Code No: RT31035 **R13** SET - 1

III B. Tech I Semester Regular Examinations November - 2015
THERMAL ENGINEERING – II
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
(Use of steam tables and Mollier chart is allowed)
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PART –A

1 a) State the methods of increasing the thermal efficiency of a Rankine cycle. Draw the neat sketch of it. [4M]
b) Describe with a neat line sketch of a Benson boiler mentioning its distinguishing features. [6M]
c) What is the effect of friction on the flow through a steam nozzle? [3M]
d) Distinguish between impulse and reaction turbine. [3M]
e) State the assumptions made for thermal efficiency of a gas turbine plant. [3M]
f) Define Thrust and Proposive efficiency. [3M]

PART -B

2 Steam at 70 bar and 450^0C is supplied to a steam turbine. After expanding to 25bar in high pressure stages, it is reheated to 420^0C at the constant pressure. Next; it is expanded in intermediate pressure stages to an appropriate minimum pressure such that part of the steam bled at this pressure heats the feed water to a temperature of 180^0C. The remaining steam expands from this pressure to a condenser pressure of 0.07bar in the low pressure stage. The isentropic efficiency of HP stage is 78.5%, while that of the intermediate and LP stage is 83% each. Determine the minimum pressure at which bleeding is necessary, the quantity of steam bled per kg of flow at the turbine inlet and the efficiency of the cycle. [16M]

3 a) Derive an expression for maximum discharge rate of gases through the chimney for a given height of the chimney. [8M]
b) Calculate the height of a chimney required to produce a draught equivalent to 1.7cm of water if the flue gas temperature is 270^0C and ambient temperature is 22^0C and minimum amount of air per kg of fuel is 17kg. [8M]

4 Steam at a pressure of 10bar and 0.9 dry discharges through a nozzle having throat area of 450mm^2. If the back pressure is 1bar. Find final velocity of the steam and cross sectional area of the nozzle at exit for maximum discharge. [16M]

5 A single row impulse turbine develops 132.4 kW at a blade speed of 175m/sec, using 2kg of steam per sec. Steam leaves the nozzle at 400m/sec. Velocity coefficient of the blades is 0.9. Steam leaves the turbine blades axially. Determine nozzle angle, blade angles at entry and exit. Assume no shock. [16M]

6 A gas turbine employs a heat exchanger with a thermal ratio of 72%. The turbine operates between the pressures of 1.01bar and 4.04bar and ambient temperature is 20^0C. Isentropic efficiencies of compressor and turbine are 80% and 85% respectively. The pressure drop on each side of the heat exchanger is0.05bar and in the combustion chamber 0.14bar. Assume combustion efficiency to be unity and calorific value of the fuel to be 41,800kJ/kg. Calculate the increase in efficiency due to heat exchanger over that for simple cycle. Take c_p=1.024kJ/kgK and γ=1.4 [16M]

7 a) State the fundamental differences between the jet propulsion and rocket propulsion. [8M]
b) List out the requirements of an ideal rocket propellant and give the applications of rockets. [8M]

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Code No: RT31035 **R13** SET - 2

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(Mechanical Engineering)

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Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
(Use of steam tables and Mollier chart is allowed)

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PART –A

1	a)	With the help of neat sketch explain regenerative cycle.	[4M]
	b)	What are the differentiating features between a water tube and a fire tube boiler?	[4M]
	c)	Explain the nozzles with the help of h-s diagram.	[3M]
	d)	Explain the functions of the blading of a reaction turbine.	[4M]
	e)	Obtain an expression for the effectiveness of a heat exchanger.	[4M]
	f)	Explain with a neat diagram closed cycle gas turbine.	[3M]

PART -B

2		Superheated steam at a pressure of 10bar and 400^0C is supplied to a steam engine. Adiabatic expansion takes place to release point at 0.9bar and it exhausts into a condenser at 0.3bar. Neglecting clearance, for a steam flow rate of 1.5 kg/s determine the quality of steam at the end of expansion and the end of constant volume operation, power developed, specific steam consumption and modified Rankine cycle efficiency.	[16M]
3		Calculate the power of a motor required to drive a fan which maintains a draught of 54mm of water under the following conditions for induced draught fan and forced draught fan. Temperature of the flue gases leaving the boiler in each case is 240^0C, temperature of the air in the boiler house is 20^0C, Air supplied per kg of fuel in each case is 18.5 kg and Mass of coal burnt per hour is 1820 kg efficiency of the fan is 82%.	[16M]
4		Dry saturated steam at a pressure of 8bar 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 is 1.135. Find the ratio of cross sectional area at exit and throat for maximum discharge.	[16M]
5		In one stage of a reaction steam turbine, both the fixed and moving blades have inlet and outlet blade tip angles of 30^0 and 20^0 respectively. The mean blade speed is 80m/sec and the steam consumption is 22,500 kg per hour. Determine the power developed in the pair, if the isentropic heat drop for the pair is 23.5 per kg.	[16M]
6	a)	Derive the thermal efficiency of an ideal gas turbine power plant.	[8M]
	b)	A gas turbine plant receives air at 1 bar and 290K and compresses it to 5bar. If the temperature of air after compression is 1000K. Find the thermal efficiency of the turbine. Take γ=1.4 for air.	[8M]
7	a)	Derive the expressions for thermal efficiency of thrust and thrust power.	[8M]
	b)	Explain the principle and working of liquid propellent rocket engine with neat sketch.	[8M]

