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Code No: 136EB

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, May - 2019

THERMAL ENGINEERING – II

(Mechanical Engineering)

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

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a) Draw a line diagram of Babcock and Wilcox water tube boilers. [2]
b) What are the advantages and disadvantages of regenerative cycle over simple Rankine Cycle? [3]
c) Define Metastable state and critical velocity. [2]
d) Discuss the effects of friction on the performance of nozzles. [3]
e) What are the advantages and disadvantages of velocity compounded Impulse Turbine. [2]
f) Explain, why pure reaction turbine is not used in practice. [3]
g) What is the purpose of inter cooling in gas turbine. [2]
h) What is the High level Jet condenser? [3]
i) Why propeller engines are not recommended now a days in air craft's? [2]
j) State the fundamental differences between the jet propulsion and rocket propulsion. [3]

PART - B

(50 Marks)

2.a) Discuss various types of safety valves.
b) A steam turbine is fed with steam having an enthalpy of 3100 kJ/kg. It moves out of the turbine with an enthalpy of 2100 kJ/kg. Feed heating is done at a pressure of 3.2 bar with steam enthalpy of 2500 kJ/kg. The condensate from a condenser with an enthalpy of 125 kJ/kg enters into the feed heater. The quantity of bled steam is 11200 kg/h. Find the power developed by the turbine. Assume that the water leaving the feed heater is saturated liquid at 3.2 bar and the heater is direct mixing type. Neglect pump work. [3+7]

OR

3.a) Explain the Regenerative cycle in detail with a neat sketch.
b) Discuss in brief with their function
i) Man hole, ii) Fusible plug, iii) Feed check valve, iv) Blow-off cock [5+5]

4.a) During a test on steam nozzle steam impinges a stationary flat plate which is perpendicular to the direction of flow and the force on the plate is measured. The force is found to be 350 N when dry saturated steam at 8 bar is expanded to 1 bar. Throat cross-section area is 5 cm^2 and exit area is such that the complete expansion is achieved under these conditions. Determine the discharge at throat.

b) What do you understand by nozzle? Discuss different types of nozzles. [6+4]

OR

5.a) Air is expanded reversibly and adiabatically in a nozzle from 13 bar and 150^0C to a pressure of 6 bar. The inlet velocity of the nozzle is very small and the process occurs under steady flow conditions. Calculate the exit velocity of the nozzle.

b) Describe the 'over expansion' and 'under expansion' in nozzles. [6+4]

6.a) Sketch the velocity diagram of a single stage impulse turbine and determine the expression for the force, work done, diagram efficiency and axial thrust.

b) A single stage steam Turbine is supplied with steam at 5bar and 200^0C at the rate of 50Kg/min. It expands into a condenser at a pressure of 0.2bar. The blade speed is 400m/sec. The nozzles are inclined at an angle of 20^0 to the plane of wheel and outlet blade angle is 30^0. Neglecting friction losses. Determine the power developed, blade efficiency and stage efficiency. [5+5]

OR

7.a) Define the following:
i) Blade efficiency
ii) Stage efficiency
iii) Overall efficiency

b) In an impulse turbine (with a single row wheel) the mean diameter of the blades is 1.05m and the speed is 3000 r.p.m. The nozzle angle is 18^0, the ratio of blade speed to steam speed is 0.42 and the ratio of the relative velocity at outlet from the blades to that at inlet is 0.84. The outlet angle of the blade is to be made 3^0 less than the inlet angle. The steam flow is 10kg/s. Draw the velocity diagram for the blades and derive the following:
i) Tangential thrust on the blades
ii) Axial thrust on the blades
iii) Resultant thrust on the blades
iv) Power developed in the blades
v) Blade efficiency [3+7]

8.a) Derive an expression for the efficiency as a function of temperature ratio and pressure ratio of the cycle for an ideal gas turbine cycle with reheat and heat exchange.

b) The following data refers to a test of the surface condenser of a steam turbine
Absolute pressure of the steam entering the condenser =5.628 kPa
Temperature of condensate leaving the condenser =32^0C
Inlet temperature of cooling water=15^0C
Outlet temperature of cooling water=30^0C
Mass of cooling water per kg of steam=32 kg
Assuming that all the heat lost by the exhaust steam is taken up by the circulating water; determine the dryness fraction of the steam as it enters the condenser. [5+5]

OR

9.a) Explain working principle of Surface Condenser with neat sketch.

b) A gas turbine unit receives air at 100kPa and 300K and compresses it adiabatically to 620kPa with efficiency of the compressor 88%. The fuel has a heating value of 44,180kJ/kg and the fuel/air ratio is 0.017kg fuel/kg air. The turbine internal efficiency is 90%. Calculate the compressor work, turbine work and thermal efficiency. [5+5]

10.a) The jet velocity from a rocket engine is 3000 m/s. The forward velocity is 1500m/s and propellant consumption is 80 kg/s. Calculate the thrust, thrust power and propulsive efficiency.

b) A turbojet is flying with a speed of 850 KMPH at an altitude, where air density is 0.17kg/m^3. The propulsive and overall efficiencies are 55% and 17% respectively. If the drag on air craft is 6000 N, calculate the exit velocity of jet, diameter of jet and propulsive power. [4+6]

OR

11.a) A jet plane having 2 jets works on turbo-jet system. It flies at a speed of 800km/hr at an altitude where density of air is 0.15 kg/m^3. The propulsive efficiency is 55%. The drag on the plane is 6500N.
Calculate
i) Absolute velocity of jet
ii) Quantity of compressed air and
iii) Diameter of jet.

b) Derive the equation for propulsive efficiency of rocket propulsion. [5+5]

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