



21. What is the necessity of FACTS devices in power system? 2 K1 CO5
22. What are the different types of substations? 2 K1 CO5

**PART - C (6 × 11 = 66 Marks)**

Answer ALL Questions

23. a) Derive an expression for inductance of a three phase line with unsymmetrical spacing. 11 K3 CO1

**OR**

- b) Illustrate and explain the structure of modern power systems with typical voltage levels. 11 K2 CO1
24. a) An overhead 3-phase transmission line delivers 5000 kW at 11 kV at 0.8 p.f. lagging. The resistance and reactance of each conductor is 4 Ω and 6 Ω respectively. Determine: (i) sending end voltage (ii) percentage regulation (iii) transmission efficiency. 11 K3 CO2

**OR**

- b) Derive the expression for the performance of transmission line for a nominal T method. 11 K3 CO2
25. a) A 3-phase transmission line is being supported by three-disc insulators. The potentials across top unit (i.e., near to the tower) and middle unit are 8 kV and 11 kV respectively. Compute (i) ratio of capacitance between pin and earth to the self-capacitance of each unit (ii) line voltage and (iii) string efficiency. 11 K3 CO3

**OR**

- b) Derive the expression for sag in overhead lines when the supports are at equal and at unequal heights. 11 K3 CO3
26. a) Explain the different methods of grading techniques with neat diagram. 11 K2 CO4

**OR**

- b) A single-core cable has a conductor diameter of 1 cm and insulation thickness of 0.4 cm. If the specific resistance of insulation is  $5 \times 10^{14}$  Ω-cm, calculate the insulation resistance for a 2 km length of the cable. 11 K3 CO4
27. a) A 2-wire d.c. ring distributor is 300 m long and is fed at 240 V at point A. At point B, 150 m from A, a load of 120 A is taken and at C, 100 m in the opposite direction, a load of 80 A is taken. If the resistance per 100 m of single conductor is 0.03 Ω, Find (i) Current in each section of distributor. (ii) Voltage at points B and C. 11 K3 CO5

**OR**

- b) Explain in detail the different methods of grounding techniques. 11 K2 CO5
28. a) Illustrate the FACTS controllers that are used in modern power system. 11 K2 CO5

**OR**

- b) Explain briefly the various types of bus bar arrangements in a substation. 11 K2 CO5