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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (S), AUGUST 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 single-phase transformer is rated 110/440V, 2.5kVA. Leakage reactance from the high voltage side is 0.08 Ω. Determine the leakage reactance in per unit.
2. Determine the symmetrical components of the three voltages.
   $V_a=230<30^0$, $V_b=230<120^0$ and $V_c=230<150^0$.
3. Explain DC load flow.
4. List and explain the different types of buses in power system.
5. Explain Phasor Measurement Unit (PMU).
6. Define critical clearing angle and critical clearing time.
7. Define sub synchronous resonance.
8. Draw the block diagram representation of generator-load model.
9. Define penalty factor.
10. List the constraints in unit commitment.

PART B

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

MODULE I

11. A single line diagram of a Power System network is shown in Figure 1. The generator, motor and transformers are rated as follows. (14)

    Generator : 50 MVA, 25 kV, X" = 0.15 pu
    Motor : 40 MVA, 20 kV, X" = 0.2 pu
    Transformer T1: 60 MVA, 33/110 kV, X= 0.1 pu
    Transformer T2 : 40 MVA, 33/110 kV, X= 0.15 pu

    The motor is drawing 20 MW at 0.85 pf leading and a terminal voltage of 15 kV when a symmetrical three phase fault occurs at the motor terminals at point 'P'. Find the fault current, subtransient currents in the generator and motor circuit.

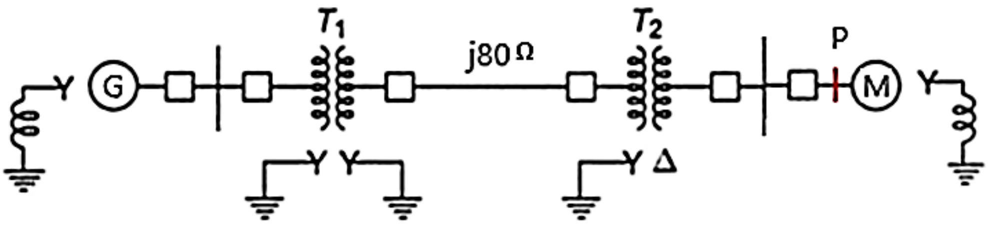

Figure 1.

OR

12. a) List any three advantages of per unit system. Obtain the expression for converting the per unit impedance expressed in one base to another. (6)

b) A 25 MVA, 11 kV alternator with solidly grounded neutral has a subtransient reactance of 0.25 pu. The negative and zero sequence reactances are 0.35 pu & 0.15 pu respectively. A double line to ground fault occurs at the terminals of the unloaded alternator. Determine the actual fault current and the line to line voltages. (8)

MODULE II

13. a) Figure 2 shows the single line diagram of a 3-bus power system. The magnitude of voltage at bus 1 is adjusted to 1.05 pu. Voltage magnitude at bus 3 is fixed at 1.04 pu with a real power generation of 200 MW. A load consisting of 400 MW and 250 MVAR is taken from bus 2. Line impedances are marked in pu on a 100MVA base. Solve the system using Fast Decoupled Load Flow (FDLF) method. (9)

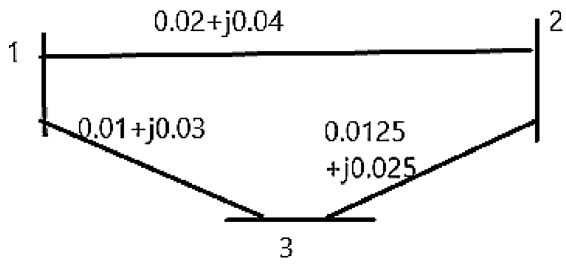

Figure 2

b) Formulate the Y_{bus} for the line data shown in Table 1. (5)

Table1

Line (bus to bus)	R (pu)	X (pu)	Y/2 (pu)
1-2	0.0181	0.0542	0.0511
1-3	0.0074	0.0327	0.0357
2-4	0.0063	0.0372	0.0357
3-4	0.0127	0.0646	0.0635

OR

14. a) Explain the algorithm for load flow analysis using Newton Raphson method. (5)

b) In the 4 bus system, shown in Figure 3, each line has an impedance of 0.05+j0.15 pu. The line shunt admittance may be neglected. The bus power and voltage specification are given in Table 2. Find the bus voltages at the end of first iteration. Assume Q_{2min}=0.2 pu and Q_{2max}= 0.6 pu. (9)

