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B.Tech DEGREE EXAMINATION, NOVEMBER 2023

Fourth Semester

18EEC214T - POWER SYSTEMS - I

(For the candidates admitted during the academic year 2020 - 2021 & 2021 - 2022)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 100**

PART - A (20 × 1 = 20 Marks)

Answer **all** Questions

		Marks	BL	CO
1.	The electric power from primary distribution line is delivered to distribution substation in the range of _____ voltage. (A) 33 kV (B) 132 kV (C) 11 kV (D) 415 V	1	1	1
2.	In the wind mill, component _____ is used to measure wind speed. (A) anemometer (B) nacelle (C) gearbox (D) pitch	1	1	1
3.	Plant capacity factor is directly proportional to (A) Average demand (B) load factor (C) Average demand and load factor (D) plant capacity	1	2	1
4.	The primary distribution voltage range is reduced as (A) 33 kV to 11 kV (B) 66 kV to 33 kV (C) 132 kV to 33 kV (D) 132 kV to 66 kV	1	2	1
5.	A conductor transfers more current on the surface and less current in the core, is known (A) Corona (B) Proximity Effect (C) Ferranti Effect (D) Skin Effect	1	1	2
6.	Self GMD is independent of (A) Conductor Resistance (B) Conductor Inductance (C) Conductor length (D) Spacing between the conductors	1	2	2
7.	Proximity effect is high in (A) Overhead line (B) Power cable (C) DC transmission (D) Low voltage transmission	1	2	2
8.	In a 110 KV, 3Ø transposed transmission system, the conductors A, B, C are arranged horizontally. The distance between the conductors AB=BC=40 cm and AC=80 cm, find the capacitance per phase per km of the line by assuming the radius of each conductor being 0.042 cm (A) 0.00784 μF/ph/km (B) 0.00392 μF /ph/km (C) 0.00184 μF /ph/km (D) 0.01532 μF/ph/km	1	2	2
9.	The bus admittance matrix is calculated as (A) $A\, Z_{primitive}\, A^T$ (B) $A^T\, Y_{primitive}\, A$ (C) $A^T\, Z_{primitive}\, A$ (D) $A\, Y_{primitive}\, A^T$	1	1	3

10. While conducting power flow analysis, for a Load bus, specified quantities are 1 1 3
(A) Voltage magnitude and voltage phase angle
(B) Real power injected and reactive power injected
(C) Real power injected and voltage magnitude
(D) Real power injected and voltage phase angle

11. The Jacobian matrix computed for NR power flow problem of a 14-bus system is of size 21 x 21. The number of load buses in this power system is 1 2 3
(A) 7
(B) 8
(C) 5
(D) 6

12. A three-phase 200 MVA, 20 kV generator has winding reactance of 2.0 Ω. Its per-unit reactance is 1 2 3
(A) 0.01
(B) 0.1
(C) 1.0
(D) 10

13. When a three-phase short occurs at the terminals of an alternator, which one of the following is true? 1 1 4
(A) Sub-transient current < Transient current < Steady state current
(B) Sub-transient current > Transient current > Steady state current
(C) Sub-transient current > Transient current < Steady state current
(D) Sub-transient current < Transient current > Steady state current

14. A symmetrical fault occurs in a power system. When the base MVA is taken as 20 MVA with the fault level of 200 MVA. Find the equivalent Thevenin's impedance in p.u. 1 2 4
(A) 0.1j
(B) 0.2j
(C) 0.3j
(D) 0.4j

15. How the Synchronous machine model is represented in short circuit studies: 1 1 4
(A) Voltage source in series with a reactance
(B) Voltage source in parallel with a reactance
(C) Current source in series with a reactance
(D) Current source in parallel with a reactance

16. A symmetrical fault occurs in a power system. When the base MVA is taken as 25 MVA, the fault level is 500 MVA. Series reactor is used to reduce the fault level to 400 MVA. The required p.u. reactance of the series reactor is 1 2 4
(A) 0.0125
(B) 0.05
(C) 0.0625
(D) 0.8

17. In a single generator system, line to ground fault occurs at the terminals of the generator with fault impedance Z_F in which one the following is true? 1 1 5
(A) $V_a^{(1)} = V_a^{(2)}$
(B) $V_a^{(1)} = V_a^{(2)} = V_a^{(0)}$
(C) $I_a^{(1)} = I_a^{(2)} = I_a^{(0)}$
(D) $I_a^{(1)} = I_a^{(2)}$ and $I_a^{(0)} = 0$

18. For a Power transformer 1 1 5
(A) Positive sequence impedance is more than negative sequence and zero sequence impedance
(B) Positive, negative and zero sequence impedances are all equal
(C) Positive and negative sequence impedances are equal
(D) Positive sequence impedance is less

19. The positive, negative and zero sequences voltages are 0.8313 p.u ,-0.1687 p.u and -0.3254 p.u respectively. Calculate the line to line voltage V_{bc}. 1 2 5
(A) 0.3372 p.u
(B) -0.3372 p.u
(C) -6.9004 p.u
(D) 6.9004 p.u

