Code No: 07A60303 **R07** **Set No. 2**

III B.Tech II Semester Examinations,APRIL 2011
THERMAL ENGINEERING - II
Mechanical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. In case of steam turbines derive expressions for the following:
   (a) Force
   (b) Work done
   (c) Diagram efficiency
   (d) Stage efficiency.
   (e) Axial thrust. [16]

2. (a) What is Steam Jet Draught?Explain its working detail.
   (b) Give relative merits and demerits of natural draught over artificial draught. [8+8]

3. (a) Give a brief explanation on the classification of rockets.
   (b) What are different types of solid propellants? Explain the desirable characteristics of solid propellants. [8+8]

4. Calculate the amount of theoretical air required for the combustion of 1 kg of acetylene (C_2H_2) to CO_2 and H_2O. [16]

5. A reaction turbine runs at 3000 RPM and the steam consumption is 20000 kg/hr. The pressure of the steam at a certain stage is 2 bar, its dryness fraction is 0.93 and the power developed by the stage is 50 kW. The discharging blade angle is 20^0 for both the fixed and moving blades and the axial velocity of the flow is 0.72 times the blade velocity. Find the rotor mean diameter and the blade height. Take the tip leakage of steam as 8%. Neglect the blade thickness. [16]

6. A simple gas turbine operating on Brayton cycle has air inlet temperature of 27^0C, pressure ratio of 9 and the maximum cycle temperature of 727^0C. What will be the improvement in the cycle efficiency and the output if the turbine process is divided into two stages each of pressure ratio 3 with intermediate reheating to 727^0C. [16]

7. For checking the air leakage into the condenser, the steam plant is run until conditions are steady and immediately steam supply to the engine is shutoff and the condensate extraction pumps are closed down. With the condenser being isolated, the temperature and the vacuum in the condenser are observed to be 42^0C and 680 mm of Hg. After 10 minutes, the values are observed to be 30^0C and 510 mm of Hg. The barometer reads 756 mm of Hg. The effective volume of the condenser is 0.4 m^3. Determine

(a) The amount of air leakage into condenser during the observed period and

(b) The mass of water vapor condensed in the same period. [16]

8. The nozzle in the stage of an impulse turbine receive steam at 12 bar superheated by 62 ^{0}C .The pressure in the wheel chamber is 4 bar .State whether the nozzle is convergent ,divergent of convergent - divergent .Assuming negligible approach velocity and 10% frictional loss, suggest suitable number of nozzles to be used for a flow rate of 450 kg/min. Approximately ,with the exit area of 2.4cm^2.Also state the exact rate of discharge through the nozzle. [16]

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Code No: 07A60303 **R07** **Set No. 4**

III B.Tech II Semester Examinations,APRIL 2011
THERMAL ENGINEERING - II
Mechanical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is back pressure turbine? What are its applications?
   (b) What is the biggest loss in a steam plant? How can this loss be reduced? [8+8]

2. (a) Make a list of any five boiler accessories and write down their functions in brief.
   (b) With the help of neat sketch explain working of Benson boiler. [8+8]

3. With the help of a neat diagram, explain the working of a Ram jet engine? What are its advantages and disadvantages compared to a Turbojet engine? [16]

4. In a shape of impulse reaction turbine operating with 50% degree of reaction, the blades are identical in shape. The outlet angle of moving blades is 19^0 and the absolute discharge velocity of steam is 100m/s in the direction at 100^0 to the motion of the blades. If the rate flow of steam through the turbine is 15000kg/h, calculate the power developed by the turbine in kW. [16]

5. The observations recorded during the trial on a steam condenser are given below: Condenser vacuum is 685 mm of Hg, barometer reading is 765 mm of Hg, mean condenser temperature is 34^0C, hot well temperature is 28^0C, condensate formed per hour is 1750 kg, circulating cooling water inlet temperature is 18^0C and outlet temperature is 30^0C and quantity of cooling water is 1300 kg/min. Determine, vacuum efficiency, under cooling of condensate, condenser efficiency, condition of steam entering the condenser and mass of air present per Kg of uncondensed steam. [16]

6. The inlet condition of steam to a convergent - divergent nozzle is 15 bar pressure and 250^0C temperature. The exit pressure is 0.4 bar .Assuming 85% nozzle efficiency and throat area of 30 cm^2,determine the exit area for the nozzle. [16]

7. In a regenerator gas turbine cycle, air enters the compressor at a temperature of 30^0C and pressure of 1.5 bar and discharges at 220^0C and 5.2 bar. After passing through the regenerator, the air temperature is 395^0C. The temperature of air entering and leaving gas turbine are 900^0C and 510^0C. Assuming no pressure drop through the regenerator, determine
   (a) The output per kg of air,
   (b) Efficiency of cycle and
   (c) Work required to drive the compressor. [16]

8. At a stage of reaction turbine, the mean ring diameter is 140 cm. The blade speed ratio is 0.7. The speed of rotation is 3000 RPM. Determine the required entrance angle for the blading if the exit angle is 20^0. Determine the work done per kg of the steam flow rate. Calculate the percentage increase in diagram efficiency if the blades are designed for and run at the best theoretical speed with the exit angle being kept at 20^0. [16]

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Code No: 07A60303 **R07** **Set No. 1**

III B.Tech II Semester Examinations,APRIL 2011
THERMAL ENGINEERING - II
Mechanical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. With the help of schematic diagram, explain the function of Turboprop engine. Represent the ideal cycle on T-s chart. Also list its advantages and applications. [16]

2. (a) What do you understand by supersaturated flow in case of nozzle and its significance.
   (b) Prove that the velocity of steam at the throat of nozzle is sonic. [8+8]

3. Define the following:
   (a) Internal work,
   (b) Internal efficiency,
   (c) Brake efficiency,
   (d) Mechanical efficiency, and
   (e) Boiler effiency.

