BIRLA INSTITUTE OF TECHNOLOGY

MESRA – 835215, RANCHI, INDIA

UG

Name: ………………………………………………… Roll No.: ……………………………………..

Branch: ………………………………………………… Signature of Invigilator: ……………………

Semester: VIth Date: 29/04/2022 (MORNING)

Subject with Code: **EE355 POWER SYSTEM ANALYSIS**

Marks Obtained	Section A (30)	Section B (20)	Total Marks (50)

INSTRUCTION TO CANDIDATE

1. The booklet (question paper cum answer sheet) consists of two sections. First section consists of MCQs of 30 marks. Candidates may mark the correct answer in the space provided / may also write answers in the answer sheet provided. The Second section of question paper consists of subjective questions of 20 marks. The candidates may write the answers for these questions in the answer sheets provided with the question booklet.
2. The booklet will be distributed to the candidates before 05 minutes of the examination. **Candidates should write their roll no. in each page of the booklet.**
3. Place the Student ID card, Registration Slip and No Dues Clearance (if applicable) on your desk. All the entries on the cover page must be filled at the specified space.
4. Carrying or using of mobile phone / any electronic gadgets (except regular scientific calculator)/chits are strictly prohibited inside the examination hall as it comes under the category of unfair means.
5. No candidate should be allowed to enter the examination hall later than 10 minutes after the commencement of examination. Candidates are not allowed to go out of the examination hall/room during the first 30 minutes and last 10 minutes of the examination.
6. Write on both side of the leaf and use pens with same ink.
7. The medium of examination is English. Answer book written in language other than English is liable to be rejected.
8. All attached sheets such as graph papers, drawing sheets etc. should be properly folded to the size of the answer book and tagged with the answer book by the candidate at least 05 minutes before the end of examination.
9. The door of examination hall will be closed 10 minutes before the end of examination. Do not leave the examination hall until the invigilators instruct you to do so.
10. Always maintain the highest level of integrity. Remember you are a BITian.
11. Candidates need to **submit the question paper cum answer sheets before leaving the examination hall**.

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

CLASS: UG **SEMESTER: 6TH**

BRANCH: EEE (MESRA/PATNA/DEOGHAR/JAIPUR) **SESSION: SP22**

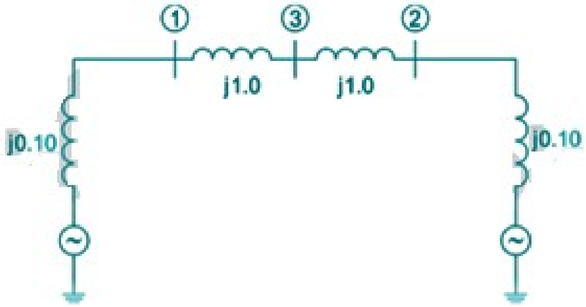
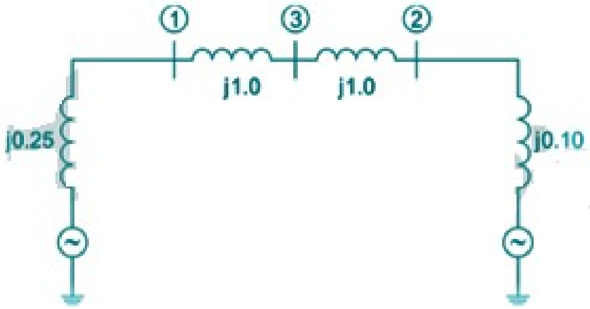
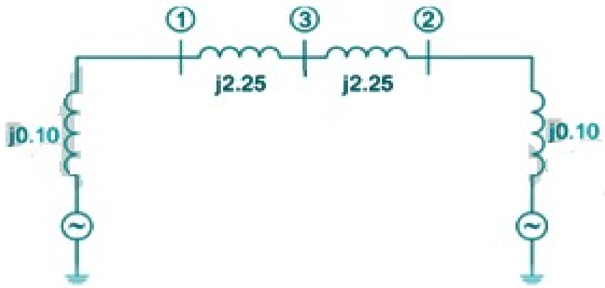
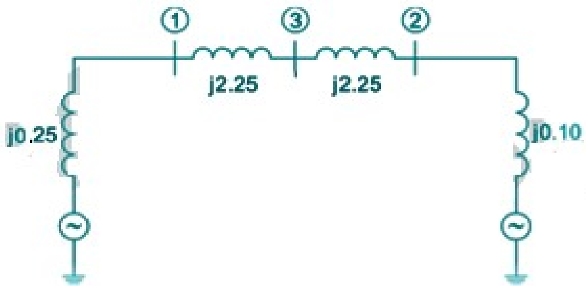
SUBJECT: EE355 Power System Analysis (SET A)

