Date: 10/05/2013

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-VIII • EXAMINATION – SUMMER 2013

Subject Code: 181904 Subject Name: Thermal Engineering

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.
- Q.1 (a) Show that the maximum discharge of fluid through a nozzle takes place when the oratio of the fluid pressure at the throat to the inlet pressure is $\left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$ where n
 - is the index of adiabatic expansion.

 (b) Explain the metastable flow of steam through a nozzle and the significance of 07 Wilson ine.
- Q.2 (a) What is the principle of operation of steam turbines? And what is the difference 07 between impulse and reaction turbines.
 - **(b)** What is compounding? Describe various ways of compounding impulse and **07** reaction turbines with merits and demerits.

OR

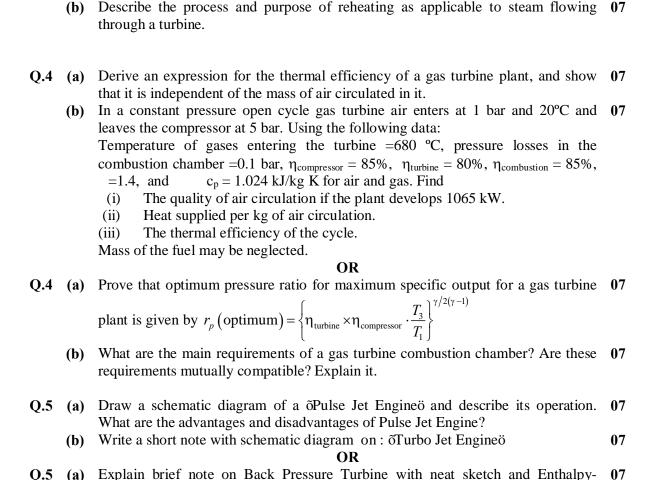
- (b) Dry saturated steam with an initial pressure of 11 bar is expanded to 1.5 bar through a convergent divergent nozzle. The flow rate of steam is estimated as 2 kg/sec. area of cross-section of nozzle as its throat is 1 cm2. If the efficiency of nozzle is 88%. Find the numbers of nozzles and exact throat and exit area. Take the index of expansion as 1.2.
- Q.3 (a) Sketch the velocity diagram of a single stage impulse turbine and determine the expression for the force, workdone, diagram efficiency, gross stage efficiency and axial thrust.
 - (b) The data pertaining to an impulse turbine is as: Blade speed: 300 m/s; isentropic enthalpy drop in nozzles: 450 kJ/kg; nozzle efficiency: 0.9; nozzle angle: 20°; blade velocity coefficient: 0.85; blade exit angle: 25°.Calculate for a mass of 1 kg/sec
 - (a) The inlet angle of moving blades,
 - (b) The axial thrust,
 - (c) The driving force on the wheel,
 - (d) The diagram power,
 - (e) The energy lost in blades due to friction,
 - (f) The diagram efficiency.

OR

Q.3 (a) Prove that the diagram or blade efficiency of a single stage reaction turbine is 07 given by

$$\eta_{bl} = 2 - \frac{2}{1 + 2\rho \cos \alpha - \rho^2}$$
 where $R_d = 50\%$ and $C_{f1} = C_{f0}$

Further prove that maximum blade efficiency is given by $(\eta_{bl})_{max} = \frac{2\cos^2\alpha}{1+\cos^2\alpha}$



(b) Write a short note on methods of attachment of blades to turbine rotors.

0.5

Entropy diagram.

07