

B.Tech 4th Semester Exam., 2018

POWER SYSTEM—I

Time : 3 hours

Full Marks : 70

Instructions :

- (i) The marks are indicated in the right-hand margin.
- (ii) There are **NINE** questions in this paper.
- (iii) Attempt **FIVE** questions in all.
- (iv) Question No. 1 is compulsory.

1. Choose the correct option (any seven) :

2×7=14

- (a) Which of the following distribution systems is preferred for good efficiency and high economy?
- (i) Single-phase, 2-wire system
 - (ii) 2-phase, 3-wire system
 - (iii) 3-phase, 3-wire system
 - (iv) 3-phase, 4-wire system

- (b) The main drawback(s) of overhead system over underground system is/are
- (i) underground system is more flexible than overhead system
 - (ii) higher charging current
 - (iii) surge problem
 - (iv) high initial cost

- (c) The highest transmission voltage used in India is
- (i) 400 kV
 - (ii) 220 kV
 - (iii) 132 kV
 - (iv) 765 kV

- (d) The function of steel wire in an ACSR conductor is to
- (i) compensate for skin effect
 - (ii) take care of surges
 - (iii) provide additional mechanical strength
 - (iv) reduce inductance

- (e) Corona is accompanied by
- (i) violet visible discharge in darkness
 - (ii) hissing sound
 - (iii) power loss
 - ✓(iv) All of the above
- (f) The conductor carries more current on the surface in comparison to its core. This phenomenon is called the
- ✓(i) skin effect
 - (ii) corona
 - (iii) Ferranti effect
 - (iv) Lenz's effect
- (g) Ferranti effect happens in transmission line when the line is
- (i) short and loaded
 - (ii) long and loaded
 - ✓(iii) long and unloaded
 - (iv) None of the above

- (h) A transmission line is distortionless if
- (i) $RG = LC$
 - (ii) $RC = GL$
 - ✓(iii) $R/C = G/L$
 - (iv) $R = G$
- (i) The receiving-end voltage of a transmission line will be greater than the sending-end voltage if the load
- (i) greater than SIL (surge impedance loading)
 - (ii) less than SIL
 - (iii) equal to SIL
 - (iv) None of the above
- (j) Capacitor grading of cable means
- (i) use of dielectrics in different concentrations
 - (ii) introduction of capacitances at various lengths of cable to counter the effect of inductance
 - ✓(iii) use of dielectric of different permittivities
 - (iv) grading according to capacitance per km length of the cable

(5)

(6)

2. (a) Explain 3-phase, 4-wire system of distribution of electrical power. 6
- (b) A 2-wire feeder ABC has a load of 100 Ampere at unity p.f. at C and 65 Ampere at p.f. 0.8 lagging at B. The impedance AB is $(0.06 + j0.08)\Omega$ and that of BC is $(0.04 + j0.12)\Omega$. If the voltage at the far end C is to be maintained at 230 V, determine the voltage (i) at A and (ii) at B. 8
3. (a) Derive an expression for the capacitance of a single-phase overhead transmission line. 7
- (b) Find out capacitance of a single-phase line 30 km long consisting of two parallel wires each 15 mm diameter and 1.5 m apart. 7
4. (a) A single-phase line has an impedance of $5\angle 60^\circ\Omega$. It is supplying a load of 120 A, 33 kV at 0.8 p.f. lagging. Calculate its regulation. 6
- (b) In a 3-phase, 4-wire system, the line voltage is 400 V and non-inductive loads of 10, 8 and 5 kW are connected between the three line conductors and the neutral. Calculate (i) the current in each line and (ii) the current in the neutral conductor. 8

5. (a) What are the sources of vibrations in a transmission line? Explain the methods used to damp out these vibrations. 7
- (b) Obtain an expression for the sag of a transmission line supported by towers of different heights at the ends. 7
6. (a) Define regulation of a 3-phase a.c. transmission system and develop an expression for approximate voltage regulation. 8
- (b) Explain surge impedance loading with respect to an overhead transmission line. 6
7. An overhead 3-phase transmission line delivers 5 MW at 22 kV at 0.8 lagging power factor. The resistance and reactance of each conductor are 4Ω and 6Ω respectively. Determine : 14
- (a) Sending-end voltage
- (b) Percentage regulation
- (c) Total line losses
- (d) Transmission efficiency

8. (a) With the neat labelled diagram, show the various parts of a high-voltage single-core cable. 6
- (b) Explain briefly the following methods of grading of cables : 8
- (i) Capacitance grading
- (ii) Intersheath grading
9. (a) A 132 kV transmission line has the following data :
- Weight of conductor = 680 kg/km
Length of span = 260 m
Ultimate strength = 3100 kg
Safety factor = 2
- Calculate the height above ground at which the conductor should be supported. Ground clearance required is 10 m. 6
- (b) The three conductors of a 3-phase transmission line are arranged in a horizontal plane and are 3 m apart. The diameter of each conductor is 4 cm. Determine the inductance per km of each phase. Assume balanced load and R, Y, B phase sequence. 8
