[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
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B. Tech 7th Semester Examination

Power System Operation and Control (NS)

EE-414

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : (i) Attempt all sections. Sections A, B, C and D have choice and E is compulsory. Each carries equal marks.

(ii) Any missing data may be assumed appropriately.

SECTION - A

1. (a) Discuss input-output characteristics and incremental flow rate characteristics of hydro plant. (10)

   (b) Discuss input-output characteristics and incremental fuel cost characteristics of thermal plant. (10)

2. A power plant has two units with the following cost characteristics:

   $C_1=0.6\ (P_1)^2 + 200\ P_1 + 2000$ Rs/hour; $C_2=1.2\ (P_2)^2 + 150\ P_2+2500$ Rs/hour where P_1 and P_2 are the generating powers in MW.

   The daily load cycle is as follows:

6:00 A.M. to 6:00 P.M.	150 MW
6:00 P.M. to 6:00 A.M.	50 MW

   The cost of taking either unit off the line and returning to service after 12 hours is Rs 5000. Maximum generation of each unit is 100 MW. Find the unit commitment schedule for 24 hour period from 6:00 A.M. one morning to 6:00 A.M. the next morning. (20)

SECTION - B

3. (a) Derive the coordination equations for economic dispatch neglecting losses. (10)

   (b) The transmission losses of a two bus system are expressed as $P_L = 10^{-3}P_{G1}$MW. Find the power generations (P_{G1} and P_{G2}) and power received by the load for the system λ = Rs. 26/MWh. The incremental fuel costs of two generators are as follows:

   $IC_1=0.02P_{G1}+16$ Rs./MWh

   $IC_2=0.04P_{G2} + 20$ Rs./MWh (10)

4. (a) Incremental costs of three units in a plant are given as:

   $IC_1=0.8\ P_1+160$ ₹/MWh; $IC_2=0.9\ P_2+120$ ₹/MWh; and $IC_3=1.25\ P_3+110$ ₹/MWh

   where P_1, P_2 and P_3 are power output in MW. Find the optimum load allocation (neglecting losses) when the total load is 242.5 MW. Using Participating Factors, determine the optimum scheduling when the load increases to 250 MW. (10)

   (b) Write algorithm and draw flow chart for the solution of co-ordination equations of economic dispatch problem by iterative method. (10)

SECTION - C

5. (a) Derive the co-ordination equations for short-term hydro-thermal scheduling problem. (10)

   (b) Write algorithm and draw flow chart for the solution of co-ordination equations of hydro-thermal scheduling problem by iterative method. (10)

6. A hydro-thermal system is used to supply the following load:

   24.00h–12.00h=1100MW

   12.00h–24.00h=1300MW

   The cost function of thermal system is given by: $C\ (P_T)=500+8.0\ P_T + 0.0016\ (P_T)^2$₹/h where P_T is power output of thermal

plant in MW. The discharge function of hydro plant is given by: $q=330+4.97\ P_H$ acre-ft/h, where P_H is power output of hydro plant in MW. The hydro plant's reservoir is limited to a drawdown of 10^5 acre-ft over the 24 h period. Find the optimal hydro-thermal schedule. Neglect inflow and losses. (20)

SECTION - D

7. What is the need of an automatic control system for generation control? Develop the complete block diagram model of automatic load frequency control of a single control area. (20)

8. (a) Two 200MW generators are operating in parallel. The droop characteristics of their governors are 5% and 4%, respectively from no load to full load. Assuming that generators are operating at 50Hz at no load, how would a load of 300MW be shared between them? What will be the system frequency at this load? Assume free governor operation. (10)

   (b) Explain the need and method of co-ordination of load frequency control and economic load dispatching. (10)

SECTION - E
(Attempt all of the following)

9. (i) Define penalty factor.

   (ii) In a power system, n generators are supplying a demand. Write power balance equation.

   (iii) Name the method which can be used to solve co-ordination equations of economic dispatch problem.

   (iv) Differentiate between unit commitment and economic dispatch.

   (v) Write the expression for B-Coefficient loss formula for n generator case.

   (vi) Name the central transmission utility of India.

   (vii) How the generator terminal voltage can be controlled?

(viii) What is area control error?

(ix) Which type of controller is used in Automatic Load Frequency Control system?

(x) What is the role of speed changer?

(xi) Write disadvantages of thermal power plants from Indian prospective.

(xii) What are the components of production cost of thermal generators?

(xiii) The heat input of a generating unit (H) is given by $H=(2P+0.005P^2+20)$ Million kcal/h. Where P is output power in MW of the generating unit. The fuel cost is ₹0.15 per 10000 kcal. Find the fuel cost per hour of the generating unit for power output of 50MW.

(xiv) Can "base point and participation factor" method be employed for unit commitment problem?

(xv) Define the term "Full-load average production cost".

(xvi) During which season the hydro power availability is maximum in India?

(xvii) What is the objective of hydro thermal scheduling problem?

(xviii) How hydro-thermal coordination improves economy?

(xix) What is spinning reserve?

(xx) Define minimum down time. (20×1=20)