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BINA CHOWDHURY CENTRAL LIBRARY
(GIMT & GIP-3)
Azara, Hatkhewapara,
Guwahati -781017

2022

B.Tech. 5th Semester End-Term Examination

EE

POWER SYSTEM - II

(New Regulation & New Syllabus)

Full Marks – 70.

Time – Three hours

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

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

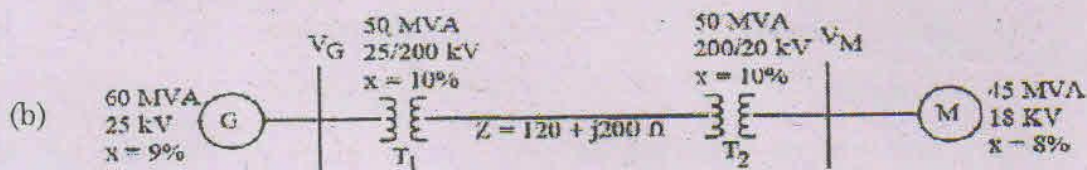
1. Find the correct answer : (10 × 1 = 10)
- (i) To reduce the generation cost of electricity
- (a) load factor should be low
(b) diversity factor should be low
(c) load factor and diversity factor should be low
(d) load factor and diversity factor should be high
- (ii) Due to power factor correction by connecting a static capacitor in parallel with the load, the power taken by the load
- (a) remains same (b) decreases
(c) Increases (d) is uncertain
- (iii) The sequence components of the fault current are as follows :
 $I_{\text{positive}} = j3.15 \text{ pu}$, $I_{\text{negative}} = -j0.84 \text{ pu}$, $I_{\text{zero}} = -j2.31 \text{ pu}$. The type of fault in the system is
- (a) LG fault (b) LL fault
(c) LLG fault (d) LLLG Fault

[Turn over

- (iv) A three phase transmission line operate at 10 KV has a resistance of 10Ω . The percentage resistance of the line at 10000 KVA is
- (a) 20% (b) 5%
(c) 10% (d) 40%
- (v) The three equivalent networks are connected in series for
- (a) SLG fault (b) LL Fault
(c) LLG fault (d) LLLG fault
- (vi) In ease of generator bus the unknown variables are
- (a) P and Q (b) P and $|V|$
(c) Q and δ (d) $|V|$ and δ
- (vii) The bus admittance matrix is a
- (a) Column matrix (b) Null matrix
(c) Sparse matrix (d) Diagonal matrix
- (viii) For a 15-bus power system with 3 voltage controlled bus, the size of the jacobian matrix is
- (a) 28×28 (b) 11×11
(c) 25×25 (d) 12×12
- (ix) The equal area criterion gives information regarding
- (a) Stability region (b) Absolute stability
(c) Relative stability (d) Swing curve
- (x) If a generator of 250 MVA rating has an inertia constant of 6MJ/MVA, its inertia constant an a 100 MVA base is :
- (a) 15 MJ/MVA (b) 10.5 MJ/MVA
(c) 6 MJ/MVA (d) 2.4 MJ/MVA

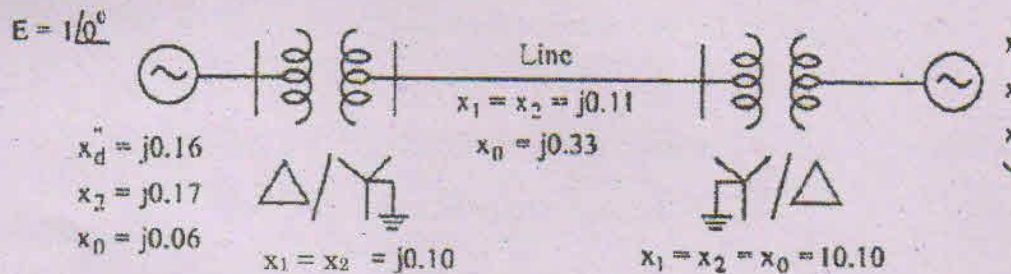
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2. (a) What is per unit impedance? Prove that per unit impedance of the transformer relent to the primary side is equal to the per unit impedance referred to secondary side? (7)



The figure shows a 3-phase radial transmission system. The ratings and reactances of the components are as shown. The Motor is drawing 45 MVA, 0.8 power factor lagging at a terminal voltage of 18 Kv (V_M) from 20 KV substation. Considering 100 MVA base for the whole system and base voltage of 25 KV on the Generator side, Determine the Terminal voltage of the Generator (V_G). (8)

3. (a) (i) Illustrate that balanced three phase system consists of positive sequence components only.
- (ii) Given, $V_a = 100 \angle 30^\circ$, $V_b = 50 \angle 300^\circ$, $V_c = 30 \angle 180^\circ$ Find the sequence components of voltages in phase a. (3+6)
- (b) Draw the sequence network for the system shown below (6)