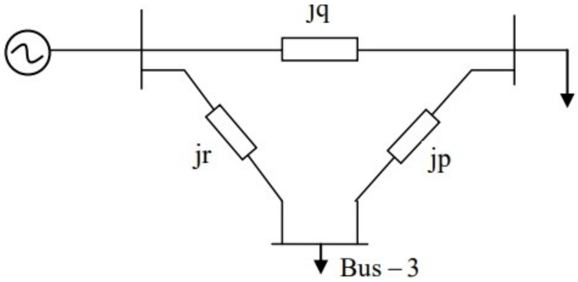
TIME: 2Hrs **FULL MARKS:50**

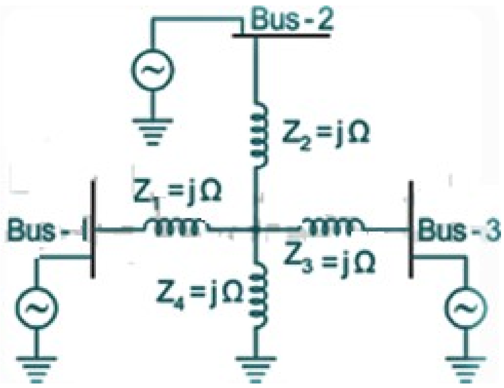
INSTRUCTIONS:
1. The question paper contains Two (2) sections. Section A comprises of 30 Marks, and Section B consists of 20 marks.
2. Both Section A and Section B are compulsory.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data handbook/Graph paper etc., to be supplied to the candidates in the examination hall.

SECTION (A)

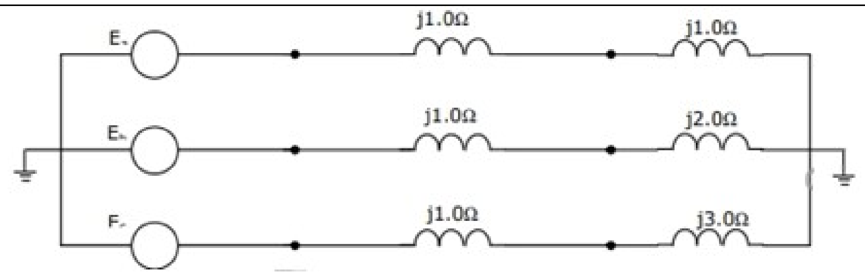
Q1.	The per unit impedance of a synchronous machine is 0.242. If base voltage is increased by 1.1 times, then per unit value will be a) 0.266 b) 0.242 c) 0.220 d) 0.200	1
Q2	The pu parameter for a 300 MVA machine on its own base are inertia M=10 pu, and reactance X=4 pu. The pu value of inertia and reactance on 50 MVA common base, respectively will be a) 60, 0.67 b) 40, 0.67 c) 60,0.4 d) 4, 10	1
Q3	Two generator units G1 and G2 are connected by 15 kV line as shown below  G_1: 250 MVA, 15 kV, positive sequence reactance X_{G1}= 25% on its own base G_2: 100 MVA, 15 kV, positive sequence reactance X_{G2}= 10% on its own base L_1 and L_2=10 km, positive sequence reactance X_L= 0.225 Ω/km on its own base. For the above system, the positive sequence diagram with the p.u values on the 100 MVA common base will be	2

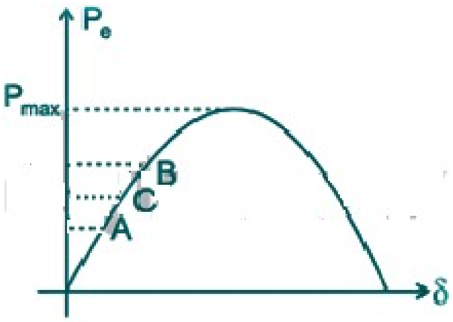
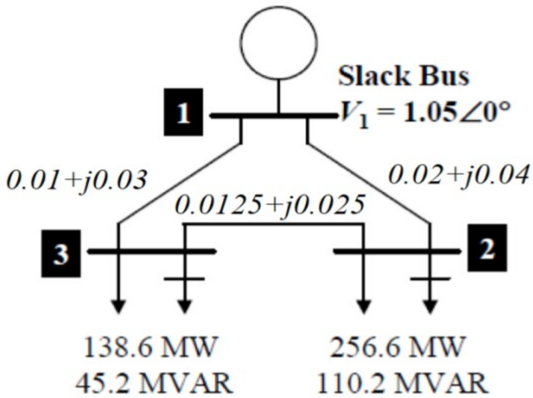
	a)  b)  c)  d)  	
Q4	A new generator having Eg = 1.4∠30 pu [equivalent to (1.212+j 0.70) pu] and synchronous reactance 'Xs' of 1.0 pu on the system base, is to be connected to a bus having voltage Vt in the existing power system. This existing power system can be represented by Thevenin's voltage Eth=0.9∠0 pu in series with	2