Table 2

Bus	P_L	Q_L	P_G	Q_G	V	Remarks
1	1.0	0.5	-	-	1.02<0	Slack bus
2	0	0	2	-	1.02	PV bus
3	0.5	0.2	0	0	-	PQ bus
4	0.5	0.2	0	0	-	PQ bus

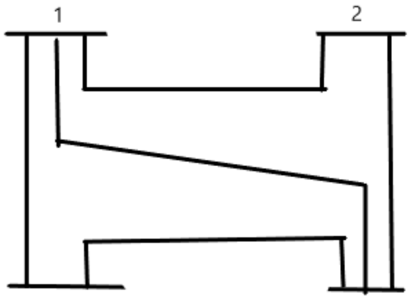

Figure 3

MODULE III

15. a) Explain the factors affecting transient stability in power systems. (7)
b) Derive the swing equation of a synchronous machine. (7)

OR

16. a) A synchronous machine is delivering 1.0pu power to an infinite bus through a double circuit transmission line as shown in Figure 4. The direct axis transient reactance of the generator is 0.3pu and the reactance of each line is 0.5pu. All reactances are given to a base of the machine rating. One of the transmission lines experiences a solid three phase fault to ground at point F. Determine the critical clearing angle before which the circuit breakers of the faulted line should operate, if stability is to be maintained in the system. (8)

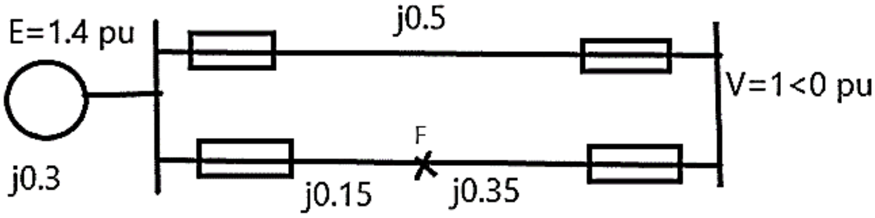

Figure 4

b) Explain equal area criterion and state the assumptions made (6)

MODULE IV

17. a) Sketch and explain the Automatic voltage regulator scheme. (7)
b) Explain SCADA system. Mention its applications. (7)

OR

18. a) Draw and explain the block diagram representation of Load Frequency control of a single area system. (10)

b) Explain free governor operation. (4)

MODULE V

19. a) Explain unit commitment. (6)

b) For a 2 bus system shown in Figure 5, if 150 MW is transmitted from plant 1 to the load, transmission loss of 15 MW is incurred. Find the required generation for each plant and the power received by load when the system λ is Rs.25/MWh. The incremental fuel costs of 2 plants are given as, (8)

$$\frac{dF_1}{dP_1} = 0.02P_1 + 16\ Rs/MWh$$
$$\frac{dF_2}{dP_2} = 0.04P_2 + 20\ Rs/MWh$$

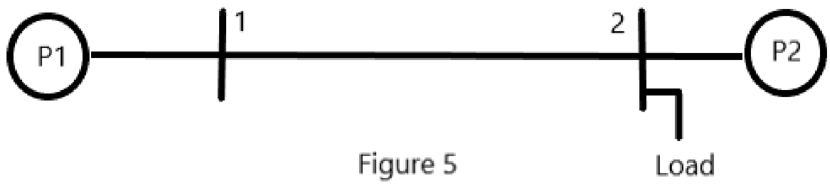

Figure 5

OR

20. a) The fuel consumption in Rs/hr for two 800 MW thermal power plant is given by (10)

$$F_1 = 12800 + 248P_1 + 0.16P_1^2$$
$$F_2 = 8000 + 240P_2 + 0.12P_2^2$$

P_1 and P_2 are in MW. Plant outputs are subjected to the following limits in MW.

$50 \le P_1 \le 250$ and

$50 \le P_2 \le 350$.

Determine the minimum cost of generation per day if the load curve is as shown in Figure 6.

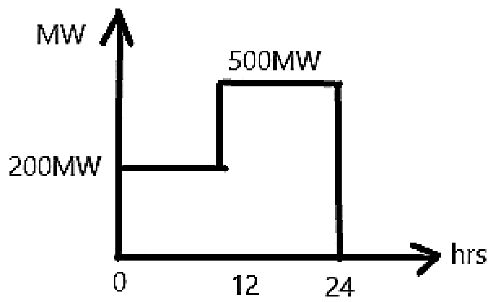

Figure 6

b) Explain the loss coefficients in economic load dispatch. (4)

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