

C.U.SHAH UNIVERSITY

Summer Examination-2018

Subject Name: Turbomachines

Subject Code: 4TE07TMA1

Branch: B.Tech (Mechanical)

Semester: 7

Date: 22/03/2018

Time: 10:30 To 01:30

Marks: 70

Instructions:

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
 - (2) Instructions written on main answer book are strictly to be obeyed.
 - (3) Draw neat diagrams and figures (if necessary) at right places.
 - (4) Assume suitable data if needed.
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Q-1

Attempt the following questions:

(14)

- a) A turbine is said to have an axial discharge when the steam leaves the blade tip at _____ to the direction of the blade motion.
(A) 60° (B) 90° (C) 180° (D) 270°
- b) The impulse reaction turbine has its driving force
(A) as an impulsive force (B) as a reaction force
(C) partly as an impulsive force and partly as a reaction force
(D) none of the above
- c) The efficiency of reaction turbine is maximum when (where α = Angle made by the absolute velocity (V) at inlet)
(A) $V_b = 0.5 V \cos \alpha$ (B) $V_b = V \cos \alpha$
(C) $V_b = 0.5 \sqrt{2} \cos \alpha$ (D) $V_b = \sqrt{2} \cos \alpha$
- d) The flow of steam is super-sonic
(A) at the entrance to the nozzle (B) at the throat of the nozzle
(C) in the convergent portion of the nozzle (D) in the divergent portion of the nozzle
- e) An open cycle gas turbine works on
(A) Carnot cycle (B) Otto cycle
(C) Joule's cycle (D) Stirling cycle
- f) The gas turbine cycle with regenerator improves
(A) thermal efficiency (B) work ratio (C) avoids pollution (D) none of these
- g) Which of the following statements is wrong?
(A) The closed cycle gas turbine plants are external combustion plants.
(B) In the closed cycle gas turbine, the pressure range depends upon the atmospheric pressure.
(C) The advantage of efficient internal combustion is eliminated as the closed cycle has an external surface.
(D) In open cycle gas turbine, atmosphere acts as a sink and no coolant is required.
- h) Reheating in a gas turbine
(A) increases the thermal efficiency (B) increases the compressor work
(C) increases the turbine work (D) decreases the thermal efficiency
- i) In a turbo jet engine, subsequent to heat addition to compressed air, to get the power output, the working substance is expanded in
(A) exit nozzle, which is a constant volume process
(B) exit nozzle, which is essentially an isentropic process



- (C) turbine blades, which is a constant volume process
 (D) turbine blades, which is essentially an isentropic process
- j) Which of the following statements is correct relating to rocket engines?
 (A) The combustion chamber in a rocket engine is directly analogous to the reservoir of a supersonic wind tunnel
 (B) The stagnation conditions exist at the combustion chamber
 (C) The exit velocities of exhaust gases are much higher than those in jet engine
 (D) all of the above
- k) In a nozzle, whole frictional loss is assumed to occur between
 (A) inlet and throat (B) inlet and outlet
 (C) throat and exit (D) all of these
- l) A rocket engine uses _____ for the combustion of its fuel.
 (A) surrounding air (B) compressed atmospheric air
 (C) its own oxygen (D) none of these
- m) The compounding of turbines is done in order to
 (A) reduce speed of rotor (B) improve efficiency
 (C) reduce exit losses (D) all of these
- n) The flow through a nozzle is regarded as
 (A) constant volume flow (B) constant pressure flow
 (C) isothermal flow (D) isentropic flow

Attempt any four questions from Q-2 to Q-8

- Q-2 Attempt all questions (14)**
- a) With neat sketch explain in detail about velocity diagram of impulse turbine. 7
 b) Derive equation for discharge of mass through nozzle 7
- Q-3 (14)**
- a) Design a convergent-divergent nozzle if air at 9 bar and 200°C expands isentropically in nozzle at the rate of 5 kg/s into a space at 1.1 bar. Assume negligible inlet velocity. If nozzle efficiency is 90 %, redesign the nozzle. 7
 b) With neat sketch explain in detail pressure-velocity compounding of impulse turbine. 7
- Q-4 Attempt all questions (14)**
- a) With the help of diagram explain about effect of variation of back pressure in nozzle. 7
 b) A turbine is supplied with steam at 35 bar and a temperature of 435°C. It is expanded in four stages to the condenser pressure of 0.04 bar. The pressure at the end of stages are 5, 1.2, and 0.25 bar respectively. Loss due to friction throughout the expansion is 24% determine a) the isentropic enthalpy drop in each stage, b) the enthalpy drop for the turbine if friction is neglected, c) the work done in kJ/kg of flow neglecting all losses other than the one stated above, d) the reheat factor and e) the specific steam consumption in kg/KWh. 7
- Q-5 Attempt all questions (14)**
- a) With neat sketch explain in detail about combustion chamber. 7
 b) An open gas turbine plant works between the fixed absolute temperature limits 300K and 1700 K the absolute pressure limit being 1 bar and 23bar. The isentropic efficiency of compressor is 0.85 and that of turbine is 0.86. Estimate the actual thermal efficiency of the plant and the power available for driving external load if the fuel consumption is 10 kg/s and the calorific value is 42000 kJ/kg. 7
- Q-6 Attempt all questions (14)**
- a) With neat sketch explain about working of ram jet engine also draw the TS diagram. 7
 b) Derive equation for thermal efficiency of Joule cycle. 7



- Q-7** **Attempt all questions** **(14)**
- a) Derive equation for optimum pressure ratio for maximum specific output in actual simple gas turbine cycle. **7**
 - b) The effective jet velocity from a rocket engine is 2900 m/sec. the forward velocity is 1450 m/s and the propellant consumption is 78 kg/sec. calculate the thrust, thrust power and propulsive efficiency. **7**
- Q-8** **Attempt all questions** **(14)**
- a) With neat sketch explain in detail about turbine blade attachment. **7**
 - b) Derive equation for thrust power, propulsive power and propulsive efficiency. **7**

