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Total Printed Pages : **3**

**8E4051**

**B. Tech. (Sem. VIII) (Main) Examination, May/June - 2010**  
**Mechanical Engg.**  
**(8ME3 Gas Turbine & Gas Power Plant)**

Time : **3 Hours**]

[Total Marks : **80**

[Min. Passing Marks : **24**

*Attempt any five questions selecting one question from each unit. All questions carry equal marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.) Units of quantities used/calculated must be stated clearly.*

Use of following supporting material is permitted during examination.

(Mentioned in form No. 205)

1. \_\_\_\_\_ Nil \_\_\_\_\_

2. \_\_\_\_\_ Nil \_\_\_\_\_

### UNIT - I

1 (a) Explain open cycle and closed cycle used for gas turbine. Also mention advantages and disadvantages of both the arrangements.

6

(b) A gas turbine set draws atmospheric air at 1 bar and 20°C. Two compressors with perfect intercooling, are used to get overall pressure ratio of 15. The maximum temperature of cycle is 1500°C. A regenerator is used to utilise the heat of exhaust gas, with its effectiveness as 0.7. Determine the efficiency of plant and work ratio. Assume compressors, turbine, generator and mechanical efficiencies as 0.85, 0.87, 0.98 and 0.96 respectively. Take  $\gamma = 1.4$  and  $C_p$  of air and gas as 1.005 ks/kgK.

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2 (a) Derive expression for optimum pressure ratio for perfect reheating and discuss the problems of using regenerator at high pressure ratio.

6



- (b) In a gas turbine plant, air at  $15^{\circ}\text{C}$  temperature is compressed to pressure ratio of 15. Maximum cycle temperature is  $1500^{\circ}\text{C}$ . A regenerator with effectiveness of 0.75 is placed. Expansion is carried out in two stages with perfect reheating. Air is reheated to  $1500^{\circ}\text{C}$  efficiency of compressor and turbines are 0.85 and 0.87 respectively and also take mechanical efficiency for compressor and turbine as 0.95, generator efficiency as 0.98. Calculate, thermal efficiency, work ratio and also air flow for an output of 240 MW.  
( $\gamma = 1.4$ ,  $C_p = 1.005 \text{ kJ/kgK}$  for air and gas)

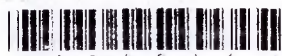
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### UNIT - II

- 3 (a) Explain losses due to incomplete combustion in gas turbine combustor. How does better combustion helps in reducing global warming? 8
- (b) With the help schematic and T.S. diagram explain Ramjet system. 8
- 4 (a) Explain performance of gas turbine with regeneration and intercooling at different pressure ratio. 8
- (b) Explain working of Rocket engine. 8

### UNIT - III

- 5 (a) Discuss the thermodynamic cycle of turbojet and also explain performance characteristics. 8
- (b) Explain working of pulsejet engine. 8
- 6 (a) Derive expressions for specific thrust and efficiency for a jet propulsion system. 8
- (b) A jet engine requires 1550 kW at 195 m/s the fuel consumption is 0.35 kg per propulsive K.W. per hour and calorific value of fuel is 42 MJ/kg. Temperature rise in combustion chamber is limited to  $520^{\circ}\text{C}$ . Calculate air fuel ratio, propulsive power and thermal efficiency. 8



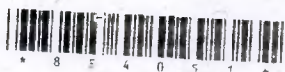
## UNIT - IV

- 7 (a) Explain combustion theory applied to gas turbine combustors. 8  
(b) With the help of velocity diagram, derive expression of workdone and efficiency on gas turbine. 8
- 8 (a) Explain fuel injection and ignition system used in gas turbine plant. 8  
(b) Air enters an axial compressor at  $25^{\circ}\text{C}$  and undergoes a pressure increase 6 times that in inlet. The mean velocity of rotor blade is 220 m/s. The inlet and exit angles of both the moving and fixed blades are  $45^{\circ}$  and  $15^{\circ}$  respectively. The degree of reaction is 50% and there are 10 stages in the compressor. If the isentropic efficiency of the compressor is 83% and axial velocity is taken constant throughout, find the work done. 8

## UNIT - V

- 9 (a) Explain the performance of gas turbine power plant at off-design conditions. 8  
(b) Explain the criteria for selection of material for gas turbines. 8
- 10 (a) Compare the advantages of steam and gas turbine plants. 8  
(b) Explain working of free piston engine plant. 8

8E4051]



3

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