Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2023
ELECTRICAL AND ELECTRONICS ENGINEERING
(2020 SCHEME)

Course Code : 20EET304

Course Name: Power Systems – II

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

PART A

(Answer all questions. Each question carries 3 marks)

1. A three phase delta-star transformer with a rating of 1000 kVA, 11kV/400V has its primary and secondary leakage reactance as 12 Ω/ph and 0.05 Ω/ph respectively. Calculate the p.u reactance of transformer.
2. What is the significance of current limiting reactors in power system? Where are they located? Give examples.
3. Starting from the first principles, obtain the equations of real power and reactive power used in load flow problem.
4. How slack bus differs from other buses in a power system? What is the significance of slack bus in load flow analysis?
5. Explain the method of solving swing equation by point-by-point method.
6. Explain critical clearing angle and its significance with respect to the stability of a power system.
7. What is control area and ACE?
8. What is SCADA? Give its purpose.
9. Distinguish between economic dispatch and unit commitment.
10. What is the significance of spinning reserve constraint in unit commitment problem? Explain with example.

PART B

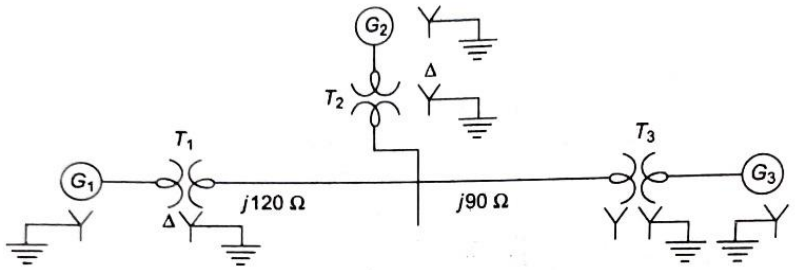
(Answer one full question from each module, each question carrie 14 marks)

MODULE I

11. The one-line diagram of a three-phase power system is shown in figure. Select a base of 30MVA, 6.6kV on the generator G_1 side. Draw the impedance diagram with all impedance marked in per-unit. The manufacture's data for each device is given as follows: (14)

G_1: 25MVA, 6.6kV, X=20%
G_2: 15MVA, 6.6kV, X=15%
G_3: 30MVA, 13.2kV, X=15%
T_1: 30MVA, 6.6Δ-115Y kV, X=10%
T_2: 15MVA, 6.6Δ-115Y kV, X=10%

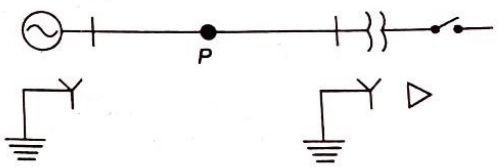
T_3: 3 Single phase units each rated 10MVA, 69/6.9kV, X=10%



OR

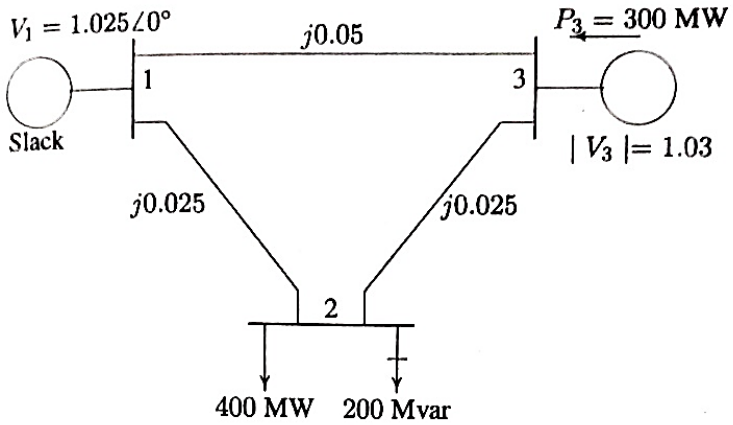
12. a) Derive the expression for fault current in a double line to ground fault on unloaded generator. Draw an equivalent network showing the inter connection of networks to simulate a line to line fault. (7)

b) A 3-phase generator is connected to a star/delta transformer as in figure. The positive, negative and zero sequence impedance of alternator are j0.1 p.u, j0.1 p.u and j0.05 p.u respectively and those for the transformer are j0.05 pu each. The positive, negative and zero sequence reactance of the line are j0.4, j0.4 and j0.8 pu respectively. Determine the fault current and voltage at fault point when a single line to ground fault occurs at point P at mid point of line and the alternator neutral is grounded. (7)



