Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC - SEMESTER–VIII• EXAMINATION – WINTER - 2016**

**Subject Code:X81901** **Date:25/10/2016**

**Subject Name: Thermal Engineering**

**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 Mollier chart and steam table are permissible.**

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | Derive general relationship between area-velocity and pressure in nozzle flow. On basis of it Explain (a) supersonic nozzle (b) subsonic nozzle (c) subsonic diffuser (d) supersonic diffuser. | **07** |
| | **(b)** | Steam is expanded in a set of nozzles from 10 bar and 300° C to 2 bar. Are the nozzles convergent or convergent-divergent? Neglecting the initial velocity, find the minimum area of the nozzles to flow 1 kg/s of steam. Assume isentropic expansion. | **07** |
| **Q.2** | **(a)** | In a stage of an impulse turbine provided with a single row wheel, the mean diameter of the blade ring is 800 mm and the speed of rotation is 3000 rpm. The steam issue from the nozzles with a velocity of 300 m/s and the nozzle angle is 20°. The rotor blades are equiangular and the blade friction factor is 0.86. What is the power developed in the blade when the axial thrust on the blades is 140 newtons? | **07** |
| | **(b)** | List different methods of attachment of blades to turbine rotor. Explain any three methods with neat sketch. | **07** |
| | | **OR** | |
| | **(b)** | Why governing of steam turbine required? Explain throttle governing of steam turbine with neat sketch. | **07** |
| **Q.3** | **(a)** | Define degree of reaction. Derive condition for maximum efficiency of Parson's reaction steam turbine. | **07** |
| | **(b)** | The angles at inlet and discharge of the blade of 50% reaction turbine are 35° and 20° respectively. The speed of rotation is 1500 rpm and at a particular stage, the mean ring diameter is 0.67m and the steam condition is at 1.5 bar, 0.96 dry. Estimate (a) the required height of blade to pass 3.6 kg /s of steam and (b) the power developed by the ring. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Explain regenerative feed heating by bleeding process used for the steam turbine. State merits of regenerative feed heating over simple Rankine cycle. | **07** |
| | **(b)** | Explain reheat cycle used for steam turbine with neat sketch. State merits and demerits of reheating of steam. | **07** |
| **Q.4** | **(a)** | Explain with neat sketch the open cycle gas turbine power plant. Also show cycle on T-S diagram and derive an expression for thermal efficiency. | **07** |

| | | | |
|---|---|---|---|
| | **(b)** | Following data obtained from a closed cycle gas turbine:<br>Ambient temperature: 27°C, Highest Temperature: 823°C, Pressure at compressor inlet: 1 bar, Pressure ratio: 4, Compressor efficiency: 80%, Turbine Efficiency: 85%, Heating value of fuel: 41800 kJ/kg, Heating losses: 10% of heating value, Assume working substance is air, $C_p$=1 kJ/kg K and $\gamma$ = 1.4.<br>Find following: (1) Compressor work per kg of fuel (2) Heat supplied per kg of fuel (3) Turbine work per kg of fuel (4) Net Work done per kg of fuel (5) Thermal efficiency (6) Work ratio | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Derive an expression for optimum intermediate pressure in an open cycle gas turbine with reheating. | **07** |
| | **(b)** | Draw the schematic diagram of a simple gas turbine cycle with inter cooling, regeneration and reheating. Draw also T-s diagram of the cycle. | **07** |
| **Q.5** | **(a)** | Explain the working of turbojet engine with neat sketch. State its merits and demerits. | **07** |
| | **(b)** | State the difference between air breathing and non-air breathing engines. Explain basic working principle of rocket engine. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | Explain pass out turbine with schematic and T-s diagram. | **07** |
| | **(b)** | Discuss the advantages of combined cycle power generation. Draw schematic diagram of combined steam and gas turbine power plant. | **07** |

**********