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SAMPLE PAPER 02

Practice the sample paper covered both important questions and exam patterns

Subject: Transmission and Distribution (EEE302)

Full Marks: 70

Time: 3 Hours

Instructions:

- Question No. 1 is compulsory. (7 MCQs, 2 Marks each)
- Answer any FOUR questions from the remaining (Q.2 to Q.7).
- Q.2 to Q.6 carry 14 marks each (Divided into A and B, 7 Marks each).
- Q.7 consists of Short Notes (Answer any FOUR, 3.5 Marks each).

Q.1 Choose the correct option (Compulsory - 7 x 2 = 14 Marks)

i) Skin effect is proportional to:

- a. Diameter of conductor
- b. Square of the diameter of conductor
- c. Inverse of diameter
- d. None of the above

ii) Which of the following faults is most likely to occur in underground cables?

- a. Breakdown of insulation
- b. Conductor snapping
- c. Galloping
- d. Short circuit with tree branches

iii) Corona loss is generally less in:

- a. AC transmission
- b. DC transmission
- c. Both have the same loss
- d. Distribution lines

iv) The string efficiency of an insulator can be increased by:

- a. Using longer cross arms
- b. Grading the insulator
- c. Using a guard ring
- d. All of the above

v) Distributor is designed mainly from the point of view of:

- a. Voltage drop
- b. Current carrying capacity
- c. Operating frequency
- d. Power factor

vi) What does XLPE stand for?

- a. Cross-Linked Polyethylene
- b. X-Ray Low Polymer Ethylene
- c. Extra Long Power Extractor
- d. Cross-Line Phase Earthing

vii) The allowable voltage variation in LT distribution systems is generally:

- a. $\pm 1\%$
- b. $\pm 6\%$
- c. $\pm 10\%$
- d. $\pm 15\%$

Answer any FOUR questions from Q.2 to Q.7

Q.2 A) Discuss the different methods of laying underground cables. Which method is most commonly used? (7 Marks)

Q.2 B) Explain the various types of insulators used in overhead transmission lines. (7 Marks)

Q.3 A) Explain the working of Radial and Ring Main distribution systems with diagrams. (7 Marks)

Q.3 B) Compare HVAC and HVDC transmission systems in detail. (7 Marks)

Q.4 A) Draw and explain the single-line diagram of an AC distribution system showing feeders, distributors, and service mains. (7 Marks)

Q.4 B) What are the different types of faults in underground cables? Explain how they occur. (7 Marks)

Q.5 A) What is Sag in overhead lines? Derive the expression for sag when supports are at equal levels. (7 Marks)

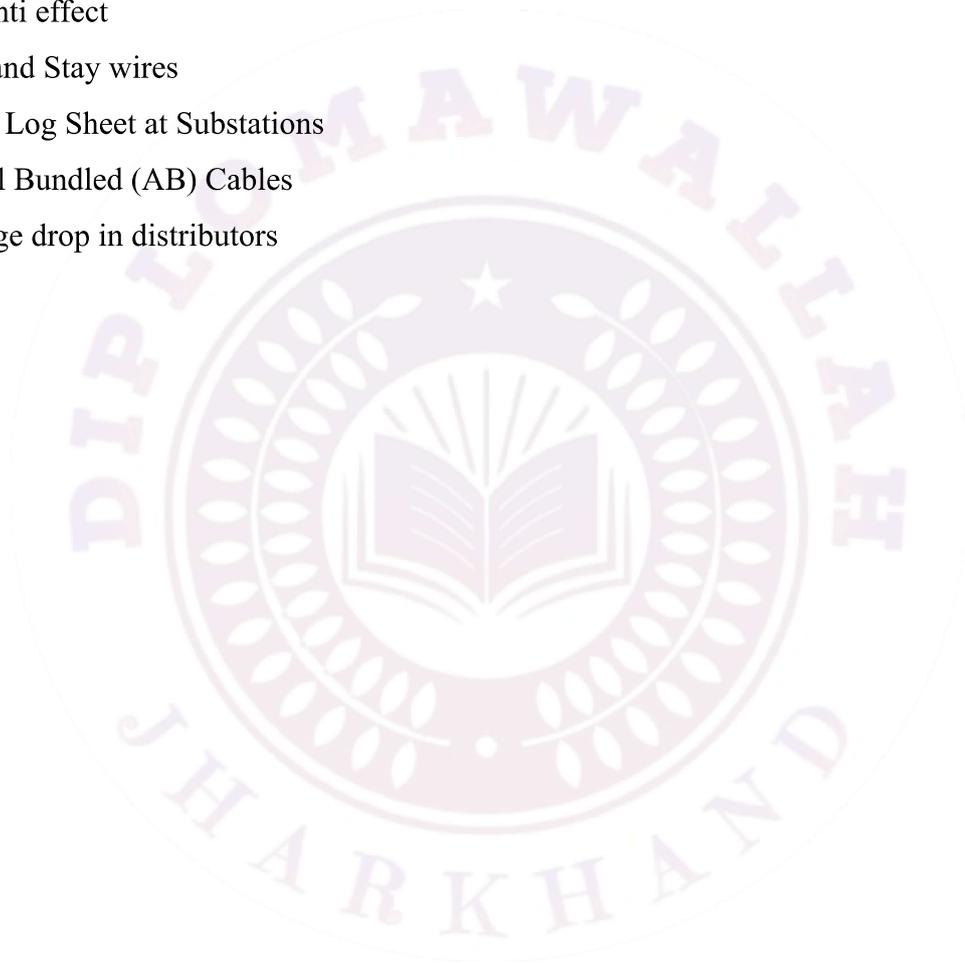
Q.5 B) Compare indoor and outdoor substations. (7 Marks)

