MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

EE-502

POWER SYSTEM – I

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. 10×1 = 10

(i) The size of conductors of modern EHV lines is obtained based on

(A) voltage drop (B) current density
(C) corona (D) skin effect

(ii) As the load factor of a generating plant increases, the generation cost per kW generated

(A) decreases (B) increases
(C) remains same (D) none of these

(iii) A synchronous compensator absorbs inductive reactive power. It is

(A) over excited (B) normally excited
(C) under excited (D) none of these

(iv) Stringing chart is used in transmission lines for

(A) designing the power
(B) calculating the sag in the conductor
(C) determining the distance between the conductor
(D) design of insulator string

(v) The surge impedance of a 100 km long underground cable is 50Ω. The surge impedance of a 40 km long cable of similar type is

(A) 20Ω (B) 50Ω (C) 80Ω (D) 125Ω

(vi) The ratio of average demand of energy and energy required according to installed capacity for power system is termed as

(A) diversity factor (B) load factor
(C) plant capacity factor (D) plant use factor

(vii) The quantity of raw materials used for generating a given quantity of power is the east in the case of

(A) thermal power plant (B) hydral power plant
(C) nuclear power plant (D) MHD

(viii) The A, B, C, D constants of transmission line are expressed as follows

(A) AD + BC = 1 (B) AD – BC = 1
(C) AD – BC = 0 (D) AB + DC = 1

(ix) When the effective resistance of a conductor increases due to the presence of current carrying conductor nearby, then the effect is called

(A) skin effect (B) proximity effect
(C) Ferranti effect (D) corona effect

(x) At the time of transposition of three phase line, the equivalent equilateral spacing between the conductors is

(A) $3\sqrt{d_1 d_2 d_3}$ (B) $\sqrt{d_1 d_2 d_3}$ (C) $d_1 d_2 d_3$ (D) $\frac{1}{3}(d_1 d_2 d_3)$

(xi) A string of insulator has 4 insulators. The voltage across the bottom unit is 30% of the total voltage. The string efficiency of insulator is

(A) 30% (B) 60% (C) 75% (D) 83.33%

(xii) What is the approximate efficiency of a normal thermal power plant?

(A) 30 – 40% (B) 20 – 25% (C) 40 – 50% (D) 60 – 70%

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. A transmission line conductor at a river crossing is supported from two towers at heights of 50 m and 80 m from water level. The horizontal distance between the towers is 300m. If the tension in the Conductor is 200 kg, find the clearance between the conductor and water level at a point midway between the towers. Weight of the conductor per meter is 0.844 kg 5

3. What is grading of cable? Why is it necessary? How many types of grading are there? 2+1+2

4. Derive an expression of inductance for single phase two wire line. 5

5. A consumer is charged electricity in the following tariff: 5
Rs. 10.40/KVA of maximum demand plus Rs 5.5 per unit consumed. The consumer has an aggregate motor of load 300 kW at a power factor of 0.8 lagging. Find out the consumer's annual bill for a load factor of 80%.

6. Discuss main features of Indian Electricity rule – 1956. 5

GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) Define string efficiency. Briefly explain one method of improving the efficiency. 8

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(b) Each conductor of a 33 kV, 3 phase system is suspended by a string of three similar insulators. If the capacitance of each disc unit is five times the capacitance to ground of each unit, calculate 7
(i) The voltage across each unit.
(ii) String efficiency.

8. (a) A 50 km long three phase, 50 Hz transmission line has resistance, reactance and susceptance are 0.1 ohm, 0.5 ohm and 10×10^{-6} S per phase per km respectively. If the line supplies load of 20MW at 0.9 p.f. Lagging 66 kV at the receiving end, calculate sending end power factor, regulation and transmission efficiency. 10
(b) Write down the different factors affecting corona loss of transmission line. 5

9. (a) Derive the expression for voltage and current distribution over a long transmission line in hyperbolic form and obtain the A, B, C, D parameters. 10
(b) The parameters of a 132 kV, 50 Hz, 3-phase transmission lines are 5
$R = 12.84\Omega \quad L = 0.162H, \quad C = 1.014\mu F$
Calculate the line constants A, B, C and D for nominal π method.

10.(a) A single core cable has an inner diameter of 6 cm and a core diameter of 20 cm. Its paper dielectric has a working dielectric stress of 60 kV/cm. Calculate the maximum permissible line voltage when such cables are used on a three phase power system. 5
(b) Find the most economical value of the diameter of single core cable to be used on 66 kV three phase system. Find also the overall diameter of the insulation if the maximum permissible stress is not to exceed 5 kV/mm. 5
(c) What is insulation resistance of a single core cable? Prove that the insulation resistance is inversely proportional to the length of the cable. 5

11. Draw the schematic diagram of a steam power plant. Explain the function of different constituents of the steam power plant. 15