Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE – SEMESTER – VIII.EXAMINATION – WINTER 2016**

**Subject Code: 181904 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.**

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | Explain difference between Convergent and Convergent- divergent nozzle. Obtain equation of steam velocity at outlet of nozzle and define nozzle efficiency. | **07** |
| | **(b)** | What is necessity of compounding in Impulse turbine? Explain velocity compounding with the help of sketch. | **07** |
| **Q.2** | **(a)** | Derive an expression of optimum pressure ratio for maximum work output, in actual Brayton cycle. | **07** |
| | **(b)** | Calculate the throat and exit diameters of a convergent- divergent nozzle, which will discharge 900 kg of steam per hour at a pressure of 8 bar superheated to $220^0$C into a chamber having a pressure of 1.5 bar. The friction loss in the divergent portion of the nozzle may be taken as 0.16 of the isentropic enthalpy drop. | **07** |
| | | **OR** | |
| | **(b)** | Sketch the velocity diagram of a single stage impulse turbine and obtain expression for the work done, diagram efficiency and axial thrust. | **07** |
| **Q.3** | **(a)** | Sketch the blade arrangement of reaction turbine with velocity triangles and define the term 'Degree of Reaction'. Also give your conclusion about the design of Parson's reaction turbine. | **07** |
| | **(b)** | In de- Laval turbine, steam comes out from nozzles with velocity of 850 m/s. The nozzle angle is $20^0$, mean blade velocity 350 m/s and the blades are equiangular. The mass flow rate is 1200 kg/min. The blade velocity coefficient is 0.8, find blade angles, axial thrust, blade efficiency and power developed in kW. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Explain principle of regenerative feed heating and state its advantage with the help of sketch. How is the mass of steam to be bled (m) calculated in analysis? | **07** |
| | **(b)** | A Parson's reaction turbine running at 400 rpm develops 80 kW per kg of steam. The exit angle of the blade is $20^0$ and the steam velocity is 1.5 times the blade velocity. Determine blade velocity and blade inlet angle. | **07** |
| **Q.4** | **(a)** | State types of Combustion chambers of Gas turbine plant and explain various requirements of a typical Combustion chamber. | **07** |
| | **(b)** | Air enters in compressor of gas turbine plant at 1 bar, 300 K with a volumetric flow rate of 5 $m^3$/s. The pressure ratio is 10 and turbine inlet temperature is 1400K. If isentropic efficiency of compressor is 0.8 and that of turbine is 0.85, find thermal efficiency of plant and power developed in kW. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Draw schematic diagram of Turboprop engine and explain its working. List its advantages and disadvantages also. | **07** |
| | **(b)** | A gas turbine plant draws air at 1 bar and 300 K. Air is compressed to 4 bar and then heated to temperature of 900 K. The isentropic efficiency of compressor is | **07** |

81 % and that of turbine is 86 %. Neglecting mass of fuel, determine overall efficiency of the plant. The plant is fitted with regenerator of 75 % effectiveness. Take Cp= 1.005 kJ/ kg K and $\gamma$= 1.4 for air and gases.

**Q.5** **(a)** Explain working of typical Combined cycle power plant with the help of sketch and state its main advantages. **07**

**(b)** Explain working of Ramjet with the help of sketch and explain its advantages and applications. **07**

**OR**

**Q.5** **(a)** Explain Thrust, Thrust power and Propulsive power in context to jet propulsion. **07**

**(b)** Explain working of Pass out turbine with the help of sketch and draw its T- S diagram also. **07**

**********