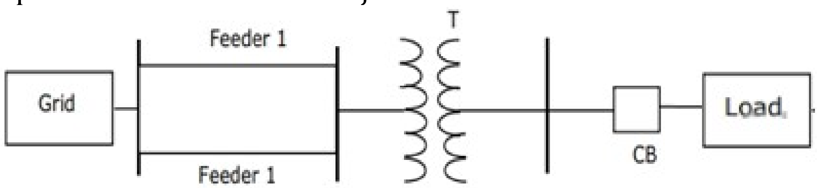
	Thevenin's impedance Zth=0.25∠90 pu. The magnitude of the voltage Vt, of the system in pu will be a) 0.990 b) 0.973 c) 0.963 d) 0.900	
Q5	What is the simplified diagram called, after omitting all resistances, static loads, capacitance of the transmission lines and magnetising circuit of the transformer? a) Single line diagram b) Resistance diagram c) Reactance diagram d) both a and b	1
Q6	A 3-bus power system is shown in the figure below, where the diagonal elements of Y-bus matrix are: Y11=−j12pu, Y22=−j15pu and Y33=−j7pu.  The per unit values of the line reactance's p, q and r shown in the figure are a) p = -0.2, q = -0.1, r = -0.5 b) p = 0.2, q = -0.1, r = 0.5 c) p = -5, q = -10, r = -2 d) p = 5, q = 10, r = 2	1
Q7.	A 3-bus power system network consists of 3 transmission lines. The bus admittance matrix of the uncompensated system is $$\begin{bmatrix} -j6 & j3 & j4 \\ j3 & -j7 & j5 \\ j4 & j5 & -j8 \end{bmatrix} pu$$ If the shunt capacitance of all transmission lines is 50% compensated, the imaginary part of the 3rd row 3rd column element (in pu) of the bus admittance matrix after compensation is a) -j7.0 b) -j8.5 c) -j7.5 d) -j9.0	2

Q8	In a load flow problem solved by Newton-Raphson method with polar coordinates, the size of the Jacobian is 100×100. If there are 20 PV buses in addition to PQ buses and a slack bus, the total number of buses in the system is a) 60 b) 61 c) 58 d) 62	2
Q9	The Gauss Seidel load flow method has following disadvantages. Tick the incorrect student. a) Unreliable convergence b) slow convergence c) choice of slack effects convergence d) good initial guess for voltage is essential for convergence	1
Q10	A 3 bus network is shown. Consider generator as Ideal voltage sources. If rows 1, 2 and 3 of the YBus matrix correspond to bus 1, 2 and 3 respectively, then YBus of the network is  (a) $\begin{bmatrix} -\frac{3}{4}j & \frac{1}{4}j & \frac{1}{4}j \\ \frac{1}{4}j & -\frac{3}{4}j & \frac{1}{4}j \\ \frac{1}{4}j & \frac{1}{4}j & -\frac{3}{4}j \end{bmatrix}$ (b) $\begin{bmatrix} -4j & 2j & 2j \\ 2j & -4j & 2j \\ 2j & 2j & -4j \end{bmatrix}$	2

	(c) $\begin{bmatrix} -\frac{1}{2}j & \frac{1}{4}j & \frac{1}{4}j \\ \frac{1}{4}j & -\frac{1}{2}j & \frac{1}{4}j \\ \frac{1}{4}j & \frac{1}{4}j & -\frac{1}{2}j \end{bmatrix}$ (d) $\begin{bmatrix} -4j & j & j \\ j & -4j & j \\ j & j & -4j \end{bmatrix}$	
Q11.	In an unbalanced three phase system phase current $I_a=1\angle(-90)$pu, negative sequence current $I_{b2} = 4\angle(-150)$pu, zero sequence current $I_{c0}=3\angle 90$ pu. The magnitude of phase current $\mathbf{I_b}$ in pu is a) 1 b) 7.81 c) 11.53 d) 13	2
Q12	The parameters of transposed overhead transmission line are given as: self reactance $X_s=0.4\Omega$/km and Mutual reactance $X_m = 0.1\Omega$/km. The positive sequence reactance X1 and zero sequence reactance X0 respectively in Ω/km are a) 0.3, 0.2 b) 0.5, 0.2 c) 0.5, 0.6 d) 0.3, 0.6	1
Q13	A 500 MVA, 50 Hz, 3-phase turbo-generator produces power at 22 kV. Generator is Y-connected and its neutral is solidly grounded. Its sequence reactances are $X_1 = X_2 = 0.15$ and $X_0 = 0.05$ pu. It is operating at rated voltage and disconnected from the rest of the system (no load). The magnitude of the sub-transient line current for single line ground fault at the generator terminal in pu will be a) 2.851 b) 3.333 c) 6.667 d) 8.553	2
Q14	A three-phase alternator generating unbalanced voltages is connected to an unbalanced load through a 3-phase transmission line as shown in figure. The neutral of the alternator and the star point of the load are solidly grounded. The phase voltages of the alternator are $E_a=10\angle 0$V, $E_b=10\angle -90$V, and $E_c=10\angle 120$V. The positive sequence component of the load current is	2

