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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S, FE) / S4 (PT) (S, FE) Examination January 2024 (2015 Scheme)

Course Code: EE306

Course Name: POWER SYSTEM ANALYSIS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1 Explain how base values can be selected and derive the formula for base impedance of a three phase system. (5)

2 Draw the sequence diagram for a single line-to-ground fault at the generator terminals and derive the equation for the fault current. Assume that the generator neutral is solidly grounded and that the generator terminals are open circuited. (5)

3 Derive the power flow equations. (5)

4 Draw the complete block diagram of a single area system and explain each block. (5)

5 Explain the various constraints in unit commitment. (5)

6 Fuel input per hour of plant 1 and 2 are given by

$F_1 = 0.2\,P_1^2 + 40\,P_1 + 120\ Rs/hr$

$F_2 = 0.25\,P_2^2 + 30\,P_2 + 150\ Rs/hr$

The maximum and minimum loading on each unit is 100MW and 25MW Determine the economic operating schedule and corresponding cost of generation if the total demand is 180MW. Neglect transmission losses. (5)

7 Derive and explain the concept of equal area criterion for stability analysis of a power system (5)

8 Define synchronising power coefficient and explain its significance. (5)

PART B

Answer any two full questions, each carries 10 marks.

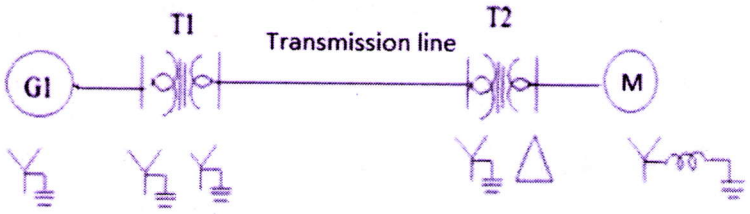
9 Draw the reactance diagram of the power system shown in figure. Neglect resistance and use a base of 100MVA, 220kV in 50Ω line. The ratings of generator motor and transformers are given below (10)

Generator:40MVA,25kV,X"=20%

Motor: 50MVA, 11kV, X"=30%

Transformer T1:40MVA, 33/220kV, X=15%

Transformer T2:30MVA, 11/220kV, X=15%



10 a) What are symmetrical components? Prove that symmetrical component transformation is power invariant. (5)

b) Draw and explain the oscillogram of short circuit current when an alternator is subjected to a 3-phase fault (5)

11 A 3-phase transmission line operating at 10 kV and having a resistance 1Ω and reactance of 4Ω is connected to the generating station bus-bars through 5 MVA step-up transformer having a reactance of 5%. The bus-bars are supplied by a 10 MVA alternator having 10% reactance. Calculate the short-circuit kVA fed to symmetrical fault between phases if it occurs (10)

(i) at the load end of transmission line

(ii) at the high voltage terminals of the transformer

PART C

Answer any two full questions, each carries 10 marks.

12 Describe the Newton-Raphson method for the solution of power flow equations in power systems (10)

13 a) Explain different types of buses in a power system. What is the significance of slack bus? (5)

b) A 100 MVA 50 Hz turbo alternator operates at no load at 3000 rpm. A load of 25MW is suddenly applied to the machine and steam valves to the turbine commences to open after 0.6sec due to the time lag in the governor system. Assuming inertia constant H of 4.5kW-s/kVA of generator capacity. Calculate the frequency to which generated voltage drops before the steam flow commences to increase to meet the new load. (5)

14 Derive the tie line model and draw the complete block diagram of a two area system without PI controller. (10)

PART D

Answer any two full questions, each carries 10 marks.

15 a) Derive the expression for economic operation of a plant having different units (5)

neglecting transmission losses?

b) The fuel-cost functions for three thermal plants in \$/h are given by (5)
$C_1 = 300 + 7P_1 + 0.004P_1^2$
$C_2 = 450 + 7.3P_2 + 0.0025P_2^2$
$C_3 = 600 + 6.6P_3 + 0.003P_3^2$
where P_1, P_2 and P_3 are power output in MW. Assuming that all units are operating at all times, what is the saving in fuel cost in \$/h for optimal scheduling of a total load of 500 MW compared to equal distribution of the load between the three units. Neglect losses.

16 a) Derive the expression for transmission loss as function of plant generation. (5)

b) A two pole 50Hz 11kV turbo generator has a rating of 60MW,0.85 pf lag. Its rotor has a moment of inertia of 8800 kg-m^2. Calculate its inertia constant in MJ/MVA and its angular momentum in MJ-s/elec.deg. (5)

17 a) Draw and explain the diagram to illustrate the application of equal area criterion to study the transient stability of a power system for a switching operation causing the switching out of one of the circuits of a double circuit line feeding an infinite bus. (5)

b) Explain the various methods to improve the transient stability of a power system. (5)

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