MODULE II

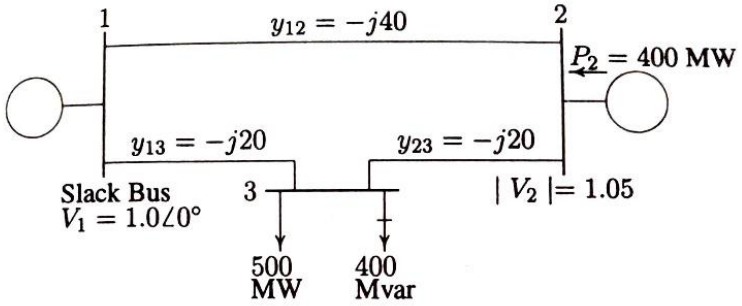
13. a) For the system shown in figure, obtain two iteration of load flow analysis using Gauss-Seidel method. Line impedances are marked in per unit on a 100MVA base. (10)



b) What is meant by acceleration factor in load flow solution .Why it is used and what is its range in G-S method (4)

OR

14. a) For the system shown in figure obtain the power flow solution using the fast-decoupled algorithm. Perform two iteration. Line admittances are marked in per unit on a base of 100 MVA.



(10)

b) State the static load flow problem. (4)

MODULE III

15. a) A 50Hz, four pole turbo-generator rated 100 MVA, 11 kV has an inertia constant of 8 MJ/MVA. Find the stored energy in the rotor at synchronous speed. If the mechanical input is suddenly raised to 80 MW for an electrical load of 50 MW, find rotor acceleration, neglecting mechanical and electrical losses. If the acceleration calculated in (ii) is maintained for 10 cycles, find the change in torque angle and rotor speed in revolution per minute at the end of this period. (8)

b) Starting from first principle, derive the swing equation of a synchronous machine. (6)

OR

16. a) A generator is transferring power to a load through a short line. The power angle equation is $P=P_m \sin\delta$. The initial power is P_i pu when a 3-phase fault occurs at the terminals of generator.

(i) Use equal area criterion to find equation for critical clearing angle and critical clearing time. (8)

(ii) Find critical clearing angle and critical clearing time if P_m=2pu, P_i=1pu, H=6 MJ/MVA, f=50Hz.

b) Explain the application of equal area criterion for a sudden increase in input of generator. (6)

MODULE IV

17. a) A two-area system connected by a tie line has the following parameters on a 1000 MVA common base.
The units are operating in parallel at a nominal frequency of 60 Hz. (9)
The synchronizing power co-efficient is given as 2.0 pu. If the load

in area1 increases by 187.5 MW, determine the new steady state frequency and the change in tie-line flow.

Area	1	2
Speed regulation	0.05	0.0625
Frequency sensitive load co-efficient	0.6	0.9
Inertia constant	5	4
Governor time constant	0.2	0.3
Turbine time constant	0.5	0.6

b) What is AVR? What are the functions? (5)

OR

18. a) Develop and explain the block diagram of automatic load frequency control of an isolated power system. (10)

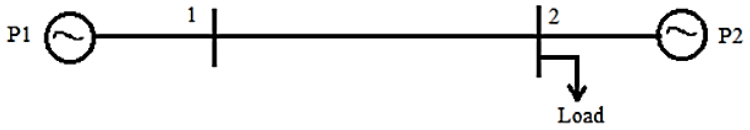
b) Enumerate the objectives of AGC. (4)

MODULE V

19. A two-bus system is shown in figure. If 100MW is transmitted from plant 1 to the load, a transmission loss of 10MW is incurred. Find the required generation for each plant and the power received by load when the system is Rs 25/MWh. The incremental fuel costs of the two plants are given below. (14)

$$\frac{dC_1}{dP_1} = 0.02P_1 + 16 \text{ Rs/MWh}$$

$$\frac{dC_2}{dP_2} = 0.04P_2 + 20 \text{ Rs/MWh}$$



OR

20. The fuel costs per hour of plants 1 & 2 are given below.
$F_1 = 0.2P_1^2 + 40P_1 + 120$ Rs/hr. and
$F_2 = 0.25P_2^2 + 30P_2 + 150$ Rs/hr.
Determine the economic operating schedule and the corresponding cost of generation if the maximum and minimum loading on each unit are 100MW and 25MW and the demand is 150MW and transmission loses are neglected. If the load is equally shared by both the units, determine the savings obtained by loading the units as per the equal incremental production cost. (14)

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