Q.6 A) Explain the phenomenon of Corona. What are the factors affecting it and how can it be reduced? (7 Marks)

Q.6 B) Explain the construction of a 3-core underground cable with a neat sketch. (7 Marks)

Q.7 Write short notes on any FOUR of the following (4 x 3.5 = 14 Marks)

- A. Ferranti effect
- B. Guy and Stay wires
- C. Daily Log Sheet at Substations
- D. Aerial Bundled (AB) Cables
- E. Voltage drop in distributors



SOLUTIONS FOR SAMPLE PAPER 2

MCQ Answer Key

i) b, ii) a, iii) b, iv) d, v) a, vi) a, vii) b

Model Answers for Long Questions

Q.2 A) Methods of Laying UG Cables:

- **Direct Laying:** A trench is dug, sand is placed at the bottom, the cable is laid, covered with bricks for mechanical protection, and backfilled. Cheap and simple but fault location is hard. This is the most commonly used method.
- **Draw-in System:** Cast iron, concrete, or PVC pipes/ducts are laid in the trench. Cables are pulled through these manholes. Used in congested areas.
- **Solid System:** Cables are laid in troughs of wood, cast iron, or asphalt, then filled with a bituminous compound. Rarely used now due to cost.

Q.2 B) Types of Insulators:

- **Pin type:** Up to 33kV, mounted on pins on cross-arms.
- **Suspension type:** >33kV, discs connected in series (string). Gives flexibility; if one disc fails, only that is replaced.
- **Strain/Disc type:** Used at dead ends, sharp curves, or river crossings to take high mechanical tension.
- **Shackle type:** Mostly used for low voltage (LT) distribution lines.

Q.3 A) Radial vs Ring Main Distribution:

- **Radial:** Feeders radiate from the substation and feed distributors at one end only. It is simple and has a low initial cost, but reliability is poor (a fault on the feeder cuts off all downstream consumers).
- **Ring Main:** The distributor forms a closed loop, fed at one or more points. It offers high reliability (if one section fails, power flows from the other path) and less voltage drop.

Q.3 B) HVAC vs HVDC:

- **HVAC:** Requires 3 conductors, has skin effect, charging current exists, high corona loss, intermediate substations are cheaper, synchronous operation required.
- **HVDC:** Requires 2 conductors, no skin effect, no charging current, lower corona loss, converter stations are expensive at both ends, no synchronization problems.

Q.4 A) AC Distribution System (SLD):

The single-line diagram consists of the main substation, primary feeders (usually 11kV) radiating outward, distribution transformers stepping down to 415V/240V, secondary distributors running along streets, and service mains tapping off to individual consumer energy meters.

Q.4 B) Cable Faults:

- **Open-circuit fault:** Occurs when the conductor breaks due to mechanical stress, joint failure, or ground subsidence. Checked by shorting conductors at one end and measuring resistance.
- **Short-circuit fault:** Happens when the insulation between two conductors fails, causing them to touch and massive current to flow.
- **Earth fault:** When the insulation between the conductor and the outer lead sheath/earth fails, current flows directly to the earth.

Q.5 A) Sag in overhead lines:

Sag is the vertical distance between the point of support and the lowest point of the conductor.

Derivation: Let l = length of span, w = weight per unit length, T = tension. Taking a point $P(x,y)$ on the curve. By taking moments about the lowest point O , $T \times y = (w \times x) \times (x/2)$. Therefore, $y = wx^2 / 2T$. At the support, $x = l/2$, so Sag $S = wl^2 / 8T$.

Q.5 B) Indoor vs Outdoor Substations:

- **Indoor:** Used up to 11kV/33kV, requires less space, high building cost, safe from weather, fault location is difficult.
- **Outdoor:** Used for 33kV and above, requires more space, lower cost, exposed to weather, easy to locate faults and expand.

Q.6 A) Corona:

Phenomenon: The bluish luminance, hissing noise, and production of ozone gas in an overhead transmission line when the voltage exceeds the critical disruptive voltage.

Factors: Line voltage, conductor size (roughness increases corona), spacing between conductors (larger spacing reduces corona), atmospheric conditions (worse in rain/fog).

Reduction: By increasing conductor size (using ACSR/bundled conductors) or increasing spacing between conductors.

Q.6 B) 3-Core Underground Cable:

Consists of Core/Conductor (usually stranded aluminum/copper), Paper Insulation, Lead Sheath (to prevent moisture), Bedding (jute/hessian to protect sheath), Armouring (galvanized steel wire for mechanical protection), and Serving (outermost fibrous layer).

Short Answer Solutions (Q.7)

A) Ferranti effect: Receiving end voltage becomes higher than sending end voltage in a long/medium unloaded transmission line due to the line capacitance (charging current).

B) Guy and Stay wires: Galvanized steel wires used to support dead-end poles or poles at sharp curves to balance the mechanical tension and prevent the pole from bending.

C) Daily Log Sheet at Substations: A crucial operational document where operators record hourly readings of voltage, current, active power, reactive power, transformer temperature, and battery status.

D) Aerial Bundled (AB) Cables: Used in overhead lines, consisting of insulated aluminum conductors tightly bundled together. Reduces theft, prevents short circuits from tree branches, and improves safety.

E) Voltage drop in distributors: As power is tapped off along the length of a distributor by various consumers, the voltage gradually drops. Distributors must be designed so that the voltage at the farthest consumer remains within statutory limits (usually $\pm 6\%$).