BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER: VI**
BRANCH: EEE **SESSION: SP/2025**

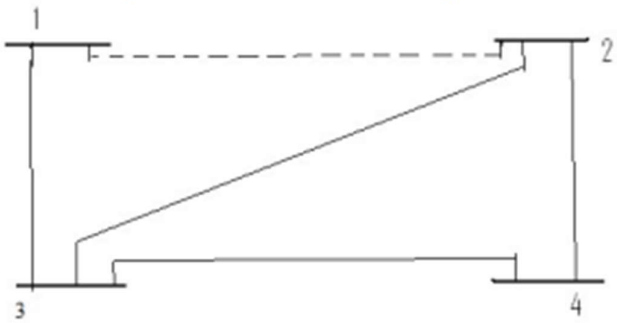
SUBJECT: EE355 POWER SYSTEM ANALYSIS

TIME: 3 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Describe the per unit system? How are the base quantities selected? How it is different from the percent system? Will the per unit value of the three-phase kVA on the 3-phase kVA base be identical to the per unit value of kVA per phase on the kVA per phase base?	[5]	1	3
Q.1(b)	A portion of a power system consist of 2 generators in parallel, connected to a step-up transformer that links them with 230 KV transmission line. The rating of these components are (where % reactances are computed based on individual component ratings): Generator G1-10 MVA, 11 kV 12 % reactance, Generator G2 - 5MVA, 11 kV 8% reactance. Transformer :15MVA, 11Y/230Δ kV, 6% reactance Transmission line: (4+j60) Ω, 230kV. Draw single line diagram and then draw the impedance diagram expressing all the parameters in per unit system with 15MVA and 25kV as the base value in generator circuit.	[5]	1	3
Q.2(a)	Give the reasons. (i) direct solution of load flow problem is not possible. (ii) Most of the buses in power system are load buses. (iii) An acceleration factor is commonly used in load flow studies using in GS method. (iv) Bus admittance matrix is a sparse matrix. (v) One of the buses is taken as slack bus in load flow studies	[5]	2	2
Q.2(b)	Table gives the line impedance identified by the buses on which these terminate. The shunt admittance at all the buses is negligible. Find Y_{bus} assuming that the line shown in figure below as dotted is not connected. What modification need to be carried out in Y_{bus} if the line shown dotted is connected.	[5]	2	3

Line bus to bus	R (pu)	X (pu)
1-2	0.05	0.15
1-3	0.10	0.30
2-3	0.15	0.45
2-4	0.10	0.30
3-4	0.05	0.15



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Q.3(a)	A synchronous generator and motor are rated 30,000 kVA, 13.2 kV, and both have sub-transient reactances of 20%. The line connecting them has a reactance of 10% on the base of the machine ratings. The motor is drawing 20,000 kW at 0.8 power-factor leading and terminal voltage of 12.8 kV when a symmetrical three-phase fault occurs at the motor terminals. Find the sub-transient currents in the generator, the motor, and the fault by using the internal voltages of the machines.	[5]	3	3
Q.3(b)	Classify the fault occurring in a power system. Give proper justification of increased current during a fault. What are the different time periods and associated reactance defined for short circuits currents?	[5]	3,4	2,1
Q.4(a)	Evaluate the following expressions in polar form: $(i)a-1; (ii)1-a^2+a; (iii)\ a^2+a+j; (iv)\ ja+a^2$ Prove that for an unbalanced system the three-phase complex power is expressed as $S_{3\varphi} = 3V_{a0}I_{ao}^* + 3V_{a1}I_{a1}^* + 3V_{a2}I_{a2}^*$ Where, a0, a1, and a2 represent zero sequence, positive sequence, and negative sequence components respectively.	[5]	4	5,2
Q.4(b)	Draw a diagram showing interconnections of sequence network for a double line to ground fault. Derive equations for sequence currents?	[5]	4	3
Q.5(a)	Derive the swing equation used for analyzing the rotor angle stability. Discuss the constant M and H and its significance in the swing equation.	[5]	5	2
Q.5(b)	Find the steady state power limit of a system consisting of a generator equivalent reactance 0.5 p.u. connected to an infinite bus through a series reactance of 1.0 p.u. The terminal voltage of the generator is held at 1.20 p.u. and the voltage at the infinite bus is 1.0 p.u. Draw the power-angle curve of a cylindrical rotor generator and show the steady state power limit determined above on the curve.	[5]	5	3

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