

EE 181701

Roll No. of candidate

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15/12/22 2021

B.Tech. 7<sup>th</sup> Semester End-Term Examination

EE

POWER SYSTEM - IV

(New Regulation w.e.f. 2017-18 &

New Syllabus w.e.f. 2018-19)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *five* from the rest.

1. (A) Tick the most appropriate answer from the given options:

(Attempt any ten questions)

(10 × 1 = 10)

(i) What is the correct expression for the electrical power developed by a hydro electric plant in kW?

(a)  $\frac{0.736WQH\eta}{75}$

(b)  $\frac{75WQH\eta}{0.736}$

(c)  $75 \times 0.736WQH\eta$

(d)  $\frac{7WQH\eta}{75 \times 0.736}$

(Symbols carry their usual meaning)

(ii) The advantage(s) of hydro plants is / are

(a) Low operating cost

(b) They can be started and loaded very quickly

(c) They can be used as base load and peak load plants as well

(d) All the above

[Turn over



- (iii) In a steam power station, water is used for cooling purposes in
- (a) Boiler (b) Economiser  
(c) Condenser (d) Superheater
- (iv) The thermal efficiency of modern steam power plant lies between
- (a) 20% – 30 % (b) 30% – 40 %  
(c) 40% – 50 % (d) more than 60%
- (v) A moderator material should have
- (a) Small atomic mass  
(b) Large atomic mass  
(c) Either small or large atomic mass  
(d) Neither small nor large atomic mass
- (vi) At times of low loads, a power system needs
- (a) Shunt capacitors (b) Synchronous condensers  
(c) Shunt reactors (d) All the above
- (vii) A consumer has a connected load of 2 kW and a maximum demand of 1 kW .  
The demand factor is
- (a) 2 (b) 0.5  
(c) 4 (d) 0.25
- (viii) In a power system
- (a) Action of P-f loop is faster than that of Q-V loop  
(b) Action of Q-V loop is faster than that of P-f loop  
(c) Speed of response of both Q-V and P-f loops is almost the same  
(d) Action of P-f loop may be faster or slower than that of Q-V loop
- (ix) The changes in reactive power at a bus have a great effect on the voltage magnitude
- (a) Of that bus (b) Of distant buses  
(c) Of all the buses (d) None of the above
- (x) When generating units are loaded to equal incremental costs, it results in
- (a) Minimum fuel costs  
(b) Fuel costs are at maximum  
(c) Fuel costs are not affected  
(d) Maximum loading of generating units

(xi) Which of the following equations is considered as a constraint to the optimization problem of a hydro thermal system?

- (a) Real power balance equation
- (b) Water availability equation
- (c) Real power hydro generation as a function of water storage
- (d) All of these

(B) Answer any five questions

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(5 × 2 = 10)

- (i) In a nuclear reactor, multiplication factor is kept almost equal to one. Why?
- (ii) What are the different types of solar thermal power plants?
- (iii) Give the classification of wind turbines.
- (iv) What does economic load scheduling mean?
- (v) Distinguish between economic dispatch and unit commitment.
- (vi) Compare constant hydro generation method and constant steam generation method.
- (vii) Explain the control area concept.
- (viii) What is meant by single area power system?
- (ix) Draw a lay out diagram of a coal based thermal plant.
- (x) Distinguish between economizer and superheater.

2. (a) What is a high pressure boiler? With the help of necessary diagram, describe working of a high pressure boiler. (7)

(b) Distinguish between dry cooling tower and wet cooling tower. (3)



3. (a) Two power plants are connected together by means of a transmission line and load is at plant -2 as shown in fig 1. When 100 MW is transmitted from plant-1, the transmission loss is 10 MW. The cost characteristics of two plants are (7)

$$C_1 = 0.05 P_1^2 + 13 P_1 \text{ Rs/Hr}$$

$$C_2 = 0.06 P_2^2 + 12 P_2 \text{ Rs/Hr}$$

Estimate optimum generation schedule for  $\lambda = 22$

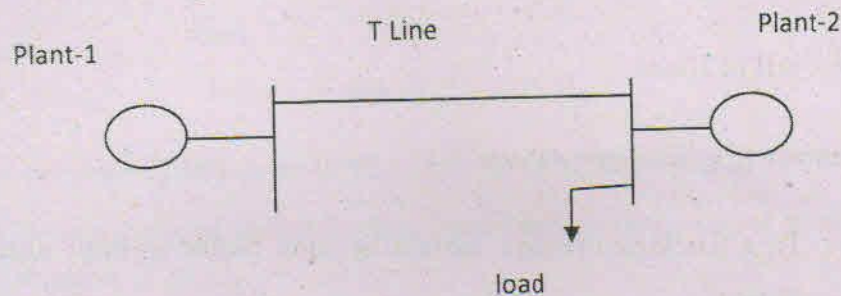


Fig. 1

- (b) Estimate the incremental cost of received power and the penalty factor of the plant shown in fig-2. If the incremental cost of production is

