B.Sc. Engg. (EE), 3rd Sem.
DTE, 1st Sem

December 09, 2023 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4301/EEE 4395
Course Title: Electrical Power Transmission and Distribution

Winter Semester, A.Y. 2022-2023
Time: 3 Hours
Full Marks: 150

There are **6 (six)** questions. Answer all **6 (six)** questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets. Assume reasonable value for any missing data, if it is required.

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1. a) A single-phase distributor one km long has resistance and reactance per conductor of 0·1 Ω and 0·15 Ω respectively. At the far end, the voltage V_B = 200 V, and the current is 100 A at a p.f. of 0·8 lagging. At the mid-point M of the distributor, a current of 100 A is tapped at a p.f. of 0·6 lagging with reference to the voltage V_M at the mid-point. Calculate: (i) voltage at mid-point V_M, (ii) sending end voltage V_A, (iii) phase angle between V_A and V_B illustrating phasor diagram. [4×2+5] [CO2] [PO2]

   b) The 3-wire d.c. system supplies a load of 4 Ω resistance across (+) ve wire and the neutral wire and a load of 6 Ω resistance across (−)ve outer and the neutral at the far end of the distributor. The resistance of each conductor is 0.15 Ω and the voltage across each outer and neutral is 240 V at the load end. Determine the load current and load voltages when there is a break in the (i) neutral wire (ii) positive outer (iii) negative outer. Assume that the load resistances and the feeding end voltages remain the same. [4×3] [CO2] [PO2]

2. a) Evaluate the inductance per phase per km of double circuit 3-phase line shown in Fig. 1. The conductors are transposed and are of radius 0·75 cm each. The phase sequence is ABC. [15] [CO3] [PO2]

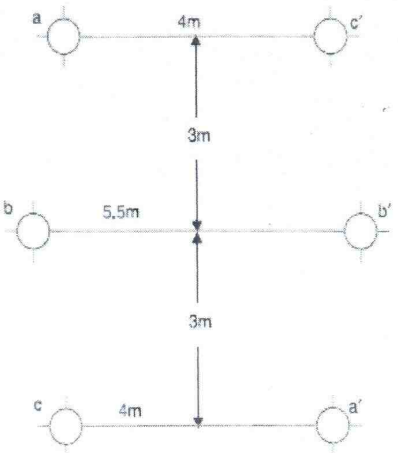

Fig. 1

   b) A 3-phase, 50 Hz, 132 kV overhead line has conductors placed in a horizontal plane 4 m apart. The conductor diameter is 2 cm. If the line length is 100 km, find i) the Capacitance of each conductor to neutral, and ii) the charging current per phase assuming complete transposition. [5×2] [CO2] [PO2]

3. a) A balanced load of 30 MW is supplied at 132 kV, 50 Hz, and 0·85 p.f. lagging by means of a transmission line. The series impedance of a single conductor is (20 + j52) ohms and the total phase-neutral admittance is 315 micro siemens. Shunt leakage may be neglected. Using the nominal T approximation, evaluate the line voltage at the sending end of the line. If the load is removed and the sending end voltage remains constant, find the percentage rise in voltage at the receiving end. [7+6] [CO3] [PO2]

b) Evaluate the following(s) for a single circuit transmission line delivering a load of 50 MVA at 110 kV and p.f. 0·8 lagging for A = D = 0·98 ∠3°; B = 110 ∠75° ohm ; C = 0·0005 ∠80° siemens:
(i) sending end voltage (ii) sending end current (iii) sending end power (iv) efficiency of transmission. [3×4] [CO3] [PO3]

4. a) With a neat diagram, describe the Murray loop test for the location of an earth fault in an underground cable. In a test for a fault to earth on a 500 m length of cable having a resistance of 1 Ω per 1000 m, the faulty cable is looped with a sound cable of the same length but having a resistance of 2·25 Ω per 1000 m. The resistance of the other two arms of the testing network at balance are in the ratio 2·75: 1. Determine the distance of the fault from the testing end of the underground cable. [8+7] [CO1] [PO1]

b) A 132 kV line with 1·956 cm dia. conductors is built so that corona takes place if the line voltage exceeds 210 kV (r.m.s.). If the value of the potential gradient at which ionization occurs can be taken as 30 kV per cm, find the spacing between the conductors. [10] [CO2] [PO2]

5. a) A two-wire d.c. distributor AB, 600 meters long is loaded as under : [5×2+3] [CO2] [PO2]

Distance from A (meters):	150	300	350	450
Loads in Amperes:	100	200	250	300

The feeding point A is maintained at 240 V and that of B at 230 V. If each conductor has a resistance of 0·01 Ω per 100 meters, calculate the following(s) :
(i) currents supplied from side A as well as side B,
(ii) power dissipated in the distributor.

b) An overhead transmission line at a river crossing is supported from two towers at heights of 40 m and 90 m above water level, the horizontal distance between the towers being 400 m. If the maximum allowable tension is 2000 kg, find the clearance between the conductor and water at a point mid-way between the towers. Weight of conductor is 1 kg/m. [12] [CO2] [PO2]

6. a) Each line of a 3-phase system is suspended by a string of 3 identical insulators of self-capacitance C farad. The shunt capacitance of connecting metal work of each insulator is 0·2 C to earth and 0·1 C to line. Determine the string efficiency of the system if a guard ring increases the capacitance to the line of metal work of the lowest insulator to 0·3 C. [13] [CO2] [PO2]

b) A 2-wire d.c. distributor ABCDEA in the form of a ring main is fed at point A at 220 V and is loaded as under :
10A at B; 20A at C; 30A at D and 10 A at E.
The resistances of various sections (go and return) are AB = 0·1 Ω; BC = 0·05 Ω; CD = 0·01 Ω; DE = 0·025 Ω and EA = 0·075 Ω. Determine :
(i) the point of minimum potential,
(ii) currents in each section of the distributor. [6×2] [CO2] [PO2]