

Total No. of printed pages = 4

EE 181404

Roll No. of candidate

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2023

B.Tech. 4<sup>th</sup> Semester End-Term Examination

POWER SYSTEM – I

New Regulation (w.e.f. 2017-18) & New Syllabus (w.e.f. 2018-19)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Q. No.1 and any *four* from the rest.

1. Choose the correct answer:

(10 × 1 = 10)

(i) The skin effect in a conductor results in

- (a) Increase in its DC resistance (b) Decrease in its AC resistance  
(c) Increase in its AC resistance (d) None of the above

(ii) The inductance of the line is minimum when

- (a) G M D is high  
(b) G M R is high  
(c) Both G M D is high and G M R is high  
(d) G M D is low but G M R is high

(iii) Corona is affected by

- (a) Size of conductor  
(b) Shape and surface condition of the conductor  
(c) Operating voltage  
(d) All of these

(iv) A transmission line consists of 9 discs of suspension insulator in each string. What is the operating voltage of the transmission line?

- (a) 11 KV (b) 33 KV  
(c) 66 KV (d) 132 KV

[Turn over

- (v) Critical voltage level of a transmission line can be increased by
- Reducing the radius of the conductors
  - Reducing the spacing between conductors
  - Increasing the radius of the conductors
  - All of the above
- (vi) Transposition of a transmission line is done to
- Reduce corona
  - Balance line voltage drop
  - Reduced skin effect
  - Reduce line loss
- (vii) What should be the value of sag for proper option of the overhead transmission line?
- High
  - Low
  - Neither too low nor too high
  - Anything
- (viii) A line that connects a distributor to the situation is called
- Feeder
  - Distributor
  - Service main
  - line
- (ix) Breakdown of cable insulation may occur due to
- Thermal instability
  - Puncture
  - Tracking
  - Any of the above
- (x) The presence of earth in case of overhead lines
- Increases the capacitance
  - Increases the inductance
  - Decreases the capacitance and increases the inductance
  - Does not affect any of the line constants

2. (a) What is an expanded ACSR conductor? 2
- (b) Determine the self GMD of the following conductor in terms of the radius 'r' of an individual strand (Fig.1). 3



Fig. 1

- (c) Give the different stages of a power system, with typical values of voltage at each stage. 5
- (d) A 20 km single phase line has two parallel conductors separated by 1.5 m. The diameter of each conductor is 0.823 cm. If the conductor has a resistance of  $0.311 \Omega/km$ , find the loop impedance of this line at 50 Hz. 5



3. (a) What is the effect of the earth on the capacitance of the transition lines? 3  
 (b) Calculate the capacitance per phase of a 3-phase double circuit line as shown in Fig. 2. Diameter of each conductor is 1.5 cm. 6

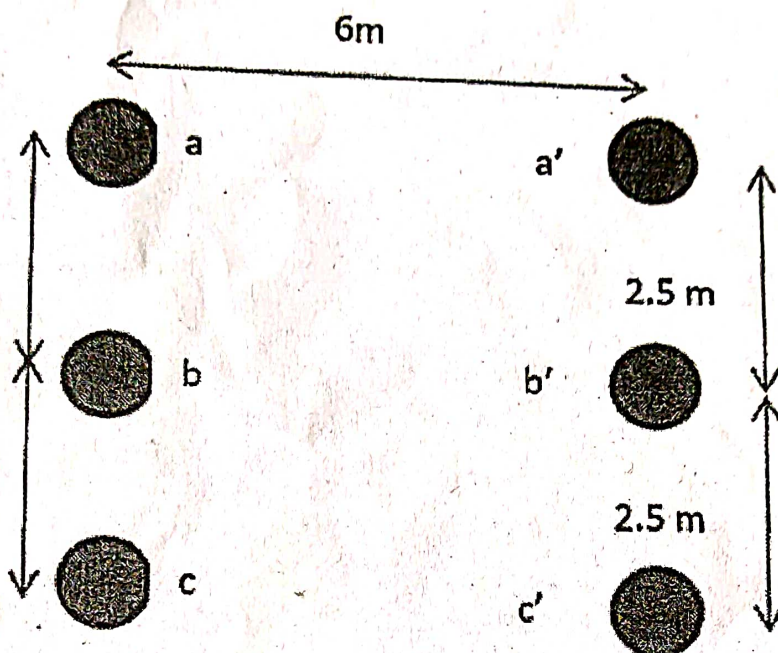


Fig. 2

- (c) Show how regulation and transmission efficiency is determined for medium lines using the nominal  $\pi$  method. Illustrate your answer with suitable phasor diagrams. 4+2=6
4. (a) Explain how the corona considerations affect the design of a line. 3  
 (b) A 132 kV overhead line conductor of radius 1 cm is built so that corona takes place when the line voltage is 210 kV(rms). If the value of the voltage gradient at which ionization occurs can be taken as 21.21 KV(rms)/cm, determine the spacing between the conductors. (5)  
 (c) A 150 km, 3- $\phi$ , 110 kV, 50 Hz transmission line transmits a load of 40,000 kW at 0.8 p.f. lagging at the receiving end.  
 Resistance/km/phase = 0.15  $\Omega$   
 Reactance/km/phase = 0.60  $\Omega$   
 Susceptance/km/phase =  $10^{-5}$  S.  
 Using nominal T-method, determine (i) the A, B, C, and D constants of the line and (ii) the regulation of the line. (7)



5. (a) What is the need for grading insulators? 3
- (b) A string of suspension insulators consists of three units. The capacitance between each pin and earth 15% of the self-capacitance of the unit. If the maximum peak voltage per unit is not to exceed 35kv, determine the greatest working voltage and the string efficiency. 5
- (c) Calculate the minimum sag permissible for 160 m span, 1.0cm diameter copper conductor allowing a maximum tensile stress of 2000 kg/cm<sup>2</sup>. Assume horizontal wind pressure 4kg/cm<sup>2</sup> of projected area. Take the specific gravity of copper as 1.9 g/cm<sup>3</sup>. 7
6. (a) Explain how sag is determined for an overhead line conductor taking into the effects of wind and ice loading. 5
- (b) Define the terms feeders, distributors, and service mains in a distribution system. What is the purpose of se interconnector in a d.c ring main distributor? 3+2=5
- (c) A d.c ring main ABCDA is fed from point A from a 250 V supply and the resistance (including both lead and return) of various sections are as follows: AB = 0.02Ω, BC = 0.018Ω, CD = 0.025Ω and DA = 0.02Ω. The main supplies load of 150 A at B; 300 A at C and 250A at D. Determine the voltage at each load. (5)
7. (a) With a neat diagram show the various parts of a high voltage single core cable. What are the classifications of underground cables according to the voltage range? 4+2=6
- (b) Prove that  $g_{\max} / g_{\min}$  in a single core cable is equal to  $D/d$  where  $g$  is the dielectric stress, 'D' is the diameter of the lead sheath, and 'd' is the diameter of the conductor. 5
- (c) The capacitance of a 3-phase belted cable is 12.6 μF between the three cores bunched together and the lead sheath and 7.4 μF between one core and the other two connected to the sheath. Find the charging current drawn by the cable when connected to 66KV, 50Hz supply. 4