$$\frac{dc_1}{dP_1} = 0.1P_1 + 3 \text{ Rs/MWh} \quad (3)$$

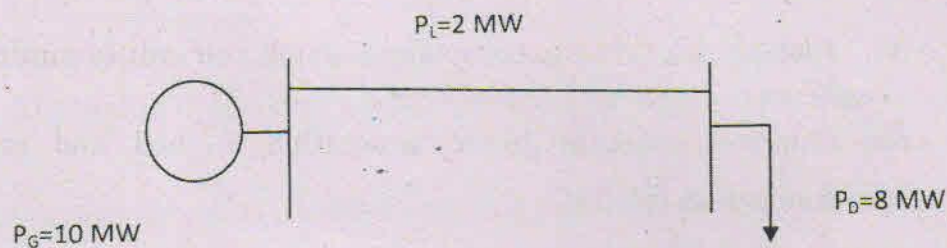


Fig. 2

4. A two plant system has a thermal station near the load center and a hydro power station at a remote location as shown in fig-3. The characteristics of both the stations are (symbols carry their usual meaning):

$$C_1 = (26 + 0.045 P_1) P_1 \text{ Rs/Hr}$$

$$W_2 = (7 + 0.004 P_2) P_2 \text{ m}^3/\text{sec}$$

$$\text{And } r_2 = \text{Rs } 4 \times 10^{-4} / \text{m}^3$$

The transmission loss coefficient  $B_{22} = 0.0025 \text{ MW}^{-1}$ .



Estimate the power generation at each station and the power received by the load when  $\lambda = 65 \text{ Rs/ MWh}$  (10)

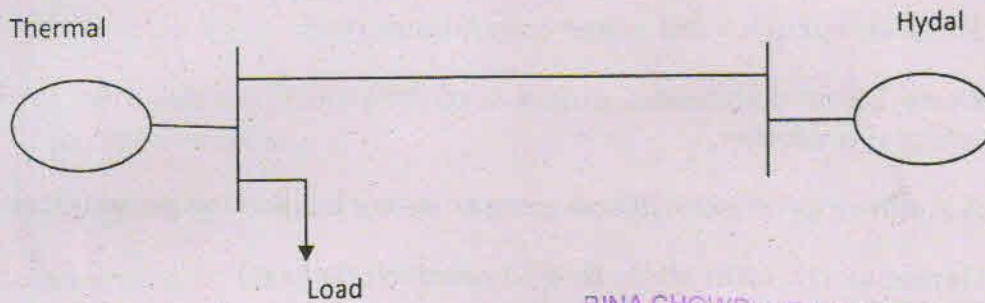


Fig. 3

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5. (a) Discuss various constraints of the unit commitment problem. (5)
- (b) (i) With the help of suitable diagram discuss working of a suitable water turbine. (5)

Or

- (ii) Discuss about some auxiliaries used a hydro plant. (5)

6. (a) (i) What are spillways? With the help of suitable diagram, describe working of any one type of spillway. (5)

Or

- (ii) Discuss in detail how a site is selected for hydro electric power plant. (5)

- (b) Draw a neat sketch of a nuclear reactor and label various parts of it. (2)
- (c) What is the purpose of moderator in a nuclear reactor? Name three moderators commonly used. Distinguish between fast reactors and thermal reactors. (3)

7. (a) What factors determine the choice of site of a thermal power plant? Why is treatment of feed water essential in thermal plants? How it is treated? (6)
- (b) Discuss how various nuclear wastes are disposed of. (4)

8. (a) Why voltage control is necessary in a power system? Describe a suitable method used for voltage control in a system. (7)
- (b) Write a note on load forecasting. (3)

9. (a) Write in brief the methods of generation of electrical energy from solar energy. (5)
- (b) Compare stand alone system and hybrid system. (3)
- (c) Draw layout of a wind power generation plant. (2)

10. (a) Draw block diagram of single load frequency control area incorporating integral controller. (4)

- (b) A single area consists of two generators with following parameters

Generator-1= 1200 MVA, R=6% (on machine base)

Generator-2= 1000 MVA, R=4% (on machine base)

The units are sharing 1800 MW at nominal frequency of 50 Hz. Unit 1 supplies 1000 MW and unit 2 supplies 800 MW. The load is now increased by 200 MW.

Estimate steady state frequency. (6)