

GUJARAT UNIVERSITY
B.E. Sem. VII (Mech.) (Old) Examination
Thermal Engineering-III

Tuesday, 1st January, 2008]

[Time : 3 Hours
 Max. Marks : 100

- Instructions :** (1) Attempt all questions.
 (2) Answer to the two sections must be written in separate answer books.
 (3) Assume additional data if necessary.
 (4) Figures to the right indicate full marks.
 (5) Use of steam table, Mollier's chart and calculator is permissible.

SECTION I

- 1(a) Derive the expression for critical pressure ratio (16)
 for a flow through a steam nozzle. Find its value for
 Dry and superheated steam.
- (b) The throat diameter of round sectional nozzle is 6 mm.
 Steam at 10 bar and 250°C expands upto pressure 1.0 bar in
 nozzle. Find mass flow rate and exit velocity.

OR.

- 1(a) Explain the Phenomenon of super saturation of steam (16)
 in the flow through nozzle with the help of H-S diagram
 and give its effects.
- (b) A steam turbine develops 200 kW with a consumption of
 17 kg/kw-hr. The steam enters the nozzle at 12 bar and 250°C
 to a pressure 1.1 bar in nozzle. If the diameter of the nozzle
 at throat is 7.2 mm find the minimum number of nozzle
 required.
- 2(a) Draw the velocity triangles of Parson's reaction turbine (16)
 and give the expression for power and stage efficiency.
- (b) In a simple impulse turbine steam leaves the nozzle with
 a velocity 1000 m/sec, at an angle of 20° to the plane of rotation.
 The mean blade velocity is 60% of velocity for maximum efficien-
 -cy. If the diagram efficiency is 70% and axial thrust is
 40 N per kg of steam find (i) The blade angles and (ii) Power
 developed for a mass flow rate 5 kg/sec.

OR

- 2(a) Derive the expression for maximum efficiency for (16)
 Parson's reaction turbine.

[P.T.O.]

OR

2(b) The outlet angle of the blade of Parsons's turbine is 20° and the axial velocity of flow of steam is 0.5 times the mean blade velocity. If the mean diameter of the blade ring is 1.2 m and rotational speed is ~~3000~~³⁰⁰⁰ r.p.m. Find
 (i) Inlet angles and (ii) power developed if dry-saturated steam at 6 bar passes through the blades. The blade height is 60 mm. Neglect the effect of blade thickness.

3 Write short notes on any three of the following (18)

- (a) Indirect control of Throttle control governing.
- (b) Pressure-velocity compounded steam turbine
- (c) Steam losses in steam turbines
- (d) Working and application of Back Pressure turbine
- (e) Labyrinth glands and packings used in steam turbine.

section - II

4(a) Derive the expression for efficiency of Brayton cycle (16)

(b) A gas turbine unit has a pressure ratio of 6 and maximum cycle temperature is 1000°C . Air enters the compressor at 27°C at the rate of 6 kg/sec, calorific value of fuel used is 42000 kJ/kg. The isentropic efficiencies of the compressor and turbine are 85% and 90% respectively. combustion and regenerator efficiency are 95% and 65%. Using $c_{p_g} = 1.07 \text{ kJ/kg}^\circ\text{K}$, $c_{p_a} = 1 \text{ kJ/kg}^\circ\text{K}$ and $\gamma = 1.4$ for air and gases find (i) power output (ii) thermal efficiency (iii) Air-fuel ratio and (iv) specific fuel consumption

OR

4(a) Explain effects of intercooling, regeneration and reheating (16) on power output and thermal efficiency of gas turbine cycle.

(b) Explain with a neat schematic diagram the working of a combined cycle power plant. Also state its importance and merits.

(c) Draw the schematic diagram of a simple gas turbine cycle with intercooling, regeneration and reheating. Draw also T-s diagram of the cycle.

D-3

B.E sem VII (Mech) Examination, Dec-2007

③

5(a) Explain working of Turbo-prop and Turbo-jet engine (16)
with neat diagram.

(b) A multistage steam turbine is provided with two stage of regenerative feed heating. The steam enters the turbine at 30 bar and 350°C and exhaust pressure is 0.1 bar. The steam is bled off at 3 bar and 0.5 bar respectively. Find

- (i) steam quantities to be tapped at each point and
(ii) gain in efficiency due to regeneration feed heating.

OR

5(a) Derive the propulsive efficiency of turbojet in terms of jet and air craft velocity.

(b) Steam is supplied to a turbine at a pressure of 100 bar and 100 degree superheat. It expands in H.P. turbine till it becomes dry. Then it is reheated at constant pressure to the same maximum temperature and then expanded in L.P. turbine to a pressure 0.1 bar. Find power out for 30 MW power plant. Find also thermal efficiency with and without reheating.

6 Answer any three of the following (18)

(a) Explain nozzle control governing. Compare it with throttle control governing.

(b) Explain working of Ram jet engine with neat diagram. Give its merits, demerits and applications.

(c) Compare impulse and reaction steam turbine.

(d) Explain working of Low pressure and mixed pressure industrial steam turbine with neat sketches.

(e) Explain any two methods of blade fixation on the turbine rotors. with neat sketches.

————— X —————