Bihar Engineering University, Patna
B.Tech. 5th Semester Examination, 2023

Course: B.Tech.   Time: 03 Hours
Code: 100507   Subject: Power System- I (Apparatus and Modelling)   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.

Q.1   Choose the correct answer of the following (Any seven question only):   [2 x 7 = 14]

(a)   By increasing the transmission voltage double of its original value, the same power can be despatched keeping the line losses _____.
(i) Equal to its original value.   (ii) Half of its original value.
(iii) Double the original value.   (iv) One - fourth of the original value.

(b)   Capacitance between the two conductors of a single phase two wire line is 0.5 μ F/km. What is the value of capacitance of each conductor to neutral?
(i) 0.5 μ F / km   (ii) 1 μ F / km
(iii) 0.25 μ F / km   (iv) 2.0 μ F / km

(c)   The most suitable location for the power factor improvement device is
(i)   Near the electrical appliance which is responsible for the poor power factor.
(ii)   At the sending end.
(iii) At the receiving end in case of transmission lines.
(iv)   Both (i) and (iii).

(d)   Which among the following happens in a low power factor?
(i)   Large kVA rating of the equipment.
(ii)   Greater conductor size.
(iii) Reduced handling capacity of the system.
(iv)   All of the above.

(e)   Transformer ratings are given in _____
(i) kW   (ii) kVAR   (iii) HP   (iv) kVA

(f)   An over excited synchronous motor operating on no load condition is called as
(i) Synchronous capacitor   (ii) Synchronous condenser
(iii) Both (i) and (ii)   (iv) None of these

(g)   Ferranti effect is defined as the condition when _____
(i) the sending end voltage is higher than the receiving end voltage.
(ii) the sending end voltage is equal to the receiving end voltage.
(iii) the sending end voltage is lower than the receiving end voltage.
(iv) None of the above.

(h)   Ferranti effect occurs _____.
(i) when a long transmission line is loaded higher than it's rated load.
(ii) when a short transmission line is loaded higher than it's rated load.
(iii) when a long transmission line is at no load or low load condition.
(iv) when a short transmission line is connected at no load or low load condition.

(i)   The skin effect causes
(i) increase the resistance of the conductor
(ii) increase the inductance of the conductor
(iii) decrease the resistance of the conductor
(iv) decrease the resistance of the conductor

(j)   At surge impedance loading (SIL) of the transmission line
(i) receiving end voltage drops below the sending end voltage
(ii) receiving end voltage becomes more than the sending end voltage
(iii) the voltage throughout the length of the transmission line remains constant
(iv) does not have any effect on the voltage level.

Q.2 (a) For an isolated conductor determine the total inductance (for both internal and external flux linkage) of the conductor. **[8]**

(b) Consider a 2-wire isolated transmission line operating at 50 Hz frequency. The spacing between two conductors is 5 cm and conductor diameter is 1 cm. Find the capacitance per unit length of the transmission line. Consider the relative permittivity of air 1.006. **[6]**

Q.3 (a) What is corona? Define disruptive critical voltage and visual critical voltage in the context of occurrence of corona? Which of these voltages has higher value? **[8]**

(b) What are the factors affecting corona? **[4]**

(c) Write any one expression for finding the corona loss. **[2]**

Q.4 (a) Draw the π or T representation of a medium transmission line and derive the expressions for A, B, C, D parameters for the model. Mention the units of these parameters. **[10]**

(b) A 3-phase, 50-Hz short transmission line has the resistance/phase = 1 ohm, inductive reactance/phase = 0·2 ohm. Determine (i) the receiving end current (ii) sending end current (iii) sending end voltage, when supplying a balanced load of 10,000 kW at 66 kV, p.f. 0·8 lagging. **[4]**

Q.5 Explain and draw the typical waveform of synchronous generator under balanced terminal short-circuit conditions for steady state, transient and sub-transient equivalent circuit. Derive the essential expression also. **[14]**

Q.6 (a) What are the different HVDC links normally adopted? **[2]**

(b) Describe the advantages of HVDC transmission system compared to AC transmission system on the basis of economy, technical performance and reliability of transmission. **[8]**

(c) What are the disadvantages of HVDC transmission? **[4]**

Q.7 (a) What is the natural cause of overvoltage? Draw a typical lightning stroke voltage characteristics with proper labelling in the axes. **[4]**

(b) What are the characteristics of switching surges? What are the methods for controlling overvoltage created by switching surges? **[6]**

(c) Describe any one method of protection of transmission line against overvoltage. **[4]**

Q.8 (a) What are the basic components of Solar PV system? Describe each component. **[5]**

(b) What are the different types of Wind turbines based on their construction. **[4]**

(c) Derive the expression of amount of electrical power than can be extracted from wind in terms of air velocity, density of air and area of turbine blades. **[5]**

Q.9 Write short notes on *any two* of the following: **[7x2=14]**

(a) Voltage source converter (VSC).

(b) Capability curve of generator.

(c) Shunt compensation of transmission line.

(d) Bewley Diagrams.