Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–VII • EXAMINATION – WINTER • 2014

Subject Code: 170901 **Date: 25-11-2014**
Subject Name: Interconnected Power Systems
Time: 10:30 am - 01:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1

(a) Prove that $Md^2\delta/dt^2 = P_m - P_e$, P_m is mechanical power, Pe is electromagnetic power and M is angular momentum (7)

(b) Derive static load flow equations. Hence explain classification of buses (7)

Q.2

(a) Taking into consideration the transmission losses, derive the criterion for the economic distribution of load between various plants of a power system (7)

(b) The Z_{BUS} matrix for a certain system is given by (7)

$$Z_{BUS} = \begin{bmatrix} 0.4054 & 0.1622 & 0.3243 \\ 0.1622 & 0.3649 & 0.2297 \\ 0.3243 & 0.2297 & 0.4595 \end{bmatrix}$$

Find the modified bus impedance matrix if the line from bus 1 to bus 3 is removed. Assume that impedance of line between bus 1 and bus 3 is 0.25 ohm

OR

(b) 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 a load of 600 MW would be shared between them? What would be the system frequency at this load? (7)

Q.3

(a) Explain GS method with the help of flowchart (8)

(b) Compare GS and NR method for load flow (6)

OR

Q.3

(a) Derive the expression for B-coeffcients. State the assumptions made (10)

(b) In a system consisting of two generating units connected through a transmission line, the incremental costs are (4)

$dF1/dP1 = 0.16P_1 + 32$ Rs/MWh, $dF2/dP2 = 0.24P_2 + 36$ Rs/MWh

The system is operating on economic dispatch with $P_1 = P_2 = 100$ MW and

$\delta P_L/\delta P_2 = 0.2$ Find the penalty factor of plant 1.

Q.4

(a) What is synchronizing coefficient? Prove that synchronizing coefficient of a machine should be positive for system stability (7)

(b) A synchronous generator connected to a 50 Hz infinite bus bar through a (7)

transformer and transmission line has an inertia constant of 3.5 MJ/MVA. The synchronous reactance of the generator is 0.8 pu and total reactance of the transformer and transmission line is 1.2 pu. If no load voltage of the generator is 1.15 pu, calculate the frequency of natural oscillations of the generator rotor if the generator is loaded to (i) 50% and (ii) 75% of its max power limit

OR

Q.4

(a) A synchronous machine is delivering power to an infinite bus through two transmission lines in parallel. Suddenly a fault occurs at the mid point of one the transmission lines which causes it to trip after some time. After the fault is cleared the synchronous machine delivers power through one of the transmission line. Derive the expression for critical clearing angle. (7)

(b) A synchronous generator is feeding 250 MW to a large 50 Hz network over a double circuit transmission line. The maximum steady state power that can be transmitted over the line with both the lines in operation is 500 MW and is 350 MW with only one line in operation. A solid three phase fault occurring at the network end of one of the lines causes it to trip. Find the critical clearing angle (7)

Q.5

(a) With the help of a neat diagram explain turbine speed governing system. Also derive its mathematical model (10)

(b) A 210 MVA, 50 Hz, turbo-alternator operates at no load at 3000 rpm. A load 75 MW is suddenly applied to the machine and the steam valves to the turbine commence to open after 1 second due to time lag in the governor system. Assuming inertia constant H = 5 kW-sec/kVA, calculate the frequency to which generated voltage drops, before the steam flow commences to increase to meet the new load (4)

Q.5

(a) Discuss in brief the methods for improving transient stability (7)

(b) Explain tie-line load bias method of frequency control (7)

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