Code No: R31034 **R10** **Set No: 1**

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

**THERMAL ENGINEERING-II**

(Common to Mechanical Engineering and Automobile Engineering)

**Time: 3 Hours** **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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**Note : Steam tables and mollier chart maybe permitted**

1. a) Explain the concept of Mean Temperature of Heat addition
   b) In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Determine
   (i) The pump work (ii) The turbine work (iii) The Rankine Efficiency
   (iv) The condenser heat flow
   (v) the dryness at the end of Expansion. Assume flow rate of steam 9.5 kg/s

2. a) What are the factors to be considered for selecting a boiler.
   b) Calculate the mass of flue gases flowing through the chimney when the draught produced is equal to 1.9 cm of water. Temperature of flue gases is $290^0$c and the ambient temperature is $20^0$ c . The flue gases formed per kg of fuel burnt are 23 kg. Neglect the losses and take the diameter of the chimney as 1.8m

3. What is the importance of critical pressure ratio. Derive the expression for the discharge through the nozzle and condition for its maximum value.

4. The first stage of an impulse turbine is compounded for velocity and has two rings of moving blades and one ring of fixed blades. The nozzle angle is $20^0$ and leaving angles of the blades are respectively as follows. First moving $20^0$,fixed $25^0$ and second moving $30^0$ velocity of steam leaving the nozzles is 600 m/s and the steam velocity relative to the blade is reduced by 10% during the passage through each ring. Find the diagram efficiency and power developed for a steam flow of 4Kg per second. Blade speed may be taken as 125m/s.

5. a) Define the term 'Degree of reaction' as applied to a steam turbine. Show that for Parsons turbine the degree of reaction is 50%
   b) In one stage of a reaction steam turbine, both the fixed and moving blades have inlet and outlet blade tip angles of $35^0$and $20^0$ respectively. The mean blade speed is 80m/s and the steam consumption is 22500 kg per hour. Determine the power developed in the pair, if the isentropic heat drop for the pair is 23.5KJ/Kg.

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Code No: R31034 **R10** **Set No: 1**

6. a) What are the effects of air leakage into the condenser. Explain the Edwards Air pump with neat Sketch.
   b) The air entering a steam condenser with steam is estimated at 6kg per hour. The temperature at inlet to air cooler section is $30^0$c and at the outlet is $26^0$c.The vacuum in the shell is essentially Constant throughout and is 721mmof Hg,While the barometer reads 758mm of Hg. Calculate
   (i) The volume of air entering the cooling section per hour
   (ii) The mass of moisture contained in the air
   (iii)The mass of steam condensed per hour in the cooling section.

7. a) What are the different types of combustion chamber. Explain them in detail
   b) A gas turbine unit receives air at 100 kPa and 300 K and compresses it adiabatically to 620 kPa with efficiency of the compressor 88%. The fuel has a heating value of 44180KJ/Kg and the Fuel/air ratio is 0.017 kg fuel /kg air. The turbine internal efficiency is 90%. Calculate the Compressor work ,turbine work and thermal efficiency. Take $C_p$= 1.005 KJ/Kg K.

8. a) List out the applications of the Rocket .Explain the liquid propellant rocket engine.
   b) Explain the principle of jet propulsion and classify the Jet propulsive engines.

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Code No: R31034 **R10** **Set No: 2**

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**THERMAL ENGINEERING-II**

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**Time: 3 Hours** **Max Marks: 75**

Answer any FIVE Questions

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**Note : Steam tables and mollier chart may be permitted**

1. a) Explain the method of Regeneration to improve the thermal efficiency of Rankine cycle with the T-s diagram.
   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 125KJ/Kg enters into the feed water. 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 heater is direct mixing type. Neglect pump work.

2. a) Explain the Scotch marine boiler with a neat sketch
   b) A coal fired boiler plant consumes 400 kg of coal per hour. The boiler evaporates 3200 kg of water at $44.5^0$ into superheated steam at a pressure of 12 bar and $274.5^0$c. If the calorific value of fuel is 32760kJ/Kg of coal. Determine (i) "Equivalent evaporation from and at $100^0$c" and (ii) Thermal efficiency of the boiler. Assume specific heat of super heated steam as 2.1 kJ/kg K

3. a) Obtain the expression for Nozzle efficiency with a neat sketch of h-s diagram
   b) Dry saturated steam at a pressure of 8 bar enters a convergent –divergent nozzle and leaves it at a Pressure of 1.5 bar, if the flow is isentropic and the corresponding expansion index as 1.135, find the ratio of cross-sectional area at exit and throat for maximum discharge.

4. a) What are the different methods to reduce the rotor speed .Explain the pressure velocity Compounding with a neat sketch.
   b) In a Delaval turbine ,the steam issues from nozzles with a velocity of 850m/s. The nozzle angle is $20^0$. Mean blade velocity is 350m/s. The blades are equiangular The mass flow rate is 1000Kg/min. Friction factor is 0.8. Determine (i) Blade angles (ii) axial thrust on the end bearing and (iii) Power developed in Kw.

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Code No: R31034 **R10** **Set No: 2**

5. Obtain the expression for blade efficiency for a single stage reaction turbine and obtain the maximum blade efficiency.

6. a) Classify the steam condensers. What are the differences between the jet condensers and Surface condensers.
   b) List out the advantages of condenser in a steam power plant.

7. a) What are the different methods to improve the efficiency of gas turbines? Explain the Regeneration method.
   b) What are the merits and demerits of closed gas turbine over open cycle gas turbine?

