Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION, APRIL 2018

Course Code: EE306

Course Name: POWER SYSTEM ANALYSIS (EE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1 A 120 MVA, 19.5 kV generator has X = 1.5 percent and is connected to a transmission line by a star-delta transformer rated 150 MVA, 230/18 kV with X = 0.1 percent. If the base to be used in the calculations is 100MVA, 230kV for the transmission line, find the per unit values to be used for the transformer and generator reactances. (5)

2 A single line to ground fault occurs at the terminals of a 30 MVA, 11 kV 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. (5)

3 What are the main functions of load frequency controller in power system? (5)

4 Classify the various types of buses in a power system for load flow studies. (5)

5 The fuel cost functions for three thermal plants in Rs/hr. are given by, (5)

$$C_1 = 500 + 5.3P_1 + 0.004P_1^2$$
$$C_2 = 400 + 5.5P_2 + 0.006P_2^2$$
$$C_3 = 200 + 5.8P_3 + 0.009P_3^2$$

Find the power generated by each plant if the total demand is 800MW.

6 What do you mean by penalty factor as referred to economic operation of power system? (5)

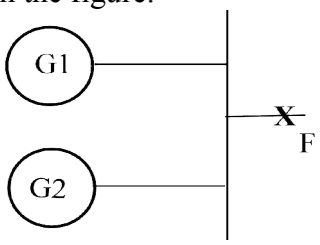
7 What are the factors affecting transient stability in power system? (5)

8 What is swing equation? Derive the expression for swing equation for a synchronous machine connected to an infinite bus. (5)

PART B

Answer any two full questions, each carries10 marks.

9 (a) Two 11 kV, 3-phase generators rated 10 MVA, 25% and 20 MVA, 40% operate in parallel. Calculate the short circuit kVA if a three phase short circuit occurs on the feeder at point 'F' as shown in the figure. (6)

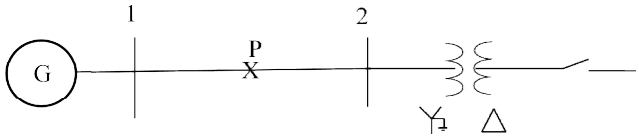


Calculate the reactance value of the feeder reactor to be included so that the short circuit kVA is reduced by 50%.

(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.

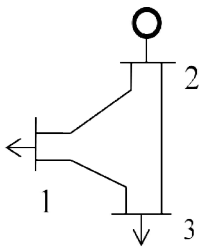
(b) Obtain the symmetrical components of the following set of unbalanced currents (4)
$I_a = 1.6\angle 250^0$, $I_b = 1.0\angle 180^0$, $I_c = 0.9\angle 132^0$.

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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