Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE- SEMESTER–VII (NEW) EXAMINATION – WINTER 2020**

**Subject Code:2171917 Date:02/02/2021**

**Subject Name:Steam and Gas Turbines**

**Time:10:30 AM TO 12:30 PM Total Marks: 56**

**Instructions:**

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Steam table and Molliar diagram is permitted.**

| | | | MARKS |
|---|---|---|---|
| **Q.1** | **(a)** | Describe different types of nozzle with neat sketch. State the function of nozzle. | **03** |
| | **(b)** | With help of S.F.E.E. prove that $C_2 = 44.72\sqrt{h_1 - h_2}$. Neglect initial velocity of steam. Where $C_2$ is outside velocity of steam from nozzle (h1 –h2) is heat drop in nozzle. | **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)** | What is function of governing system of steam turbine? Compare throttle and Nozzle Governing. | **03** |
| | **(b)** | 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. | **04** |
| | **(c)** | Show that in a 50 % reaction turbine stage, the maximum efficiency is $(2cos^2\alpha) / (1 + cos^2\alpha)$. where α is the nozzle angle. | **07** |
| **Q.3** | **(a)** | Explain with neat sketch any one method of attachment of blade to turbine rotor. | **03** |
| | **(b)** | Why compounding of impulse turbine is necessary? What are various methods of reducing rotor speed? Explain anyone method with neat diagram. | **04** |
| | **(c)** | The following particulars refer to a stage of a Parson's steam turbine comprising one ring of fixed blades and one ring of moving blades. Mean diameter of blade ring = 70 cm, Steam velocity at exit from blades = 160 m/s, R.P.M. = 3000, Blade outlet angle =200, steam flow through blades = 7 kg/s. Draw the velocity diagram and find the following: - (a) Blade inlet angle, (b) Tangential force on ring of moving blades, (c) Power developed in stage. | **07** |
| **Q.4** | **(a)** | Compare the impulse and reaction turbines. | **03** |
| | **(b)** | Enlist different losses in steam turbine. | **04** |
| | **(c)** | Draw p-v &T-s diagram for gas turbine cycle with: (1) Intercooler, (2) Reheating (3) Regeneration. Also state the difference between Intercooler and Reheating gas turbine cycle. | **07** |
| **Q.5** | **(a)** | State the difference between steam turbine and gas turbine. | **03** |

| | | | |
|---|---|---|---|
| | **(b)** | Find the efficiency of constant pressure closed cycle gas turbine. | **04** |
| | **(c)** | In an open cycle regenerative gas turbine plant, the air enters the compressor at 1 bar, 32 $^0$C and leaves at 6.9 bar. The temperature at the end of combustion chamber is 816 $^0$C. the isentropic efficiencies of compressor and turbine are respectively 0.84 and 0.85. combustion efficiency is 90 % and the regenerator effectiveness is 60 %, Determine Thermal efficiency of the plant. | **07** |
| **Q.6** | **(a)** | State the different applications of Gas turbine. | **03** |
| | **(b)** | Describe any four requirements of a typical combustion chamber of the gas turbine power plant. | **04** |
| | **(c)** | A simple gas turbine takes air at 1.01 bar and 15.5 $^0$C and compresses it through a pressure ratio 5:1, the adiabatic efficiency of compression being 85 %. The gases enter the turbine at a temperature 540 $^0$C and expand to 1.01 bar, the turbine efficiency being 80. Estimate the flow of air and gases in kg/s, for a net power of 1500 kW, making the following assumptions,<br>Fall of pressure through the combustion system is 0.07 bar, Cp for both air and combustion gases =1.047 kJ/kgK, k = 1.4. Neglect additional mass flow due to fuel. | **07** |
| **Q.7** | **(a)** | Explain the working of turboprop engine with neat sketch. State its merits and demerits. | **03** |
| | **(b)** | Explain effect of operating variables on work ratio in gas turbine power plant. | **04** |
| | **(c)** | Draw & Explain Can type combustor with swirl floe flame stabilizer. | **07** |
| **Q.8** | **(a)** | Give classification of propulsive engine. | **03** |
| | **(b)** | Differentiate between (i) Turbojet engine and Turboprop engine (ii) Ramjet engine and Pulsejet engine | **04** |
| | **(c)** | What is the principle of jet-propulsion? Explain Thrust, Thrust power, Propulsive power and Propulsive Efficiency. | **07** |

**********