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Code No: RT31035 **R13** SET - 3

III B. Tech I Semester Regular Examinations November - 2015
THERMAL ENGINEERING – II
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
(Use of steam tables and Mollier chart is allowed)
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PART –A

1	a)	Derive the expression for thermal efficiency of Regenerative cycle.	[4M]
	b)	What is the purpose of a steam stop valve? Explain its working principle.	[4M]
	c)	Define the critical pressure ratio for the nozzle of the steam turbine.	[4M]
	d)	List out various methods to reduce rotor speed.	[3M]
	e)	Write briefly about the usage of gas turbines.	[3M]
	f)	Define thrust Augmentation.	[4M]

PART -B

2		A steam power plant of 110 MW capacity is equipped with regenerative as well as reheat arrangement. The steam is supplied at 80bar and 55^{o}C of superheat. The steam is extracted at 7bar for feed heating and remaining steam is reheated to 350^{o}C and then expanded to 0.4bar in the LP stage. Assume indirect type of feed heaters. Determine the ratio of steam bled to steam generated, the boiler generating capacity in tones of steam per hour and the thermal efficiency of the cycle.	[16M]
3	a)	What is the significance of draught in boiler practice?	[8M]
	b)	A chimney is 28m high and the temperature of the hot gases in the chimney is 320^{o}C. The temperature of outside air is 23^{o}C and the furnace is supplied with 15kg of air per kg of coal burnt. Calculate draught in mm of water.	[8M]
4		Estimate the mass flow rate of steam in a nozzle with the following data: inlet pressure and temperature is 10bar and 200^{o}C; back pressure is 0.5bar; throat diameter is 12mm.	[16M]
5		The air entering a steam condenser with steam is estimated at 6kg per hour. The temperature at inlet to air cooler section is 30^{o}C and at the outlet 26^{o}C. The vacuum in the shell is essentially constant throughout and is 721mm of Hg, while the barometer reads 758 mm of Hg. Calculate the volume of air entering the cooling section per hour, the mass of moisture contained in the air and the mass of steam condensed per hour in the cooling section.	[16M]
6		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.	[16M]
7	a)	Explain the working difference between propeller jet, turbojet and turbo propeller.	[8M]
	b)	Describe the working of Rocket engine with neat sketch.	[8M]

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Code No: RT31035 **R13** SET - 4

III B. Tech I Semester Regular Examinations November - 2015
THERMAL ENGINEERING – II
(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**
(Use of steam tables and Mollier chart is allowed)

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PART –A

1	a)	Mention the advantages and disadvantages of regenerative cycle.	[4M]
	b)	Explain why air preheaters are used in a high pressure boiler?	[3M]
	c)	What do you mean by a supersaturated flow? Explain with the help of h-s diagram.	[4M]
	d)	Prove that the vacuum efficiency decreases with the increase in barometric pressure.	[4M]
	e)	Distinguish between an ideal gas turbine plant and an actual gas turbine plant.	[3M]
	f)	Define Thrust and Thrust power.	[4M]

PART -B

2 A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 150^{o}C expands through the high pressure turbine. It is reheated at a constant pressure of 40bar to 550^{o}C and expands through the low pressure turbine to a condenser at 0.1bar. Draw T-S and h-s diagrams and find the Quality of steam at turbine exhaust, cycle efficiency and steam rate in kg/kWh. [16M]

3 A coal fire boiler plant consumes 400kg of coal per hour. The boiler evaporates 3200 kg of water at 44.5^{o}C into superheated steam at a pressure of 12 bar and 274.5^{o}C. If the calorific value of fuel is 32760 kJ/kg of coal. Determine equivalent evaporation from and at 100^{o}C and the thermal efficiency of the boiler. Assume specific heat of superheated steam as 2.1 kJ/kg.K. [16M]

4 Steam enters a group of nozzles of a steam turbine at 12bar and 220^{0}C and leaves at 1.2bar. The steam turbine develops 220kW with a specific steam consumption of 13.5kg/kWh. If the diameter of nozzles at throat is 7mm, calculate the number of nozzles. [16M]

5 At a certain pair in a reaction turbine, the steam leaves the fixed blade at a pressure of 3bar with a dryness fraction of 0.98 and a velocity of 130m/sec. The ratio of axial velocity of 130m/sec. The blades are 20mm high and discharge angle for both the rings is 20^{0}. The ratio of axial velocity of flow to the blade velocity is 0.7 at inlet and 0.76 at exit from the moving blade. If the turbine uses 4kg of steam per second with 5% tip leakage. Find the mean blade diameter and the power developed in the ring. [16M]

6 Determine the efficiency of a gas turbine plant fitted with a heat exchanger of 75% effectiveness. The pressure ratio is 4:1 and the compression is carried out in two stages of equal pressure ratio with intercooling back to initial temperature of 290K. The maximum temperature is 925K. The turbine isentropic efficiency is 88% and each compressor's isentropic efficiency is 85%. For air γ=1.4 and cp=1.005kJ/kg K. [16M]

7	a)	Explain the working difference between propeller jet, turbojet and turbo propeller.	[8M]
	b)	Describe the working of Rocket engine with neat sketch.	[8M]

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