DW_JUT

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SAMPLE PAPER 3

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) To reduce the corona effect, the size of the conductor must be:

a. Increased

b. Decreased

c. Kept the same

d. Changed to a different material

ii) In a transmission line, the equivalent circuit of a short line neglects:

a. Resistance

b. Inductance

c. Capacitance

d. Both a and b

iii) A trivector meter measures:

a. Active power only
b. Reactive power only
c. Apparent power only
d. All of the above

iv) The voltage drop in a ring main system is _____ compared to a radial system:

a. More
b. Less
c. Equal
d. Infinite

v) In outdoor substations, the clearances required between conductors are _____ than indoor substations:

a. More
b. Less
c. Same
d. Zero

vi) What does CMRI stand for in energy metering?

a. Common Meter Reading Instrument
b. Current Measuring Resistance Indicator
c. Centralized Meter Relay Interlock
d. Circuit Mains Relay Input

vii) The material used for the manufacture of ground/earth wire on top of transmission towers is:

a. Aluminium
b. Galvanized steel
c. Copper
d. Brass

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

Q.2 A) Derive the expression for voltage regulation and transmission efficiency for a short transmission line using a vector diagram. *(7 Marks)*

Q.2 B) Explain the construction of a 3-core underground cable with a neat sketch. *(7 Marks)*

Q.3 A) Discuss the different methods of laying underground cables. *(7 Marks)*

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

Q.4 A) Explain the working of Radial and Ring Main distribution systems. Which is better and why? *(7 Marks)*

Q.4 B) A short 3-phase transmission line has a series line impedance per phase of (15 + j20) ohms. The load at the receiving end is 10 MW at 33 kV and 0.8 power factor lagging. Calculate the voltage regulation. *(7 Marks)*

Q.5 A) Explain the various types of insulators used in overhead transmission lines. *(7 Marks)*

Q.5 B) What are the different types of faults in underground cables? Explain how they occur. *(7 Marks)*

Q.6 A) Draw and explain the single-line diagram of an AC distribution system showing feeders, distributors, and service mains. *(7 Marks)*

Q.6 B) What is Sag in overhead lines? Derive the expression for sag when supports are at equal levels. *(7 Marks)*

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

A. String efficiency & Guarding

B. Daily Log Sheet at Substations

C. Trivector energy meter & CMRI

D. Aerial Bundled (AB) Cables

E. XLPE cables

SOLUTIONS FOR SAMPLE PAPER 3

MCQ Answer Key

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

Model Answers for Long Questions

Q.2 A) Voltage Regulation & Efficiency (Short Line):

In a short transmission line, shunt capacitance is neglected. The equivalent circuit has Resistance (R) and Inductance (X) in series.
From the vector diagram:
$V_s = V_r + I(R \cos \varphi_r + X \sin \varphi_r)$.
% Regulation = $[I(R \cos \varphi_r + X \sin \varphi_r) / V_r] \times 100$.
Transmission Efficiency = Output Power / Input Power = $(V_r \times I \times \cos \varphi_r) / (V_r \times I \times \cos \varphi_r + I^2R)$.

Q.2 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).

Q.3 A) Methods of Laying UG Cables:

- **Direct Laying:** Cable is laid in a trench, covered with sand and bricks. Cheap and simple.
- **Draw-in System:** Cables are pulled through pipes/ducts laid underground. Easy to repair and replace.
- **Solid System:** Cables laid in troughs and filled with bituminous compound.

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) 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.
- **Ring Main:** The distributor forms a closed loop, fed at one or more points. It offers high reliability (power flows from the other path during faults) and less voltage drop. Ring Main is better for reliability.

Q.4 B) Numerical Solution:

Load P = 10 MW = 10×10^6 W, V_r = 33000 V, cos φ = 0.8.

I = P / ($\sqrt{3} \times V_r \times \cos \varphi$) = 10,000,000 / (1.732 × 33000 × 0.8) = 218.69 A.

Z = 15 + j20 Ω (R = 15, X = 20).

Voltage drop/phase = 218.69 (15 × 0.8 + 20 × 0.6) = 218.69(12+12) = 5248.56 V.

V_{rn} (per phase) = 33000 / √3 = 19052.5 V.

V_S = 19052.5 + 5248.56 = 24301.06 V.

% Regulation = (5248.56 / 19052.5) × 100 = 27.54%.

Q.5 A) Types of Insulators:

- **Pin type:** Up to 33kV, mounted on cross-arms.
- **Suspension type:** >33kV, discs connected in series (string).
- **Strain type:** Used at dead ends, sharp curves to take tension.
- **Shackle type:** Mostly used for LT distribution lines.

Q.5 B) Cable Faults:

- **Open-circuit fault:** Conductor breaks due to mechanical stress.
- **Short-circuit fault:** Insulation between two conductors fails.
- **Earth fault:** Insulation between conductor and lead sheath/earth fails.

Q.6 A) AC Distribution System (SLD):

Includes main substation, primary feeders (11kV), distribution transformers (11kV/415V), secondary distributors, and service mains.

Q.6 B) Sag in overhead lines:

Sag is the vertical distance between support point and lowest point of the conductor.
Derivation: Taking moments about lowest point O: T × y = (w × x) × (x/2). $y = wx^2 / 2T$. At support, x = l/2, so Sag $S = wl^2 / 8T$.

Short Answer Solutions (Q.7)

A) String Efficiency & Guarding:
String Efficiency: Ratio of voltage across the whole string to (n × voltage across disc nearest to conductor). Ensures uniform voltage distribution.

Guarding: A protective framework placed under power lines crossing roads or telecom lines to catch broken live wires.

B) Daily Log Sheet at Substations: An operational document recording hourly parameters like voltage, current, active/reactive power, and transformer temperatures to monitor system health.

C) Trivector energy meter & CMRI:
Trivector: Measures kVArh, kWh, and kVAh for industrial loads.
CMRI: Common Meter Reading Instrument, a handheld device to download data from electronic meters optically.

D) Aerial Bundled (AB) Cables: Insulated aluminum conductors tightly bundled with a bare neutral. Offers high safety, reduces short circuits, and prevents power theft.

E) XLPE cables: Cross-Linked Polyethylene. Used for high voltage UG cables. Can withstand higher temperatures (up to 90°C continuous) and thermal stress than PVC.
