Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(EE-PS)/SEM-1/PSM-101/2012-13

2012

POWER SYSTEM OPERATION AND CONTROL

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer Q. No. 1 and any *four* from the rest.

1. a) Explain the term 'Participation factor' and 'Base point' in respect of Economic Dispatch Problem. 4

   b) Explain the significance of Inertia constant of synchronous generator with respect to power system frequency control. 3

   c) Compare 'Synchronous condenser' and 'Tap changing transformer' as voltage control devices. 2

   d) How Economic Dispatch problem is different from the Unit Commitment Problem ? 2

   e) Explain the interdependence between reactive power and bus voltage of power system. 3

2. a) Explain the importance of 'Spinning reserve' and 'Ramp-up & Ramp-down' constraints in the unit commitment problem.

   b) How start-up & shut-down costs are included in the unit commitment problem when

      i) the units are allowed to cool down

      ii) the units are in 'Banking' condition ?

   c) Explain the priority order approach for solving the unit commitment problem. How are different constraints taken into consideration using the shut-down algorithm ? 4 + 4 + 6

3. a) Derive the condition for the Economic Generation Schedule of the thermal generators of a power system.

   b) Explain the steps of the iterative solution procedure of the Generation Scheduling problem.

   c) The two generators of a power plant have the following input-output characteristics and capacity limits :

   $I_1 = 600 + 45P_1 + 0 \cdot 01P_1^2$ Rs./hr.

   $I_2 = 1400 + 42P_2 + 0 \cdot 006P_2^2$ Rs./hr.

   $50 \le P_1 \le 300$ MW; $100 \le P_2 \le 700$ MW.

   Obtain a generation schedule for the whole range of operation of the generators. 5 + 4 + 5

4. a) Classify the hydro-thermal scheduling problems.

   b) Discuss the economic justification of the pumped storage plants.

   c) Formulate the scheduling problem for pumped storage plants and derive the condition for optimum schedule.

   3 + 4 + (4 + 3)

5. a) Explain the term 'Power System Security'.

   b) Why contingencies are ranked for power system security analysis ?

   c) How contingencies may be ranked ?

   d) Discuss the method of 'Distribution factors' for contingency analysis. 2 + 3 + 4 + 5

6. a) Obtain a model for 'Tie line' to be used in load-frequency control problem.

   b) Define Area Control error for frequency-bias-tie-line control.

   c) Draw the Transfer function block diagram of a two-area power system for frequency bias-tie-line control. (Derivations are not needed) 5 + 3 + 6

7. a) Show that transmission loss may be expressed as a function of the active power outputs of the Generators of a power system. Justify the assumptions you make.

   b) A 4-GW power system is interconnected with a 10-GW power system. The 4 GW system has the system parameters R = 2·5 Hz/P.U. μW, B = 8·5 $\times 10^{-3}$ P.U. μW/Hz. The 10-GW system has the same parameters in terms of the 10-GW base. A 40 MW load increase takes place in the 10-GW system. Find the static frequency drop and tie line power interchange. Nominal frequency of the system = 50 Hz. (6 + 3) + 5

8. Write short notes on the following :

   a) Load forecasting for power system operation. 4

   b) Dynamic programming approach for unit commitment problem. 5

   c) Frequency dependence of loads. 5

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