4. In a gas turbine, the air is compressed to a pressure ratio of 6 when the air enters at 15^0 C. The same air is then heated to a maximum possible temperature of 750^0C, first in a regenerator and then in a combustion chamber. It is then expanded in two stages such that the expansion work is maximum. The air is reheated to 750^0C after the first stage. Determine the cycle thermal efficiency, the work ratio and the net work per kg of air. [16]

5. In a reaction turbine, the diameter of the rotor is 2m and the speed is 840 rpm. The steam consumption is 870 kg/min. The height of the blade at a particular stage is 15 cm. The exit angle of the nozzles and moving blades is 25^0. The pressure at this stage is 0.3 bar and the steam is 0.98 dry. Estimate the power developed and the heat drop in kW during the stage if the turbine efficiency is 78%. [16]

6. In a surface condenser, air enters the condenser along with the steam at a rate of 10 kg/hr. The temperature of air cooler inlet section is 32^0C and the outlet is at 29^0C. The vacuum in the condenser is kept constant at 715 mm of Hg, while the barometer reads 755 mm of Hg. Calculate,
   (a) The volume of air entering the cooling section per hour.
   (b) The mass of moisture contained in the air.
   (c) The mass of steam condensed per hour in the cooling section. [16]

7. Orsat analysis of the products of combustion of a hydrocarbon fuel of unknown composition is as follows:
   Carbon dioxide (CO_2) = 8% Carbon monoxide (CO) = 0.5%
   Oxygen (O_2) = 6.3% Nitrogen (N_2) = 85.2% Determine the following:

   (a) Air-fuel ratio;

   (b) Percent of theoretical air required for combustion. Superheated steam at a pressure of 10 bar and 400^0C is supplied to a steam engine. Adiabatic expansion takes place to release point at 0.9 bar and it exhaust into a condenser at 0.3 bar. [16]

8. (a) List the advantages of steam turbines over gas turbines.

   (b) Determine the isentropic enthalpy drop in the stage of Persou's reaction turbine which has the following particulars:
   Speed = 1500 rpm
   Mean diameter of the rotor = 1 m
   Stage efficiency = 80%
   Speed ratio = 0.7
   Blade outlet angle = 20^0

   [8+8]

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Code No: 07A60303 **R07** **Set No. 3**

III B.Tech II Semester Examinations,APRIL 2011
THERMAL ENGINEERING - II
Mechanical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) What do you mean by a super saturated flow ?Explain in detail with the help of T-S diagram.
   (b) Define degree of under cooling? [8+8]
2. (a) Write a short note on 'bleeding of steam turbines' and its significance.
   (b) Write about classification of steam turbines. [8+8]
3. (a) Compare water tube and fire tube boilers.
   (b) Describe the working of a Locomotive boiler with the aid of neat sketch.[8+8]
4. (a) The exit velocity from a jet unit is 650m/s for an air flow of 40 kg/s through the unit. The aircraft is flying at 250 kmph. Calculate the thrust developed, thrust power and the propulsion efficiency. Neglect the effect of the fuel.
   (b) What are the different methods of transporting the propellants from their storage tanks to the rocket motors? Explain them briefly with help of schematic diagram. [8+8]
5. At a particular stage of a reaction turbine, the mean blade speed is 160 m/s and the steam is at a pressure of 3.5 bar and 175^0C. The fixed and moving blades have inlet angle of 30^0 and exit angle of 60^0. The blade height is 0.1 times the rotor diameter. The steam flow is 13.5kg/s. Determine:
   (a) Blade height
   (b) Power develooped by the stage
   (c) Specific enthalpy drop if the stage efficiency is 85%. [16]
6. What are the different component efficiencies that are considered in Turbojet engine for evaluating the performance? Briefly give their significance along with their formulae. Also represent these component efficiencies on T-s chart while representing the thermodynamic cycle for Turbojet. [16]
7. A steam turbine discharges 5500 kg of steam per hour at 35^0C and a dryness fraction of 0.9. The air leakage is estimated to be 18 kg/hr. At the suction of air pump, temperature is 32^0C and the temperature of condensate is 30^0C. Find,
   (a) The vacuum gauge reading
   (b) Capacity of air pump

(c) Loss of condensate in kg/hr

(d) The quantity of cooling water required if the rise in the temperature of cooling water is limited to 10^0C. [16]

8. Steam at 20 bar, 360^0C is expanded in a steam turbine to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water in to the boiler.

(a) Assuming ideal processes, find per kg of steam the net work and the cycle efficiency.

(b) If the turbine and the pump have each 80% efficiency, find the percentage reduction in the net work and cycle efficiency. [8+8]

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