



Name :

Roll No. :

Invigilator's Signature :

CS/B.TECH/AUE/SEM-8/AUE-823/2013
2013
GAS TURBINE ENGINE

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.*

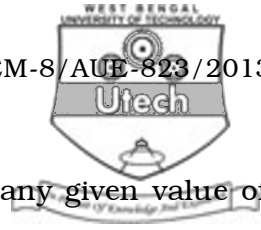
GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct answers for the following : $10 \times 1 = 10$
- i) Thermodynamic cycle for working of gas turbine engine is
- a) Diesel Engine b) Dual Cycle
- c) Brayton Cycle d) Sterling Cycle.
- ii) A gas turbine cycle can be operated
- a) only as an open cycle arrangement
- b) only as a closed cycle arrangement
- c) both open and closed cycle arrangement
- d) none of these.



- iii) Major application of gas turbine is for
- a) aircraft
 - b) locomotive
 - c) IC engine
 - d) all of these.
- iv) Function of inlet duct is to
- a) provide sufficient air supply to engine
 - b) prevent surges
 - c) ensure uniform pressure and velocity to compressor inlet
 - d) all of these.
- v) Brayton cycle consists of
- a) two adiabatic and two isentropic
 - b) two adiabatic and two isothermal
 - c) two isothermal and two constant pressure
 - d) two isentropic, one constant pressure and one constant volume.
- vi) An ideal cycle with reheat, intercooling and heat exchanger will increase
- a) efficiency
 - b) work output
 - c) both (a) and (b)
 - d) none of these.



vii) For the maximum specific output of any given value of t , the optimum pressure ratio is given by

- a) $c = t$
- b) $c = t^2$
- c) $c = \sqrt{t}$
- d) $c = 1/t$.

viii) The efficiency of the ideal cycle is a function of

- a) only the γ of the working fluid
- b) only the pressure ratio
- c) both γ and pressure ratio
- d) inlet temperature of turbine.

ix) When a heat exchanger is added to an ideal cycle

- a) power output decreases but the efficiency increases
- b) power output increases but the efficiency decreases
- c) both remain the same
- d) power output remains the same but the efficiency increases.



x) The specific weight of gas turbine power plant is

- a) 50 kg/kW b) 20 kg /kW
- c) 100 kg/kW d) 80 kg/kW.

GROUP – B

(Short Answer Type Questions)

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

2. State the assumptions made in an ideal cycle analysis of gas turbines. How are the actual cycles different from ideal cycle ?
3. Derive the expression of specific work output and the efficiency of a simple cycle.
4. Mention the various advantages and disadvantages of a Pulse jet engine.
5. Mention the advantages and disadvantages of gas turbine engine over reciprocating engines.
6. Briefly explain the process of combustion in a gas turbine combustion chamber.

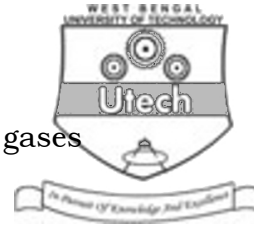


GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Derive the expression for specific work output and the efficiency of a simple cycle with heat exchanger. Draw their trends as a function of pressure ratio. $6 + 2$
- b) Compute the indicated mean effective pressure and efficiency of a Brayton cycle if the temperature at the end of combustion is 2000 K and the temperature and pressure before compression are 350 K and 1 bar. The pressure ratio is 1.3. Assume $C_p = 1.005 \text{ kJ/kg K}$.
 $R = 0.287 \text{ kJ/kg-K}$. 7
8. a) What are the various assumptions made in practical cycle ? 5
- b) An oil gas turbine installation consists of a compressor, a combustion chamber and turbine. The air taken in at pressure of 1 bar and temperature of 30°C is compressed to 6 bars with an isentropic efficiency of 87%. Heat is added by combustion of fuel in combustion chamber to raise the temperature 700°C . The efficiency of the turbine is 85%. The calorific value of the oil used is 43.1 MJ/kg . Calculate for an air flow of 80 kg/min , neglecting the effect of fuel in the mass flow rate
- (i) the air-fuel ratio of the turbine gases



- (ii) the final temperature of exhaust gases
- (iii) the net power of installation
- (iv) the overall thermal efficiency of the installation.

Assume $C_{pa} = 1.005 \text{ kJ/kg-K}$, $\gamma_a = 1.4$ and
 $C_{pg} = 1.147 \text{ kJ/kg-K}$, $\gamma_g = 1.33$. 10

9. What are the different types of combustors used in gas turbine engines and what are the factors affecting the performance ? Explain the various processes of combustion in combustion chamber. Describe the requirements of the combustion chamber. 4 + 6 + 5
10. What is meant by thrust ? Derive the thrust equation for a general propulsion engine. With a sketch describe the different parts of a ramjet engine. What are the advantages and disadvantages of ramjet engines ? 3 + 7 + 5
11. In a gas turbine plant air enters the compressor at 1 bar and 7°C. It is compressed to 4 bar with isentropic efficiency of 82%. The maximum temperature at the inlet to the turbine is 800°C. The isentropic efficiency of the turbine is 85%. The calorific value of the fuel used is 43.1 MJ/kg. The heat losses are 15% of the calorific value. Calculate the following :
- (i) Compressor work in KJ/kg



- (ii) Heat supplied in kJ/kg
 - (iii) Turbine work in kJ/kg
 - (iv) Net work in kJ/kg
 - (v) Thermal efficiency
 - (vi) Air/Fuel ratio
 - (vii) Specific fuel consumption in kg/kWh
 - (viii) Ratio of compressor work to turbine work.
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