8. Explain the Turbo-Jet showing the basic cycle on T-S diagram and obtain the thermal efficiency.

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**Code No: R31034** **R10** **Set No: 3**

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

**THERMAL ENGINEERING-II**

(Common to Mechanical Engineering and Automobile Engineering)

**Time: 3 Hours** **Max Marks: 75**

Answer any FIVE Questions

All Questions carry equal marks

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**Note : Steam tables and mollier chart may be permitted**

1. a) What are the different thermodynamic variables affecting efficiency and out output of Rankine cycle. Explain their influence on Rankine cycle.
   b) A steam power plant working on Rankine cycle has the range of operation from 40 bar dry saturated to 0.05bar. Determine (i) the cycle efficiency (ii) work ratio (iii) specific fuel consumption.

2. a) What do you mean by draught. Classify the draught system. Discuss about the balanced draught System.
   b) Determine the draught produced in cm of water by a chimney of 50 m height when the temperature of the flue gases passing through the chimney is such that the mass of flue gases discharge is maximum in a given time. The ambient air temperature is $20^0$c .

3. a) Explain the super saturated flow in the nozzle. Explain the effects of super saturation.
   b) Determine the throat area ,exit area and exit velocity for a steam nozzle to pass 0.2 kg/s when the inlet conditions are 12 bar and $250^0$c and the final pressure is 2 bar .Assume that expansion is isentropic and inlet velocity is negligible. Take n=1.3 for super heated steam.

4. a) Define the following as related to steam turbines (i) speed ratio (ii) Blade velocity coefficient (iii) Diagram Efficiency (iv) stage efficiency.
   b) In a De-laval turbine, the steam enters the wheel through a nozzle with velocity of 500m/s and at an angle of $20^0$ to the direction of motion of the blade .The blade speed is 200m/s and the exit angle of the moving blade is $25^0$. Find the inlet angle of the moving blade, exit velocity of steam and its direction and work done per kg of steam.

5. In a 50 percent reaction turbine stage running at 3000 rpm the exit angles are $30^0$ and the inlet angles are $50^0$.The mean diameter is 1m. The steam flow rate is 10000 kg/min and the stage efficiency is 85%.Determine (i) Power output of the stage (ii) the specific enthalpy drop in the stage (iii) The percentage increase in the relative velocity of steam when it flows over the moving blades.

6. a) Explain about the High level Jet condenser.
   b) In surface condenser the vacuum maintained is 700mmof Hg. The barometer reads 754mm.If the temperature of condensate is $18^0$c, Determine (i) mass of air per Kg of steam (ii)Vacuum Efficiency.

7. a) List out the merits and demerits of gas turbines.
   b) Explain about the open cycle and closed cycle turbines with neat sketches and also draw the P-V & T-S diagrams.

8. a) Explain the working difference between the propeller jet, turbo jet and turbo prop.
   b) Explain the turbo prop with a neat sketch.

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Code No: R31034 **R10** **Set No: 4**

III B.Tech. I Semester Supplementary Examinations, June/July - 2014

**THERMAL ENGINEERING-II**

(Common to Mechanical Engineering and Automobile Engineering)

**Time: 3 Hours** **Max Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks
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**Note : Steam tables and mollier chart may be permitted**

1. a) Explain the modified Rankine cycle with neat sketches of P-v &T-S diagrams
   b) Explain the orsat apparatus with neat sketch for the analysis of flue gases.

2. a) Explain the difference between the fire tube boilers and water tube boilers
   b) Obtain the expression of condition for maximum discharge through a chimney.

3. A De-Laval type impulse turbine is to develop 150 KW with a probable consumption of 7.5 Kg Of steam per KWh with initial pressure being 12 bar and the exhaust 0.15bar.Taking the diameter at the throat of each nozzle as 6mm, Find the number of nozzles required. Assume that 10% of the total drop is lost in diverging part of the nozzle; find the diameter at the exit of the nozzle and quality of steam which is to be fully expanded as it leaves the nozzle.

4. Derive the expression for maximum blade efficiency in a single stage impulse turbine

5. a) Define the term 'degree of reaction 'as applied to a steam turbine. show that for Parsons reaction turbine the degree of reaction is 50%.
   b) In one stage of reaction steam turbine, both the fixed and moving blades have inlet and outlet blade tip angles of $35^0$ and $20^0$ respectively. The mean blade speed is 80 m/s and the steam consumption is 22500 kg per hour. Determine the power required in the pair, if the isentropic heat drop for the pair is 23.5KJ/kg.

6. The observations recorded during the trail on a steam condenser are given below. condenser vacuum=685mm Hg, Barometer reading=765 mmHg, Mean condensate temperature $34^0$c hot well temperature $28^0$c condensate formed per hour=1750kg,circulating cooling water inlet temp=$18^0$ c circulating cooling water outlet temperature $30^0$c ,quantity of cooling water 1300Kg/min .Determine (i) vacuum efficiency (ii) under cooling of condensate (iii) condenser Efficiency (iv) condition of steam as it enters the condenser (v) mass of air present per kg of uncondensed steam. Take R for air= 0.287 KJ/Kg K, specific heat of water =4.186KJ/kg K.

7. a) List out the differences between the open cycle gas turbines and closed cycle gas turbines
   b) In an air standard regenerative gas turbine cycle the pressure ratio is 5.Air enters the compressor at 1 bar, 300 K and leaves at 490 K. The maximum temperature in the cycle is 1000 K. Calculate the cycle efficiency, given that the efficiency of regenerator and the adiabatic efficiency of the turbine are each 80%.Assume for air, the ratio of specific heats is 1.4. Also show the cycle on T-S diagram

8. a) Explain about the Ram-Jet engine
   b) Explain the working difference between the propeller-jet, turbojet and turbo-prop

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