Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH(EE)/SEM-1/EDPM-105A/2012-13

2012

POWER SYSTEM OPERATION AND CONTROL

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

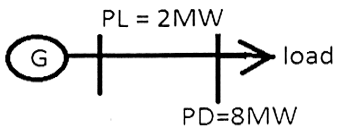
Candidates are required to give their answers in their own words as far as practicable.

Answer Q. No. 1 and any *four* from the rest. $5 \times 14 = 70$

1. Answer any *seven* of the following : $7 \times 2 = 14$

   a) What is the condition for optimum operation ?

   b) Determine the incremental cost of received power and the penalty factor of the plant shown in figure below if the incremental cost of production is $\frac{dF_1}{dP_1} = 0 \cdot 1P_1 + 3 \cdot 0$ Rs./MWhr.



   c) What is penalty factor ? What is the formula with reference to $\frac{\partial Pl}{\partial Pn}$?

d) What are the advantages of dynamic approach ?

e) What do you mean by priority ordering ?

f) What is equations for availability and unavailability ?

g) Write notes on control area concept.

h) Define flat-tie line loading control.

i) Define area control error (ACE).

j) What is the improvement of Dynamic response ?

k) Write damping coefficient formula.

l) State power system static security levels.

m) State Patton's security function.

2. Define and explain the synchronizing coefficient between two areas of a two-area power system. Write the formula of synchronizing coefficient.

   Two interconnected areas 1 and 2 have the capacity of 1000 MW and 500 MW respectively. The incremental regulation and damping torque coefficient for each area on its base are 0·1 pu and 1·0 pu respectively. Find the steady state change in system frequency from a nominal frequency of 50 Hz and the change in steady state tie-line power following a 50 MW change in load of area 1.

3. What is meant by the unit commitment problem ? Write the constraints in unit commitment problem. Write the equations for startup cost when cooling and banking. Define spinning reserve. Explain elementary treatment of Optimum Power Flow (OPF) with inequality constraints (control variables) along with conditions for minimization of *L*. Explain the inequality constraints on Dependent Variables.

4. What do you understand by incremental fuel rate ? State its unit. What do you understand by heat rate ? Give the units of heat rate curve. A system consists of two plants connected by a tie-line and load which is located at plant 2. When 100 MW are transmitted from plant 1 a loss of 10 MW takes place on the tie-line. Determine the generation schedule at both the plants and power received by the load when λ for the system is Rs. 25 per MWhr and the incremental fuel costs are given by the equations $\frac{dF_1}{dP_1} = 0 \cdot 03P_1 + 17$ Rs./MWhr and $\frac{dF_2}{dP_2} = 0 \cdot 06 + 19$ Rs./MWhr. 2 + 1 + 2 + 1 + 8

5. State the factors affecting power system security. "One way to gain speed of solution in a contingency analysis procedure is to use an approximate model of the system. For many systems the use of DC load flow models provides adequate capability." Justify. Draw the flow chart for contingency analysis procedure. Explain linear sensitivity factors with reference to (i) generation shift factors and (ii) line outage distribution factors. 3 + 2 + 3 + 3 + 3

6. What is system state classification ? What is loss of load probability (LOLP) ? Explain frequency and duration of a state. Explain power system reliability. What are the basic methods of state estimation ? Explain. A radial system consists of a transformer and a distributor 0·5 km long. Given : λ_{tr} = 0·5 failures/year and $\lambda_{\text{distributor}}$ = 8 failure per km per year, μ_r = 5 hours, μ_{dist} = 4 hours. Find (i) λ_{system}, (ii) Down time per outage, (iii) Total outage time per year. 2 + 2 + 2 + 2 + 3 + 3

7. Write short notes on any *two* of the following : 2 × 7

   a) Optical schedule of Hydrothermal system

   b) Model of speed governing system

   c) Proportional plus integrating control in signal area block diagram.

   d) Deregulation and its background.

8. What are the methods of compensation in Transmission line ? How are voltage stability problems solved in power system ? A load bus is composed of induction motor where the nominal reactive power is 1 pu. The shunt compensation is K_{sh} (0·8). Find the reactive power sensitivity at the bus with respect to change in voltage. 5 + 5 + 4

==========