	 a) 1.310∠-107 A b) 0.332∠-120 A c) 0.996∠-120 A d) 3.510∠-81 A	
Q15	The severity of line-to-ground and three phase faults at the terminals of an unloaded synchronous generator is to be same. If the terminal voltage is 1.0 p.u. and Z1=Z2=j0.1 p.u., Z0=j0.05 p.u., for the alternator, then the required inductive reactance for neutral grounding is a) 0.0166 pu b) 0.05 pu c) 0.1 pu d) 0.15 pu	1
Q16	Which among the following reactance have a greater value? a) Sub transient reactance b) Transient reactance c) Synchronous reactance d) None of these	1
Q17	Why are series reactors used? a) Improve the transmission efficiency b) Improve the power factor of the power system c) To bring down the fault level within the capacity of switchgear instruments d) All of these	1
Q18	In which of the following given faults, all the sequence voltages at the fault point in a power system are equal? a) LG b) LLG c) LLL d) LL	1
Q19	The zero sequence current of a generator for line to ground fault is j3 pu. Then the current through the neutral during the fault is a) j3 b) j1 c) j9 d) j6	1
Q20	Equal area criterion is employed to determine a) Steady State Stability b) Transient Stability c) Reactive Power Limit d) Rating of CB	1

Q21	In rotor angle stability, condition for stability is a) $dP/d\delta = 0$ b) $d\delta/dt = 0$ c) $dV/dt = 0$ d) $dQ/d\delta = 0$	1
Q22	During a disturbance on the synchronous machine, the rotor swing from A to B before finally settling down to a steady state at point C on the power angle curve. The speed of the machine during oscillation is synchronous at points  a) A and B b) A and C c) B and C d) only at C	1
	Section B	
Q23	Figure below shows the single-line diagram of three-bus power system with generation at bus 1. The scheduled loads at buses 2 and 3 are as marked on the diagram. Line impedances are marked in per unit on 100 MVA base and the line charging susceptance are neglected.  a) Using Gauss-Seidel method, determine the phasor values of the voltage at load buses 2 and 3 (P-Q buses). Perform the calculation for one iteration. b) Find slack bus real and reactive power. Or	4

	Explain the Newton Raphson load flow method for solution of basic power flow equations.	
Q24	For the Y-bus matrix given in per unit values, where the first, second, third and fourth row refers to bus 1,2,3 and 4 respectively, draw the reactance diagram. $$Y_{bus} = j\begin{bmatrix} -6 & 2 & 2.5 & 0 \\ 2 & -10 & 2.5 & 4 \\ 2.5 & 2.5 & -9 & 4 \\ 0 & 4 & 4-8 & \end{bmatrix}$$	4
Q25	A single line-to-ground fault occurs on an unloaded generator in phase a. The positive, negative, and zero sequence impedances of the generator are j0.25 p.u., j0.25 p.u., and j0.15 p.u. respectively. The generator neutral is grounded through a reactance of j0.05 p.u. The prefault generator terminal voltage is 1.0 p.u. (a) Draw the positive, negative, and zero sequence networks for the fault given. (b) Draw the interconnection of the sequence networks for the fault analysis. (c) Determine the fault current. (d) Determine the rating of the CB at a bus near the fault point.	4
Q26	Determine the required MVA rating of the circuit breaker CB for the system shown in given figure. Consider the grid as infinite bus. Choose 6 MVA as base. Transformer: 3-phase, 33/11 kV, 6 MVA, 0.01+j0.08 p.u. impedance. Load: 3-phase 11 kV, 5800 kVA, 0.8 lag, j0.2 p.u. impedance. Impedance of each feeder 9+j 18 Ω.  Or Draw a general circuit which can be used to determine the zero sequence network of two winding transformer. Using this circuit, draw the zero sequence networks of a) star-star transformer with star grounded on secondary side, b) delta-delta transformer, and c) delta-star transformer with star grounded with some neutral impedance Zn.	4
Q27	Derive the swing equation of a synchronous machine swinging against an infinite bus. Clearly state the assumption in deducing the swing equation. Or	4

	Why do we decide the rating of a circuit breaker on the basis of symmetrical short-circuit currents? Can feeder reactors permit the use of circuit breakers of lower ratings? Illustrate with example.	