4. (a) Deduce the condition of the fault on a line to line (L-L) fault in an unloaded generator considering the effect of fault impedance and neutral impedance and draw the sequence network. (7)
- (b) A 50 MVA, 1 kV three-phase alternator was subjected to different types of faults. The fault currents are as under :
- 3-phase fault = 2000 A; Line-to-Line fault = 2600 A ; Line-to-ground fault = 4200 A The generator neutral is solidly grounded. Find the values of the three sequence reactances of the alternator. Ignore resistances. (8)
5. (a) Distinguish between steady state, transient and dynamic stability. Starting from the first principle, derive the swing equation of a synchronous machine. (7)
- (b) A 100 MVA, 13.8 kV, 60 Hz 4 pole turbo generator has an inertia constant of 10 MJ/MVA. (a) Find the stored energy in the rotor at synchronous speed. (b) If the input to the generator suddenly raised to 60 MW for an electrical load of 50 MW, find the rotor acceleration. (c) if the rotor acceleration calculated in part (b) is maintained for 12 cycle, find the change in torque angle and rotor speed in rpm at the end of this period. (8)

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6. (a) The Maximum demand of a power plant is 60 MW with plant capacity factor 55% and plant utilization factor of 80%. If plant use factor is 75%, then
- What will be the daily energy produced and reserve capacity of the plant.
 - What will be the maximum energy that could be produced daily if the plant operating schedule is fully loaded when in operation and the average no. of hours during which the plant is not in service per day?
- (3+3)
- (b) From Y_{BUS} for the Network using direct inspection method. (4)

Element Impedances

1-2 j1.0

2-3 j0.4

2-4 j0.2

3-4 j0.2

3-1 j0.8

4-5 -j0.8

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- (c) Determine the Generation cost per unit of energy from the following plant data :

Installed capacity — 210MW

Capital cost of the plant = Rs. 12,000 per KW

Interest and depreciation — 15%

Fuel consumption = 0.9 Kg/KWh

Fuel Cost = Rs. 400 per 1000Kg

Salaries, Wages, Repairs and other

Operating cost Per annum = Rs, 10, 00,000/-

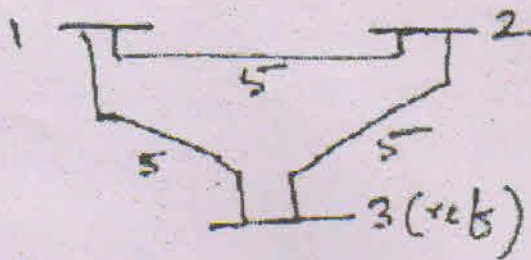
Load factor = 70%

Peak load = 90MW

(5)

7. (a) Explain in details (with related diagram) the arcing phenomenon in case isolated neutral system. (7)
- (b) A 132 kV, 3 phase, 50 cycle overhead line is 50 km long has a capacitance to earth for each phase is $0.0157 \mu\text{F}/\text{km}$. Determine the inductance and KVA rating of the Peterson coil. (8)

8. (a)



Form Z_{Bus} assuming Bus 3 as reference bus. (7)

- (b) (i) Mention two advantages of neutral grounding system
(ii) State the application of Generator neutral breaker
(iii) Write short notes on Peterson coil. (2+2+4=8)

9. Line data and bus of a 4-bus network given below. Using GS method determine

- (a) all voltage profile up to first Iteration. Take $\alpha = 1.6$ (12+3=15)
- (b) If $C_V = 0.001$, verify one iteration is sufficient for convergence.

Line data

Bus code	Admittance (pu)
1-2	$2-j8.0$
1-3	$1-j4.0$
2-3	$0.666-j2.664$
2-4	$1-j4.0$
3-4	$2-j8.0$

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Bus data

Bus code	$P_G(\text{pu})$	$P_L(\text{pu})$	$Q_G(\text{pu})$	$Q_L(\text{pu})$	$V_i(\text{pu})$	Remarks
1	—	—	—	—	1.06 $\angle 0^\circ$	Slack
2	0.0	0.5	0.0	0.2	—	PQ
3	0.0	0.4	0.9	0.3	—	PQ
4	0.0	0.3	0.0	0.1	—	PQ

10. Form only Jacobian matrix using NR method if the magnitude at bus -2 is to be maintained at 1.03 and $0 \leq Q_2 \leq 0.8$. (15)

Line data

Bus code	R(pu)	X(pu)	B(pu)
1-2	0.026	j0.11	j0.04
1-3	0.026	j0.11	j0.04
2-3	0.026	j0.11	j0.04

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Bus data

Bus code	$P_G(\text{pu})$	$P_L(\text{pu})$	$Q_G(\text{pu})$	$Q_L(\text{pu})$	$V_i(\text{pu})$	Remarks
1	—	—	—	—	1.04 $\angle 0$	Slack
2	1.5	—	0.0	—	1.03	PV
3	0.0	1.2	0.0	0.5	—	PQ