

Total No. of printed pages = 4

ME 181702

Roll No. of candidate

--	--	--	--	--	--	--	--	--	--

03/07/2023

2022

BINA CHOWDHURY CENTRAL LIBRARY
(CMT & GIPS)
Azara, Hatkhowapara,
Guwahati - 781017

B.Tech. 7th Semester End-Term Examination

ME

APPLIED THERMODYNAMICS - II

New Regulation (w.e.f 2017- 18) & New Syllabus (w.e.f 2018 - 19)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No, 1 and any *Four* from the rest.

1. Answer the following questions : (MCQ) (10 × 1 = 10)
- (i) The multi stage compression as compared to single stage compression.
 - (a) Improves volumetric efficiency for the given pressure ratio
 - (b) Reduces work done per kg of air
 - (c) Reduces cost of compressor
 - (d) Gives more uniform torque
 - (e) All of the above
 - (ii) The multi stage compression as compared to single stage compression
 - (a) Improves volumetric efficiency for the given pressure ratio
 - (b) Reduces work done per kg of air
 - (c) Reduces cost of compressor
 - (d) Gives more uniform torque
 - (e) All of the above
 - (iii) In a closed cycle gas turbine, the air is compressed
 - (a) Isothermally
 - (b) Polytropically
 - (c) Isentropically
 - (d) None of these

[Turn over

- (iv) The thermal efficiency of a simple gas turbine for a given turbine inlet temperature with increase in pressure ratio
- (a) Increases
 - (b) Decreases
 - (c) First increases and then decreases
 - (d) First decreases and then increases
- (v) Which of the following is not an air-breathing engine?
- (a) Turbojet
 - (b) Turbofan
 - (c) Rocket
 - (d) Scramjet
- (vi) The performance of Ram Jet engine is best at
- (a) Low speed
 - (b) High speed
 - (c) Medium speed
 - (d) None
- (vii) What is Refrigeration?
- (a) Refrigeration is the process of removing heat from a substance and cooling it to a temperature or below the actual temperature
 - (b) Refrigeration is the process of adding heat from a substance and cooling it to a temperature
 - (c) Refrigeration is used to increase the level of humidity in the air by adding heat
 - (d) None of the mentioned
- (viii) Which of the following is NOT the advantages of using a closed Air Refrigeration system?
- (a) Compact in construction
 - (b) Lower coefficient of performance
 - (c) Lighter in weight
 - (d) Environmental Friendly
- (ix) The specific humidity is the mass of water vapour present in
- (a) one cubic meter of wet air
 - (b) one cubic meter of dry air
 - (c) one kg of wet air
 - (d) one kg of dry air
- (x) The difference between dry bulb temperature and dew point temperature is called
- (a) dry bulb depression
 - (b) wet bulb depression
 - (c) dew point depression
 - (d) degree of saturation

BINA CHOWDHURY CENTRAL LIBRARY
(GIMT & GIPS)
Azara, Hatkhowapara,
Guwahati - 781017

2. (a) Classify the various types of air compressions? (5)

(b) Following data relate to a performance test of a single acting 14 cm × 10 cm reciprocating compressor: (10)

Suction pressure = 1 bar

Suction temperature = 20° C

Discharge pressure = 6 bar

Discharge temperature = 180° C

Speed of compressor = 1200 r.p.m

Shaft power = 6.25 kW

Mass of air delivered = 1.7 kg/mm

Calculate the following:

(i) The actual volumetric efficiency;

(ii) The indicated power;

(iii) The isothermal efficiency;

(iv) The mechanical efficiency;

3. (a) Explain the effects of operating variables on thermal efficiency of gas turbine. (5)

(b) A gas turbine plant consists of two turbines. One compressor turbine to drive compressor and other power turbine to develop power output and both are having their own combustion chambers which are served by air directly from the compressor. Air enters the compressor at 1 bar and 288K and is compressed to 8 bar with an isentropic efficiency of 76%. Due to heat added in the combustion chamber, the inlet temperature of gas to both turbines is 900°C. The isentropic efficiency of turbine is 86% and mass flow rate of air at the compressor is 23 kg/s. The calorific value of fuel is 4200kJ/kg. Calculate the output of the plant and the thermal efficiency if mechanical efficiency is 95% and generator efficiency is 96%. Take $c_p = 1.005$ kJ/kg K and $\gamma = 1.4$ for air and $c_{pg} = 1.128$ kJ/kg K and $\gamma = 1.34$ for gases. (10)

4. (a) Multi-staging improves performance of a reciprocating compressor – Write your comment on the statement. (5)

(b) A turbo-jet engine flying at a speed of 960 km/h consumes air at the rate of 54.5 kg/s. Calculate: (10)

(i) Exit velocity of jet when the enthalpy change from the nozzle is 200 kJ/kg and velocity co-efficient is 0.97.

(ii) Fuel flow rate in kg/s when air-fuel ratio is 75:1

(iii) Thrust specific fuel consumption. power.

5. (a) Explain the function of parts of a simple vapour compression system with T-S diagram. (5)
- (b) 28 tonnes of ice from and at 0°C is produced per day in ammonia refrigerator. The temperature range in the compressor is from 25°C to -15°C . The vapour is dry and saturated at the end of compression and an expansion valve is used. Assuming a coefficient of performance of 62% of the theoretical, calculate the power required to drive the compressor.

Temp $^{\circ}\text{C}$ Enthlpy (kJ/kg) Entropy of liquid (kJ/kgK) Entropy of Vapour (kJ/kgK)

	Liquid		Vapour	
25	100.04	1319.22	0.3473	4.4852
-15	-54.56	1304.99	-2.1338	5.0585

Take latent heat of ice = 335 kJ/kg. (10)

6. (a) Differentiate between open and closed air refrigeration system. (5)
- (b) A single stage double-acting air compressor is required to deliver 14 m^3 of air per minute measured at 1013 bar and 15°C . The delivery pressure is 7 bar and the speed 300 r.p.m. Take the clearance volume as 5% of the swept volume with the compression and expansion index $n = 1.3$. Calculate? (10)
- (i) Swept volume of the cylinder;
- (ii) The delivery temperature;
- (iii) Indicated power.

BINA CHOWDHURY CENTRAL LIBRARY
(OINIT & GIPS)
Azara, Hatkhowapara,
Guwahati - 781017

7. Write short notes on (any three) (3 × 5 = 15)
- (a) Classification of Refrigeration.
- (b) Turboprop engines.
- (c) Difference between propeller-jet and turbo-jet.
- (d) Dry Bulb, Wet Bulb and Dew Point temperatures
- (e) Ramjet