

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII(NEW) EXAMINATION – SUMMER 2019

Subject Code:2171917

Date:21/05/2019

Subject Name:Steam and Gas Turbines (For Equivalency)

Time:02:30 PM TO 05:00 PM

Total Marks: 70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Use of steam tables, Mollier chart and calculator is permissible.

- Q.1**
- (a) Describe different types of nozzle with neat sketch. State the function of nozzle. **03**
- (b) A nozzle is supplied with dry steam at 12 bar and back pressure is 1 bar. Whether the nozzle is convergent or divergent? Calculate throat and exit diameter if it discharges 15 kg steam per minute. **04**
- (c) What is critical pressure? Derive the expression for critical pressure ratio in flow through nozzles. Calculate its value for superheated steam. **07**

- Q.2**
- (a) Derive an expression for exit velocity of steam in terms of enthalpy of fluid at inlet and at exit and the velocity of steam at inlet. **03**
- (b) Explain back pressure turbine with neat sketch. **04**
- (c) Show that in a 50 % reaction turbine stage, the maximum efficiency is $\frac{2\cos^2\alpha}{1+\cos^2\alpha}$. where α is the nozzle angle. **07**

OR

- (c) A reaction turbine running at 400 rpm with 50 % reaction develops 75 KW per kg per second of steam. The exit angle of the blade is 20° and the steam velocity is 1.4 times the blade velocity. Determine: **07**
- (i) Blade velocity and
- (ii) Inlet angle of the blades.
- Q.3**
- (a) Explain working of mixed pressure turbine. **03**
- (b) State various methods of governing and explain with neat sketch the Nozzle Control Governing. **04**
- (c) A mean blade ring diameter of a single stage impulse turbine is 0.7 meter. It runs at 3000 R.P.M. The nozzle angle is 21° and blade speed ratio is 0.46. The blade friction factor is 0.95 and the discharge is axial. Calculate blade inlet and outlet angles and Power output per kg of steam. **07**

OR

- Q.3**
- (a) Compare the impulse and reaction turbines. **03**
- (b) Explain velocity compounded impulse turbine with neat diagram. **04**
- (c) The velocity of steam leaving the nozzle of an impulse turbine is 900 m/s and nozzle angle is 20°. The blade velocity is 300 m/s and the blade friction factor is 0.7. Calculate for mass flow rate of 1 kg/s and symmetric blading: **07**
- (i) The blade inlet angle
- (ii) The axial thrust
- (iii) The tangential force
- (iv) The diagram power and efficiency.

- Q.4**
- (a) State the advantages of closed gas turbine cycle over open gas turbine cycle. **03**
- (b) Explain ideal gas turbine cycle with regeneration. **04**

- (c) In a gas turbine cycle, air at 27°C and 0.98 bar is compressed to 6 bar. The temperature of air is increased to 750°C as it passes through the combustion chamber. The isentropic efficiencies of compressor and turbine are 0.8 and 0.85 respectively. Determine the efficiency of the plant. **07**

OR

- Q.4** (a) What do you understand by combined gas turbine cycle power plants and what are their objectives? **03**
- (b) Derive an expression for net work done by gas turbine power plant. Also state the condition of maximum work done. **04**
- (c) The compressor and turbine unit of a small gas turbine plant have an isentropic efficiency of 85 %. The inlet temperature to the compressor is at 15°C and the maximum temperature during the cycle is 700°C . The pressure ratio is 4. Assuming $c_p = 1.1\text{ kJ/kg K}$ and $c_v = 0.786\text{ kJ/kg K}$, calculate the specific output and the overall efficiency of the cycle. Neglect all other losses. **07**

- Q.5** (a) What are the advantages and disadvantages of jet engine? **03**
- (b) Explain Thrust, Thrust Power and Propulsive Power in context to jet propulsion. **04**
- (c) Explain with neat sketch "Ram jet engine." **07**

OR

- Q.5** (a) Explain the Principle of jet propulsion with neat sketch. **03**
- (b) What are the advantages and disadvantages of Pulse Jet Engine? **04**
- (c) Write a short note on: "Turbo prop engine." **07**
