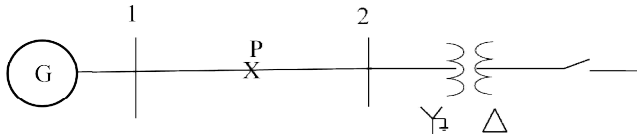
(b) Find the expression for three phase power in terms of symmetrical components. (4)

10 A synchronous generator and motor are rated 30MVA, 13.2kV and both have sub-transient reactances of 20%. The line connecting them has a reactance of 10% on the base of the machine ratings. The motor is drawing 20,000kW at 0.85 power factor lagging at a terminal voltage of 12.8 kV when a symmetrical three phase fault occurs at the motor terminals. Find the sub-transient current in the generator, motor and fault. (10)

11 (a) A three phase generator is connected to a star-delta transformer as shown in the figure. (6)



The reactance values referred to a common base are :

	Z_1	Z_2	Z_0
Alternator	j0.1	j0.1	j0.05
Transformer	j0.05	j0.05	j0.05
Transmission line	j0.4	j0.4	j0.8

Determine the fault current when a double line to ground fault occurs at point 'P' at the mid-point of the line if the alternator neutral is grounded. Assume that the generator is not loaded.

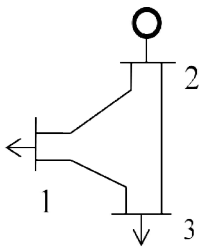
(b) Obtain the symmetrical components of the following set of unbalanced currents (4)
$I_a = 1.6\angle 250^0$, $I_b = 1.0\angle 180^0$, $I_c = 0.9\angle 132^0$.

PART C

Answer any two full questions, each carries 10 marks.

12 Explain the computational procedure for load flow solution using fast decoupled load flow method. (10)

13 Figure shows a three bus power system. The impedance of each line is (0.026 + j0.11) pu. (10)



The bus details are given in the table below

Bus	P_G(pu)	Q_G(pu)	P_L(pu)	Q_L(pu)	|Vi|(pu)	Angle	Remarks
1	-	-	1.0	0.5	1.03	0^0	Slack bus
2	1.5	-	0	0	1.03	-	PV bus
3	0	0	1.2	0.5	-	-	PQ bus

Assuming a flat voltage start, find the voltages and bus angles at the buses at the end of the first iteration using Gauss-Siedel method.

14 A two area system connected by a tie line has the following parameters on a 1000 MVA common base. (10)

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

The units are operating in parallel at a nominal frequency of 60 Hz. 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.

PART D

Answer any two full questions, each carries 10 marks.

15 Prove that the maximum permissible sudden increase in load is 72.5% of the steady state limit if the machine is initially at no load. (10)

16 (a) Explain Equal Area criterion and state the assumptions made. (5)

(b) Derive the expression for transmission losses as a function of power generation. (5)

17 (a) What is unit commitment problem? What are the constraints and the solution techniques for unit commitment problem involving thermal plants? (5)

(b) Find the energy stored in the rotor of a three phase, 50 Hz. 250 MVA turbo alternator with H=7.5 MJ/MVA. Determine the value of the inertia constant M. The generator is initially supplying a steady power of 150 MW. If the mechanical power input to the turbine is suddenly decreased to 100 MW, evaluate the initial acceleration of the rotor neglecting all losses. Assume 6 poles. Also find the rotor speed after 10 cycles. (5)

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