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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), MAY 2024
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. Discuss the necessity of base value in per unit quantities.
2. Prove that symmetrical components transformation is power invariant.
3. What is the significance of current limiting reactors in power system? Where are they located? Give examples.
4. Explain the computational procedure for load flow solution using fast decoupled load flow method.
5. Describe all methods to improve transient stability limit of power system.
6. Explain Equal area criterion and state the assumptions made.
7. List out the main functions of load frequency controller in power system.
8. Develop the block diagram of automatic load frequency control of an isolated power system.
9. Obtain the expression of incremental production cost for economic dispatch neglecting losses.
10. Examine the reason for maintaining spinning reserve on unit commitment.

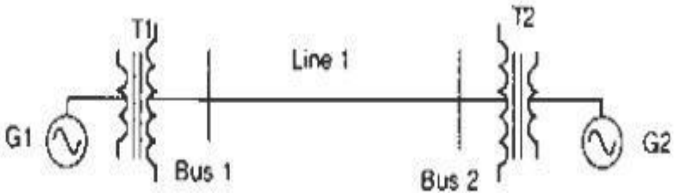
PART B

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

MODULE I

11\. a) Draw the impedance diagram the power system shown in the figure below, the specifications of the components are the following. (10)

G1: 25 kV, 100 MVA, X=9%
G2: 25 kV, 100 MVA, X=9%
T1: 25 kV/220 kV, 90 MVA, X=12%
T2: 220kV/ 25 kV, 90 MVA, X=12%
Line1: 220 kV, X= 150 ohms. Choose 25 kV as the base voltage at the generator G1, and 200 MVA as the MVA base.



b) Obtain the expression for converting the per unit impedance expressed on one base to another. (4)

OR

12. a) The voltage across a three-phase unbalanced load are $V_a=300<20$ Volt, $V_b=360<90^0$ Volt and $V_c=500<-140^0$ Volt. Determine the symmetrical component of voltages. The phase sequence is ABC. (6)

b) A single line to ground fault occurs at the terminals of a 30MVA, 11kv generator. The positive, negative and zero sequence impedances in pu are j0.2, j0.2 and j0.05 respectively. Find the line currents under faulted conditions. Assume that the generator is solidly grounded. (8)

MODULE II

13. The following is the system data for a load flow solution. The line admittances are given below. (14)

Bus code	Admittance
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

The schedule of active and reactive powers.

Bus code	P(pu)	Q(pu)	V(pu)	Remarks
1	-	-	1.06	Slack
2	0.5	0.2	1+j0.0	PQ
3	0.4	0.3	1+j0.0	PQ
4	0.3	0.1	1+j0.0	PQ

Determine the voltages at the end of first iteration using Gauss-Seidel method. Take $\alpha=1.6$

OR

14. a) Draw and explain the flow chart load flow solution using Newton-Raphson method. (10)

b) Write a brief note on Gauss Siedel method load flow. (4)

MODULE III

15. a) Using equal area criterion, derive an expression for critical clearing angle for a system having a generator feeding an infinite bus through a single circuit line. (10)

b) Discuss why transient stability limit is lower than steady state stability limit. (4)

OR

16. a) Derive an expression for swing equation of the synchronous machine. (6)

b) A 50 Hz four-pole turbo generator rated 20 MVA, 13.2 kV has an inertia constant of H = 9.0 kW-sec/kVA. Determine the K.E. stored in the rotor at synchronous speed. Determine the acceleration if the input less the rotational losses is 25000 HP and the electric power developed is 15000 kW. If the acceleration computed for the generator is constant for a period of 15 cycles, determine the change in torque angle in that period and the r.p.m. at the end of 15 cycles. Assume that the generator is synchronized with a large system and has no accelerating torque before the 15 cycle period begins. (8)

MODULE IV

17. A single area consists of two generating units with the following characteristics. (14)

unit	Rating	Speed regulation R (pu on unit MVA base)
1	600 MVA	6%
2	500 MVA	4%

The units are operating in parallel, sharing 900 MW at the nominal frequency. Unit 1 supplies 500 MW and Unit 2 supplies 400 MW at 60 Hz. The load is increased by 90 MW.

(a) Assume there is no frequency dependent load ie, D=0. Find the steady state frequency deviation and the new generation on each unit.

(b) The load varies 1.5% for every 1% change in frequencies D=1.5. Find the steady state frequency deviation and the new generation on each unit.

OR

18. a) Two generators rated 200 MW and 400 MW are operating in parallel. The droop characteristics of their governors are 4% and 5% respectively from no load to full load. Assuming that the generators are operating at 50 Hz at no load, how would a load of 600 MW be shared between them? What will be the system frequency at this load? Assume free governor operation. (8)

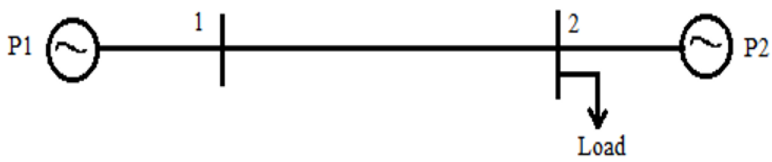
b) Explain the functions of SCADA in power systems. (6)

MODULE V

19. a) A two-bus system is shown in figure below. If a load of 125MW is transmitted from plant 1 to the load, a loss of 15.625MW is incurred. Determine the generation schedule and the load demand if the cost of received power is Rs.24/MWhr. Solve the problem using coordination equations and the penalty factor method. The incremental production costs of the plants are, (10)

$dF_1/P_1 = 0.025P_1 + 15$

$dF_2/P_2 = 0.05P_2 + 20$



b) Define penalty factors and loss coefficients in economic operation of power system. (4)

OR

20. a) A 2-bus system consists of two power plants connected by a transmission line. The cost curve characteristics of the two plants are, (8)

$C_1 = 0.01P_1^2 + 18P_1 + 20$ Rs/hr.

$C_2 = 0.03P_2^2 + 33P_2 + 40$ Rs/hr.

When a power of 120 MW is transmitted from plant 1 to load (near to plant 2), a loss of 16.425 MW is occurred. Determine the optimal scheduling of plants and load demand, if cost of received power is 36 Rs/MWh.

b) What is unit commitment problem? What are the constraints and solution techniques for unit commitment problem involving thermal plants. (6)

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