic system (d) Photovoltaic Power Generation

II. Wind Energy

- i. To state the historical development of wind generated Electricity in the following countries (a) Denmark (b) USA (c) United Kingdom
- ii. To enumerate the wind energy potential
To state the annual velocity & power duration curves
To describe the windmill
To describe the use of wind energy as (a) power generation (b) water pumping system
To describe the method of wind Energy conservation, distribution & utilization system.

III. Solar Cell

- i. Photo voltaic systems components and application
The principle of energy storage system
The principle of power condition system
The principle of voltaic applications
- ii. Design of stand Alone system
Describe (a) The solar module performance (b) Battery performance (performance of lead Acid Battery, Nickel cadmium Batteries) (c) Power control system (d) The method of regulation & system sizing (e) To state the application in water pumping.

APTITUDE TEST

- **20 Marks**

- (a) Numerical And Figurework Tests: (4 Marks)

These tests are reflections of fluency with numbers and calculations. It shows how easily a person can think with numbers. The subject will be given a series of numbers. His/Her task is to see how the numbers go together to form a relationship with each other. He/She has to choose a number which would go next in the series.

- (b) Verbal Analysis And Vocabulary Tests: (6 Marks)

These tests measure the degree of comfort and fluency with the English language. These tests will measure how a person will reason with words. The subject will be given questions with alternative answers, that will reflect his/her command of the rule and use of English language.

- (c) Visual And Spatial/3-D Ability Tests: (4 Marks)

These tests are used to measure perceptual speed and acuity. The subject will be shown pictures where he/she is asked to identify the odd one out; or which comes next in the sequence or explores how easily he/she can see and turn around objects in space.

- (d) Abstract Reasoning Tests: (6 Marks)

This test measures the ability to analyse information and solve problems on a complex, thought based level. It measures a person's ability to quickly identify patterns, logical rules and trends in new data, integrate this information, and apply it to solve problems.

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