Code No: 55020 **R09**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, February/March - 2016

APPLIED THERMODYNAMICS-II

(Common to ME, AME)

Time: 3 hours **Max. Marks: 75**

Answer any five questions

All questions carry equal marks

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1.a) What is the effect of reheat on i) the specific output, ii) the cycle efficiency, iii) steam rate, and iv) heat rate, of a steam power plant.

b) The percent composition of a sample of anthracite coal was found to be Carbon = 90%, Hydrogen = 3.3%, Oxygen = 3%, Nitrogen = 0.8%, Sulphur = 0.9% and ash =2%. If 50% of excess air is supplied, find the percentage composition of dry flue gases by volume. [7+8]

2.a) With a neat diagram explain the working of Benson Boiler? Discuss its merits and demerits.

b) A closed – cycle regenerative gas turbine operating with air as the working medium. Assume the following data: P_1 = 1.4 bar, T_1 = 310 K, P_2/P_1 = 5, T_{max} = 1050 K, effectiveness of the regenerator is 100%, net output = 3000 kW. Assuming the compression and expansion to be isentropic, calculate i) Thermal efficiency, and ii) mass flow rate of air per minute. [7+8]

3.a) Derive the expression for specific work output and the efficiency of a simple gas turbine with reheat and heat exchange cycle.

b) A jet propelled plane has two jets of 25 cm diameter and the net power at the turbine is 3000 kW. The fuel consumption per kWh is 0.42 kg with fuel of calorific value 49000 kJ when flying at a speed of 300 m/s in atmosphere having density of 0.168 kg/m^3. The air fuel ratio is 53. Calculate i) the absolute velocity of jet. ii) The resistance or drag of the plane. iii) The overall efficiency of the plane, and iv) the efficiency of the turbine. [7+8]

4.a) Describe briefly, with sketches, the principle and working of a surface condenser and compare with surface condensers.

b) In a condenser test; the following observation were made:

Vacuum = 70 mm of Hg	Barometer = 76 mm of Hg
Mean temperature of condensation = 35^0 C	Hot well temperature = 29^0 C
Mass of cooling water = 45500 kg/h	Inlet water temperature = 16.5 ^{0}C
Outlet water temperature = 31^0C	Mass of condensate = 1200 kg/h

Find i) Mass of air present unit condenser volume, ii) the state of steam entering the condenser, iii) the vacuum efficiency iv) the condensate undercooling and v) condenser efficiency. [7+8]

5.a) Why mountings are essential in boilers? Name different mountings and functions of each.

b) Derive expressions for the thrust and propulsion efficiency of rockets and compare with those of turbojet. [7+8]

6.a) What is reheat factor? Explain it with the help of T-s and h-s chart. Why is it greater than unity? Explain.

b) One stage comprising a pair of blade rings of a 50% reaction axial flow turbine has inlet and outlet angles of 80^0 and 20^0. The mean diameter of the blades is 1.8 m and the turbine runs at 20 rps.
Steam is admitted to the stage at 12 bar pressure and 200^0 C temperature and undergoes an adiabatic heat drop of 18 kJ. Five percent of the heat supplied is lost through leakage. If the power developed in the stage is 460 kW, determine:
i) the stage efficiency; ii) the blade height. [7+8]

7.a) What is the condition of maximum blade efficiency in single – stage impulse turbine? What is its value? Sketch how efficiency varies with blade – steam velocity.

b) The rotational speed of an impulse steam turbine wheel is 3000 rpm. The nozzle is inclined at 20^0 to the plane of the wheel and its efficiency is 0.885. The isentropic heat drop for the stage is 160 kJ/kg. If the ratio of blade speed to steam speed is 0.4, the blade velocity coefficient is 0.82 and the blading efficiency is 0.76, find i) the mean blade ring diameter, (ii) the residual energy of steam at outlet in kJ per kg of steam, and iii) the power developed by the wheel when the steam flow is 15 kg/s. [7+8]

8.a) Explain the term nozzle efficiency, velocity coefficient and discharge coefficient as applied to nozzles.

b) A convergent- divergent nozzle expands steam from a pressure and temperature of 10 bar, 300^0C to 1.2 bar. The final condition is supersaturated and friction may be neglected. Taking n = 1.3 throughout, determine, by calculation from the tables, the throat and exit areas required per kg per second.
If the nozzle efficiency were 90%, find the change in the required exit area.
[7+8]

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