Registration No.: | | | | | | | | | | |

Total Number of Pages: 02 **Course: B.Tech**

Sub_Code: REL5C001

5th Semester Back Examination: 2025-26

SUBJECT: Electric Power Transmission and Distribution

BRANCH(S): EEE, ELECTRICAL

Time: 3 Hours

Max Marks: 100

Q.Code: U068

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right-hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) What are the typical transmission voltages used in India, and why is electrical power stepped down before distribution to consumers?

b) What is the Skin Effect? How does it influence conductor design?

c) Find the maximum power that can be transmitted over a line with X = 25 Ω if the voltages at both ends are 110 kV.

d) What is the significance of the geometric mean radius (GMR) in transmission line parameter calculations?

e) A 3-phase EHV transmission line operates at a line-to-line voltage of 400 kV and has a characteristic (surge) impedance of 400 Ω. Determine the surge impedance loading (SIL) of the line in MW.

f) What is sag in overhead transmission lines? Explain the factors affecting sag and its importance in line design. Briefly explain.

g) The ABCD constants of a 3-phase transmission line are A = D = $0.9\angle 0.8^\circ$; B = $150\angle 83^\circ$; C = $0.0018\angle 89^\circ$ mho. With the sending-end voltage 330 kV and no load at the receiving end, calculate the magnitude and angle of the receiving-end voltage.

h) Which type of power plant has the shortest gestation period and why?

i) What is the purpose of using a neutral wire in distribution systems? Explain briefly.

j) The currents in a 3-phase unbalanced system are: $I_R = (20 - j10)$ A; $I_Y = (-5 + j15)$ A; $I_B = (10 - j20)$ A. The phase sequence is RYB. determine the positive sequence component of the R-phase current.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Write a short note on- Nuclear Power Generation.

b) What will be the equivalent radius of a bundle conductor having its part conductors of radius 'r' on the periphery of a circle of diameter 'd' if the number of conductors is 2, 3, 4, 6?

c) Explain clearly the 'skin effect' and 'proximity effect' when referred to overhead lines.

d) A 400 V, 3-phase 4-wire service mains supplies a star connected load. The resistance of each line is 0.1 ohm and that of neutral 0.2 ohm. The load impedances are $Z_R = (6 + j9)$, $Z_Y = 8$ ohms and $Z_B = (6 - j8)$. Calculate the voltage across each load impedance and current in the neutral. Phase sequence RYB.

e) Justify the need of capacitors in distribution systems.

f) An overhead line has the following data: Span length 160 metres, conductor diameter 0.95 cm, weight per unit length of the conductor 0.65 kg/metre. Ultimate stress 4250 kg/cm^2, wind pressure 40 kg/m^2 of projected area. Factor of safety 5. Calculate the sag.

g) Describe the vibration of power conductors and the methods used to damp out these vibrations.

h) The line-to-ground voltages on the high voltage side of a step-up transformer are 100 kV, 33 kV, and 38 kV on phases *a*, *b* and *c* respectively. The voltage of phase-a leads that of phase-*b* by 100° and lags that of phase-*c* by 176.5°. Determine analytically the symmetrical components of voltage.

i) Derive an expression for Sag of a line supported between two supports of same height.

j) Compare overhead lines with underground cables.

k) What is Kelvin's Law? State the limitations of Kelvin's Law.

l) Determine the insulation resistance of cable and find the condition for maximum value of electrostatic stress in a single core cable.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 **a)** Define Geometric Mean Radius (GMR) and Geometric Mean Distance (GMD). How are they used in inductance calculation of transmission lines? **(6)**

b) Derive the expression for inductance per phase of a symmetrical three-phase overhead line using GMR and GMD. **(6)**

c) Calculate the charging current per km for a single-phase equivalent of a 3-phase line whose capacitance per phase is 10 nF/km at 132 kV (line-line), 50 Hz. **(4)**

Q4 **a)** Explain the difference between short, medium, and long transmission lines. Derive the ABCD constants for each type. **(10)**

b) Describe the nominal-π and nominal-T models of a medium transmission line with neat equivalent circuits and phasor diagrams. **(6)**

Q5 For a 5-disc suspension string, each disc has self-capacitance C and to-ground capacitance 0.25C. If a guard ring introduces an additional capacitance of 0.2C from the lower link-pin to earth, find the new voltage distribution across the discs and the string efficiency. **(16)**

Q6 **a)** List five differences between overhead lines and underground cables with respect to capacitance, thermal rating, maintenance, and fault behavior. **(10)**

b) Draw and explain the sequence-network interconnection for a single line-to-ground fault and compare with the double line-to-ground case. **(6)**