Code No: 115ER

R13

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, November - 2015
THERMAL ENGINEERING – II
(Common to ME, AME)

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) Compare and contrast the gaseous and liquid fuels. [2]
b) What is the condition for max? Discharge through nozzle. [3]
c) Explain the effect of friction on the blade diagram efficiency in steam turbines. [2]
d) Explain the effect of Regeneration in gas turbines. [3]
e) Explain the analysis of rocket propulsion. [2]
f) Explain different types of calorific values of fuels. [3]
g) Explain significance of boiler mountings and accessories. [2]
h) Explain velocity diagram of Parsons reaction turbine with all notations. [3]
i) How Fuels used in closed cycle gas turbine? [2]
j) Explain thrust power and propulsion efficiency of jet propulsion. [3]

PART - B (50 Marks)

2.a) Obtain the efficiency and steam requirement for Rankine cycle.
b) Steam power plant has boiler and condenser pressures of 60 bar and 0.1 bar: respectively. Steam coming out of the boiler is dry and saturated. The plant operates on the Rankine cycle. Calculate thermal efficiency. [5+5]

OR

3.a) Write the details of combustion of solids and liquid fuels.
b) Decane (C_{10} H_{22}) burns with 95% of theoretical air, producing a gaseous mixture of CO_2, CO, H_2O and N_2. Determine the
i) Air-fuel ratio on a molar basis,
ii) Analysis of products on a dry molar basis. [5+5]

4.a) Draw the line diagram and explain the working principle of economizer and discuss the precautions to be made in usage.
b) With the help of line diagram, explain the working of super critical boiler. [5+5]

OR

5.a) Explain the effects of irreversibilities on the performance of nozzle.
b) Calculate the throat and exit diameters of a convergent- divergent nozzle, which will discharge 820 kg of steam per hour at a pressure of 8 bar superheated to 220^0C into a chamber having a pressure of 1.5 bar. The friction loss in the divergent portion of the nozzle may be taken as 0.15 of the isentropic enthalpy drop. [5+5]

6.a) Derive the equation optimum work out put in impulse turbine.

b) The reaction turbine runs at 300 rpm and the steam consumption is 20000 kg/h. The pressure of steam at a certain pair is 2 bar, its dryness fraction is 0.93 and the power developed by the pair is 50 kW. The discharge blade angle is 20^0 for both the fixed and moving blades and the axial velocity of flow is 0.72 times the blade velocity. Find the drum diameter and the blade height. Take the tip leakage steam as 8%. Neglect the blade thickness. [5+5]

OR

7.a) Explain with neat line diagram the working of evaporative steam condenser.

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]

8.a) Explain the concept of thermal refinement in gas turbines.

b) A gas turbine unit has a pressure ratio of 6 and maximum cycle temperature of 610^0C. The isentropic efficiency of the turbine and compressor are 0.82 and 0.8 respectively. Calculate the power output in kW of an electric generator, geared to the turbine, when air enters the compressors at 15^0C at a rate of 16 kg/s.
Take C_p = 1.005 kJ/kg.K and γ = 1.4 for compression process and
Cp = 1.11 kJ/kg.K and γ= 1.333 for expansion process. [5+5]

OR

9.a) Explain the significance of multistage compression in gas turbine and how the working is done.

b) Air compressed from 100 kPa, 300K to 1000 kPa in a two stage compressor with intercooling between stages. The air is compressed to 300 kPa and is cooled back to 300K in an intercooler before entering the second stage compressor. Each compression stage is isentropic. For steady state operation and negligible changes in kinetic and potential energy from inlet to exit, determine (i) temperature at exit of second compressor, (ii) the total compressor work input pet unit of mass flow; (iii) reduction in work input by intercooling and two-stage compression. (iv) isothermal compression work. [5+5]

10.a) Explain the working of turboprop engine and its advantages.

b) A jet propelled engine having two jets and working on turbojet has a velocity of 210 m/s, when flying at an altitude of 12000 m. The density of air at this altitude is 0.172 kg/m^3. The resistance or drag of the plane is 6670.8 N and propulsive efficiency of the jet is 50%. The overall efficiency of the unit is 18%. Calorific value of the fuel is 4.895×10^4 kJ/kg. Calculate
i) Absolute velocity of jet,
ii) Quantity of air compressed per minute,
iii) Diameter of jet,
iv) Net power output of the plant
v) Thrust specific fuel consumption,
vi) Air-fuel ratio. [5+5]

OR

11.a) Explain the nuclear propellant rocket in detail.

b) 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. [5+5]

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