

Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech(EE)/SEPARATE SUPPLE/SEM-7/EE-704C/2011**

**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.*

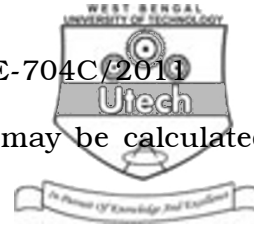
**GROUP – A**

**( Multiple Choice Type Questions )**

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

10 × 1 = 10

- i) If the load factor increases, the cost of generation per kwh
  - a) increases
  - b) decreases
  - c) remains unaffected
  - d) may increase or decrease.
- ii) Diversity factor is always
  - a) less than unity
  - b) equal to unity
  - c) more than unity
  - d) none of these.



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

- a) straight line method
- b) diminishing value method
- c) sinking fund method
- d) all of these.

iv) A power plant has a maximum demand of 15 MW. The load factor is 50% & plant factor is 40%. The operating reserve is

- a) 3 MW
- b) 3.75 MW
- c) 6 MW
- d) 7.5 MW.

v) A generating station which has a high investment cost is usually operated as

- a) peak load station
- b) base load station
- c) medium load station
- d) none of these.



- vi) The incremental transmission loss of a plant is
- a) always positive
  - b) always negative
  - c) can be positive or negative
  - d) unpredictable.
- vii) The unit of heat rate is
- a) Kw
  - b) K Cal/hour
  - c) K Cal/KWh
  - d) KWh/Kcal.
- viii) A system has 5 generators each having a capacity of 400 MW. If 4 of these generators are running while the system load is 1300 MW, the spinning reserve is
- a) 700 MW
  - b) 300 MW
  - c) 1600 MW
  - d) 1300 MW.
- ix) Low power factor has the drawback (s) of
- a) increased transmission and distribution losses
  - b) poor voltage regulation
  - c) high cost of equipment for a given load
  - d) all of these.



- x) Reactive power is delivered in a system by
- a) Capacitor bank
  - b) Reactor
  - c) Induction machine
  - d) All of these.
- xi) Penalty factor in economic operation of the power system is to be considered when
- a) generator loss is considered
  - b) turbine losses are considered
  - c) transmissions are considered
  - d) none of these.
- xii) One kilogram of uranium (  $U^{235}$  ) is equivalent to that obtained by burning high grade coal
- a) 1000 KG
  - b) 5 Tonnes
  - c) 1000 tonnes
  - d) 2500 tonnes.



**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.

3 × 5 = 15

2. Define the terms 'Load factor' and 'Diversity factor' and explain the economic implications of these factors on the cost of energy generation.
3. Explain briefly the various costs which form the total cost of a power system.
4. What are the objectives of a consumer tariff fixed by the power supply company ? State the difference between two part and three part tariff.
5. Discuss the various constraints related to unit commitment problem.
6. Write short notes on any *two* of the following :  $2 \times 2 \frac{1}{2}$ 
  - a) Availability based tariff
  - b) Cross subsidization in tariff
  - c) Spinning reserve
  - d) Power factor tariff.



**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following.

3 × 15 = 45

7. a) Show that transmission loss of a power system can be expressed as a function of the active power outputs of the generators in the system. State the assumptions you make. 5 + 2

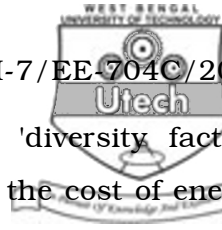
- b) The loss coefficients for a system with two plants are

$$B_{11} = 0.001 \quad B_{12} = 0.0007 \quad B_{22} = 0.0015$$

If the power outputs are 200 MW and 150 MW respectively, determine the load on the system. Also, calculate the penalty factors of the plants.

If the system  $\lambda$  is Rs. 130 per MWh, calculate the incremental fuel costs of the plants. 4 + 2 + 2

8. a) Explain the difference between the Unit Commitment and the Economic Dispatch problem. 3
- b) What are the various costs to be considered in the Unit Commitment problem ? 3
- c) Why are minimum ON time and minimum OFF time constraints important ? 3
- d) Discuss the basic principle of the dynamic programming method in solving the Unit Commitment Problem. 6



9. a) Define the terms 'load factor' and 'diversity factor'. Explain the effect of these factors on the cost of energy generation.
- b) A power station has to meet the following load demand :
- Load X : 50 kW between 10 AM and 6 PM
- Load Y : 30 kW between 6 PM and 10 PM
- Load Z : 20 kW between 4 PM and 10 PM
- Plot the daily load curve and determine :
- diversity factor
  - load factor.
10. a) What is a tariff ? Discuss and compare various tariffs commonly practised by utilities.
- b) A small scale industry has a maximum demand of 50 kW and maintains a monthly load factor of 60%. A power utility offers the following alternative tariff :
- Standing charge of Rs. 30 per kW of maximum demand plus Rs. 1.20 per kWhr.
  - First 500 units at Rs. 2.00 per unit, next 500 units at 1.50 per unit and additional energy at Rs. 1.10 per unit.

Which of the two tariffs is economical and what is the corresponding monthly bill ?



11. Write short notes on any *three* of the following :  $3 \times 5$

- a) Cross-subsidization
- b) Base load and Peak load stations
- c) Difference between Load curve and Load duration curve
- d) Availability based tariff
- e) Reactive power optimisation.

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