



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech(EE-OLD)/SEM-4/ME(EE)-411/2012**

**2012**

**THERMAL POWER ENGINEERING**

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**

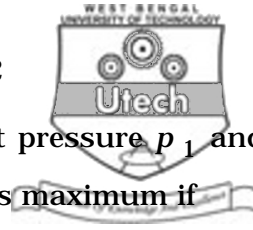
**( Multiple Choice Type Questions )**

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

10 × 1 = 10

i) Bomb calorimeter is used to determine the calorific  
value of

- a) solid fuels only
- b) liquid fuels only
- c) solid as well as liquid fuels
- d) gaseous fuel.



- ii) For a steam nozzle with inlet & outlet pressure  $p_1$  and  $p_2$ , the mass flow rate per unit area is maximum if

a)  $\frac{p_1}{p_2} \leq \left( \frac{2}{n+1} \right)^{\frac{n}{n+1}}$

b)  $\frac{p_2}{p_1} \leq \left( \frac{1}{n+1} \right)^{\frac{n}{n+1}}$

c)  $\frac{p_2}{p_1} \leq \left( \frac{2}{n-1} \right)^{\frac{n}{n-1}}$

d)  $\frac{p_2}{p_1} \leq \left( \frac{1}{n+1} \right)^{\frac{n+1}{n}}$ .

- iii) The pressure on the two sides of the impulse wheel of steam turbine

- a) is same
- b) is different
- c) decreases from one side to the other
- d) increases from one side to the other.

- iv) For maximum blade efficiency of Parson's reaction steam turbine

a)  $\frac{V_b}{V_i} = \cos \alpha$

b)  $\frac{V_b}{V_i} = \frac{\cos \alpha}{2}$

c)  $\frac{V_b}{V_i} = \cos^2 \alpha$

d)  $\frac{V_b}{V_i} = \frac{\cos^2 \alpha}{2}$ .



v) Draught produced by chimney is described as

- a) induced draught                      b) natural draught
- c) forced draught                      d) balance draught.

vi) Basic closed cycle for gas turbine is

- a) Carnot cycle                      b) Rankine cycle
- c) Brayton cycle                      d) Stirling cycle.

vii) The maximum volumetric efficiency can be increased for four stroke I.C. engines by

- a) increasing cylinder dia
- b) increasing the inlet valve diameter
- c) increasing piston speeds
- d) decreasing piston speeds.

viii) Compression ratio of S.I. engines normally varies from

- a) 4 to 6                      b) 6 to 12
- c) 10 to 18                      d) 14 to 22.



- ix) For the same compression ratio
- a) Otto cycle is more efficient than diesel cycle
  - b) efficiency of both are same
  - c) diesel cycle is more efficient than Otto cycle
  - d) none of these.
- x) Ignition quality of diesel engine fuel is expressed by an index called
- a) octane number
  - b) cetane number
  - c) C.V.
  - d) auto-ignition temperature.
- xi) Ignition quality of petrol engine fuel is expressed by an index called
- a) cetane number
  - b) octane number
  - c) auto-ignition temperature
  - d) C.V.



**GROUP - B**

**( Short Answer Type Questions )**

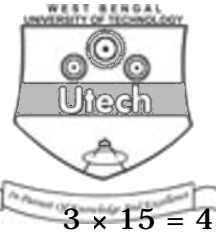
Answer any *three* of the following.

3 × 5 = 15

2.
  - a) How are fuels classified ?
  - b) How can you distinguish secondary fuels from the primary ones ?
  - c) How does the volatile matter content determine the rank of coal ?
  - d) How does sulphur occur in coal ?
  - e) What is the effect of volatile matter in the combustion process ?

1 + 1 + 1 + 1 + 1
3.
  - a) Draw neat diagrams to represent schematically :
    - i) Natural circulation
    - ii) Forced multiple circulation
    - iii) Open hydraulic system
    - iv) Combined circulation.
  - b) What is the combustion efficiency of PFBC boilers ?

4 + 1
4. What are the pollutants in the automotive engine exhaust ?  
How are they controlled ?
5. Describe briefly the working principle of an ESP with a neat sketch.
6. Derive an expression of power required at the blade to run a steam turbine.



**GROUP - C**

**( Long Answer Type Questions )**

Answer any *three* of the following.

3 × 15 = 45

7. a) Show with usual notations that the thermodynamic efficiency of a constant pressure closed gas turbine is given by  $\eta_{th} = 1 - \left( \frac{1}{R_p} \right)^{\frac{\gamma-1}{\gamma}}$ .
- b) An open cycle gas turbine works between the pressure range of 1 bar & 6 bar & temperature range of 300 K & 1023 K. The  $C_v$  of the fuel used is 43000 kJ/kg. Find the following :
- i) A : F ratio
  - ii) Thermal efficiency of the plant
  - iii) kW generating capacity of the plant if the flow of air is 10 kg/sec.
- 7 + 8
8. a) What is a valve timing diagram ? Explain the terms 'pre-ignition' and 'delay period'.
- b) Calculate the relative efficiency on IP basis and  $a : f$  ratio used for a 4-stroke gas engine developing 3.5 kW of BP at 160 rpm & at full load, assuming  $\eta_v = 87\%$ ,  $\eta_{mech} = 73.5\%$
- $V_c = 2100$  cu.cm     $V_s = 9000$  cu.cm
- Fuel consumption 5 cu.m/hr,
- $C_v$  of fuel = 18000 kJ/hr and all working cycles are effective.
- 6 + 9



9. a) Write the steps of Morse test to find the IP of an I.C. engine.

b) Give schematically the working principle of Zenith carburettor.

c) Explain the term 'knock rating' of fuel. 5 + 5 + 5

10. a) Show that for maximum discharge of steam through nozzle takes place when the ratio of steam pressure at throat to the inlet pressure is given by

$$\frac{P_2}{P_1} = \left( \frac{2}{n+1} \right)^{\frac{n}{n-1}}$$

b) What are the limitations of chimney draught ?

c) Give a schematic arrangement for the gas analysis.

7 + 4 + 4

11. a) Define compounding as used in turbine. Explain clearly velocity compounding & pressure compounding with sketch.

b) A steam power plant has the range of operation from 40 bar dry saturated to 0.5 bar. Determine the cycle efficiency of the turbine. 7 + 8