20.	Swing equation used in transient stability analysis is (A) Non-linear algebraic equation (B) Linear algebraic equation (C) Non-linear differential equation (D) Linear differential equation	1	1	5

PART - B (5 × 4 = 20 Marks)

Answer **any 5** Questions

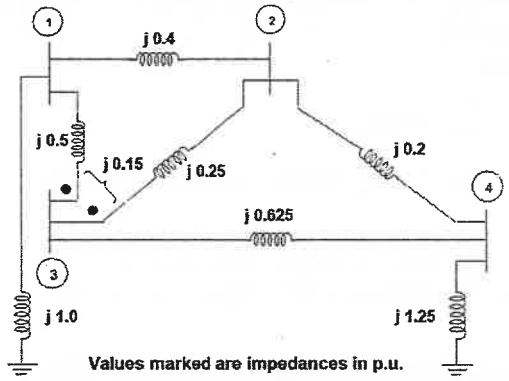
		Marks	BL	CO
21.	List the parameters affecting skin effect in transmission line.	4	2	1
22.	Define string efficiency and list the methods of improving string efficiency in line insulators.	4	2	2
23.	A single phase 9.6 kVA, 500 V / 1.5 kV transformer has a leakage reactance of 1.302 Ω with respect to primary side. Find its per-unit impedance with respect to primary and secondary sides.	4	3	3
24.	Discuss how the transmission loss can be calculated after obtaining the power flow solution.	4	1	3
25.	What are the factors to be considered for the selection of circuit breakers for short circuit study?	4	2	4
26.	Consider a balanced three-phase single generator system. For a line to line fault through some fault impedance, write the fault conditions, draw the interconnections of the sequence networks, write the equations for the sequence components of terminal currents and terminal voltages.	4	3	5
27.	Consider a synchronous motor connected to infinite bus. Discuss its stability when its output is suddenly increased.	4	3	5

PART - C (5 × 12 = 60 Marks)

Answer **all** Questions

		Marks	BL	CO
28.	(a) Derive an expression for the inductance per phase for a 3-phase overhead transmission line when (i) conductors are symmetrically placed and (ii) conductors are unsymmetrically placed but the line is completely transposed. **(OR)** (b) Show how regulation and transmission efficiency are determined for medium lines using (i) nominal T method and (ii) nominal Π method. Illustrate the answer with suitable vector diagrams.	12	3	1
29.	(a) Deduce an approximate expression for sag in overhead lines when (i) supports are at equal levels and (ii) supports are at unequal levels. **(OR)** (b) Define sub-station and its need in the power system. What are the different types of bus-bar arrangements used in sub-stations? Illustrate the answer with suitable diagrams.	12	3	2

30. (a) For the network shown, neglect the mutual coupling and compute Y_{bus} matrix using the bus incidence matrix and the primitive admittance matrix. Take the orientation of elements as from 1 to 2; from 3 to 1; from 3 to 2; from 4 to 2; from 3 to 4; from 0 to 1 and from 0 to 4. 12 3 3



(OR)

(b) Discuss the algorithmic steps and explain the solution procedure for the power flow solution using Newton Raphson method.

31. (a) For the network with the following data, construct the bus impedance matrix. 12 3 4

Element No.	Between buses		p.u. impedance
1	0	1	j 0.3
2	2	3	j 0.5
3	4	1	j 0.44
4	0	3	j 0.3
5	2	1	j 0.6
6	1	3	j 0.4

(OR)

(b) The bus impedance matrix of a four-bus power system, with values in p.u., is given by

Generators are connected to buses 1 and 2 and their subtransient reactances were included while computing Z_{bus}. A three-phase fault occurs at bus 3 with a fault impedance of j0.08 p.u. Find the subtransient current in the fault. If the sub-transient reactance of the generator in bus 2 is 0.2 p.u., determine the sub-transient fault current supplied by the generator. Also find the voltage at bus 4.

32. (a) Consider a balanced three-phase single generator system. For a double line to ground fault through some fault impedance, derive the fault conditions, draw the interconnections of the sequence networks, derive the equations for the sequence components of terminal currents and terminal voltages. 12 3 5

(OR)

(b) Two synchronous machines are connected through three-phase transformers to the transmission line as shown.

The ratings and reactance of the machines and transformers are:

Machines 1 and 2: 100 MVA, 20 kV, $X_1 = X_2 = 20$ %, $X_{m0} = 4$ %, $X_n = 5$ %

Transformers T_1 and T_2: 100 MVA, 20 Δ / 345 Y kV, X = 8 %

On a chosen base of 100 MVA, 345 kV in the transmission line circuit, the line reactance are $X_1 = X_2 = 15$ % and $X_0 = 50$ %. Draw each of the three sequence networks and find Z_{bus}^1.

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