

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VII (NEW) EXAMINATION – WINTER 2017

Subject Code: 2171917

Date: 22/11/2017

Subject Name: Steam and Gas Turbines

Time: 10:30 AM TO 01:00 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) | State and Draw different types of steam nozzle with neat sketch. | 03 |
| (b) | Give classification of propulsive engine. | 04 |
| (c) | Derive expression for ideal open cycle gas turbine with inter cooling reheating and regeneration. | 07 |

- Q.2**
- | | | |
|-----|--|-----------|
| (a) | Explain the Principle of jet propulsion with neat sketch. | 03 |
| (b) | Estimate the mass flow rate of steam in a nozzle with the following data:
Inlet pressure and temperature = 12 bar and 200°C
Back Pressure = 1 bar
Throat Diameter = 10 mm | 04 |
| (c) | Draw Schematic diagram of turbo prop engine and explain its working. | 07 |

OR

- Q.3**
- | | | |
|-----|---|-----------|
| (c) | Explain the working of turbojet engine with neat sketch. | 07 |
| (a) | Explain working of mixed pressure turbine. | 03 |
| (b) | Explain pressure compounding of impulse turbine with the help of neat sketch. | 04 |
| (c) | A simple impulse turbine has a mean blade ring diameter of 100 cm and runs at 5000 rpm. The nozzle angle is 16° and the steam leaves at nozzles with a velocity of 800 m/s. The blades are equiangular and the blade friction factor is 0.9. Determine: (i) the inlet angles of the blade for shockless entry of steam, (ii) the diagram power for a steam flow of 800 kg/h. (iii) the diagram efficiency, (iv) the axial thrust, and (v) loss of kinetic energy due to friction. | 07 |

OR

- Q.3**
- | | | |
|-----|---|-----------|
| (a) | Explain working of back pressure turbine. | 03 |
| (b) | What is function of governing system of steam turbine? Compare throttle and Nozzle Governing. | 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 = 80 cm, turbine speed = 3000 rpm, steam velocity at exit from blades = 180 m/s, blade outlet angle = 16°, steam flow through blades = 10 kg/s. Draw the velocity diagram and find the following ; (i) blade inlet angle, (ii) tangential force on the ring of moving blades, (iii) power developed in stage. | 07 |
- Q.4**
- | | | |
|-----|--|-----------|
| (a) | List out the advantages of closed cycle gas turbine over open cycle gas turbine power plant. | 03 |
| (b) | Derive the expression for net work done by the gas turbine power plant. | 04 |
| (c) | Derive expression for mass flow rate through the nozzle. | 07 |

OR

- Q.4** (a) Explain with neat sketch working of steam and gas combined cycle power plant. **03**
- (b) Explain effect of operating variables on work ratio in gas turbine power plant. **04**
- (c) Air enters the compressor of an open cycle, constant pressure gas turbine at 1 bar and 27° C. The pressure of air after compression becomes 4 bar. The isentropic efficiencies of compressor and turbine are 78% and 84% respectively. The air fuel ratio used is 75:1. If the rate of flow of air is 2.5 kg/s, determine the power developed and thermal efficiency of the cycle. Take $C_p=1.005\text{kJ/kg K}$ and $\gamma=1.4$ both for air and gases. The calorific value of fuel used = 42,000 kJ/kg. **07**
- Q.5** (a) What are the main types of gas turbine combustion chamber? **03**
- (b) Describe any four requirements of a typical combustion chamber of the gas turbine power plant. **04**
- (c) Explain different methods to improve the thermal efficiency of a gas turbine power plant with T-S diagram. **07**

OR

- Q.5** (a) Enlist different losses in steam turbine. **03**
- (b) Write short note on labyrinth packing. **04**
- (c) Explain with neat sketch various method of attachment of blade to turbine rotor. **07**
