Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH(EE)/SEM-7/EE-704C/2011-12

2011

POWER GENERATION ECONOMICS

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.

GROUP – A
(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) A power plant connected to grid has a maximum demand of 20 MW. The annual load factor is 50% while the plant capacity factor is 40%. The operating reserve of the plant is

a) 3·75 MW b) 5 MW

c) 6·5 MW d) 8 MW.

ii) If the load factor increases, the fuel cost per unit kWh of generated electrical power

a) increases

b) decreases

c) remains unchanged

d) first increases and then decreases with load factor.

iii) A generating station with high fuel cost is preferred to be operated as

a) base load station b) peak load station

c) both (a) and (b) d) none of these.

iv) Annual depreciation cost of a plant may be calculated by

a) Sinking fund method

b) Straight line method

c) Percentage method

d) any of these.

v) Low power factor has the drawback(s) of

a) high cost of equipment for a given load

b) increased transmission & distribution losses

c) poor voltage regulation

d) all of these.

vi) Penalty factor in economic operation of the power system is to be considered when

a) generator loss is considered

b) transmission losses are considered

c) turbine losses are considered

d) none of these.

vii) Which of the following power plants has the highest initial cost ?

a) Steam power plant b) Diesel power plant

c) Gas power plant d) Nuclear power plant.

viii) Which of the following power plants can be operated both as base load and a peak load plant ?

a) Nuclear plant b) Hydro power plant

c) Diesel power plant d) Solar power plant.

ix) Which of the following is not a storage type power plant ?

a) Pumped hydro b) Solar thermal

c) Gas turbine d) Geothermal.

x) Five 200 MW plants are connected to a grid having a peak demand of 1000 VA. If the generators are operating at a lagging *pf* of 0·85, the spinning reserve is

a) 0 MW b) 50 MW

c) 150 MW d) 250 MW.

xi) A storage type power plant is essential for betterment of a grid that suffers from

a) very low peak demand

b) very high peak demand but high load factor

c) very high peak demand but low load factor

d) very low peak demand but high load factor.

xii) Which of the following power plants has the longest life ?

a) Thermal

b) Hydel

c) Nuclear

d) Gas turbine combined cycle.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following $3 \times 5 = 15$

2. What are the problems of high VAR loading in a grid ? What are the measures adopted in a grid to minimize these problems ? 2 + 3

3. What is spinning reserve ? Why is it important to keep a spinning reserve in the grid ? What is the downside of keeping a high spinning reserve ? 2 + 2 + 1

4. What are the components of two part tariff ? State how it differs from the 'three part tariff'. 3 + 2

5. What are the importances of unit commitments in a grid ? Discuss the basis of economic load scheduling of power plants in a connected grid. 2 + 3

6. Write down the salient requirements for a site to instal a thermal power plant.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 15 = 45

7. The annual load duration curve of a grid is represented by a straight line with maximum demand of 100 MW, and minimum demand of 30 MW. The load has to be catered by one base load plant *B* and one peak load plant *P*. The annual operating costs for the two plants are as follows :

$C_B = 4000 \times L_B + 2 \cdot 5 \times Q_B$ and $C_P = 2500 \times L_P + 3 \cdot 0 \times Q_P$

respectively. (Here, *L* is the rating of a plant in kW, *Q* is the total annual generation in kWh, and *C* is in Rs.) Find the rating of the two plants so that the annual cost of generation is minimum of the grid.

8. a) A residential consumer has 10 lamps of 40W each connected to his premises. His demand is as follows :

i) From 12 midnight to 5 am — 40W

ii) From 5 am to 6 pm — no load

iii) From 6 pm to 7 pm — 320 W

iv) From 7 pm to 9 pm — 360 W &

v) From 9 pm to 12 midnight – 160W.

Plot the load curve on plain paper taking *X*-axis as time & *Y*-axis as demand. Find the average load, maximum load, load factor and electric energy consumption during the day. 8

b) What is state estimation ? How is it relevant to power system operation and control ? 7

9. a) What are the merits of a pumped hydro plant ? 4

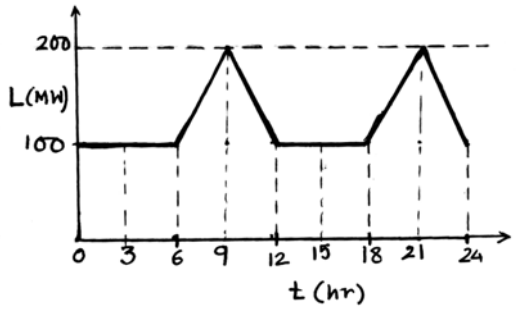
   b) The load curve of a grid for a duration of 24 hr is as shown in the figure. Determine

      i) the daily energy requirement of the grid 2½

      ii) the load factor 2½

      iii) energy consumed during the pumping in a pumped hydro plant, which may be used to make the load curve of the grid a perfectly flat one. Assume no losses in the pumped hydro plant 3

      iv) the duration for which the pumped hydro plant will run in generating mode 3



10. An industrial consumer has a choice between low and high voltage supply available at the following rates :

    For high voltage — Rs. 50 per kW per year + paise 4 per kWh

    For low voltage — Rs. 55 per kW per year + paise 5 per kWh

    In order to have high voltage supply, consumer has to instal his own transformer which costs Rs. 110 per kW. The losses in the transformer are 4% of full load. Determine the number of working hours per week above which high voltage supply will be economical.

    Assume interest and depreciation 12% of capital, working weeks per year 50 and load of consumer as 1·5 MW.

11. Write short notes on any *three* of the following : 3 × 5

a) Economic load dispatch

b) Economic aspect of base load and peak load power plant

c) Availability based tariff

d) Heat rate and incremental rate of power plants

e) Pool tariff in transmission system.

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