Code No: R1631035 **R16** SET - 1

III B. Tech I Semester Regular Examinations, October/November - 2018

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. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
4. Use of Steam Tables and Mollier Chart is allowed.

~~~~~~

PART –A

1. a) What do you understand by 'adiabatic flame temperature'? [2M]
   b) In what circumstances the water tube boilers are used in preference to the fire tube boilers? Give reasons in support of your answer. [2M]
   c) What do you understand by `` degree of under-cooling``? [2M]
   d) What is the effect of blade friction on steam turbine performance? [3M]
   e) Explain the merits and demerits of closed and semi-closed cycle gas turbines. [3M]
   f) Write the advantages and limitations of ram jet engine [2M]

PART -B

2. a) Explain the concept of ``mean temperature of heat addition``. [5M]
   b) In a regenerative cycle the inlet conditions are 40 bar and 400^0C. Steam is bled at 10 bar in regenerative heating. The exit pressure is 0.8 bar. Neglecting pump work, determine the efficiency of the cycle. [9M]

3. a) What are the essentials of a good steam boiler? Estimate the factors which should be considered while selecting a boiler. [6M]
   b) What do you understand by feed check valve? Explain the working of a feed check valve with a neat sketch. [8M]

4. a) Explain the classification and working principle of a nozzle. [6M]
   b) Steam from nozzle enters into a single stage impulse turbine at 300 m/s absolute velocity. The nozzle angle=25^0. The blade rotor mean diameter is 100cm and rotating at a speed of 2000 rpm. Find the blade angles if the axial thrust is zero. Find the power developed when the steam flow rate is 600 kg/min. Take blade velocity coefficient=0.9. [8M]

5. a) Discuss the merits and demerits of surface condensers over jet condensers. [6M]
   b) Show that for maximum diagram efficiency of a reaction turbine the blade-steam speed ratio is equal to cos α, where α is the angle of absolute velocity at inlet. State the assumptions made. [8M]

6. a) Discuss briefly the methods employed for the improvement of thermal efficiency of an open cycle gas turbine plant. [6M]
   b) In a simple gas turbine plant, air enters at 1 bar and 20^0C and compressed with isentropic efficiency of 80% to 4bar. Then it is heated in combustion chamber with A:F ratio=90:1. The Calorific value of a fuel used is 41.8 MJ/kg. If air flow is 3kg/sec, find the power developed and thermal efficiency by the plant. Take C_p= 1kJ/kg ^{0}C and Υ=1.4 for air as well as gas. [8M]
~~~~~~

7. a) What do you understand by after burning? Explain. [6M]

   b) A turbojet engine indicates 45 kg of air per second and propels an aircraft with a uniform flight speed of 880 km/h. The isentropic enthalpy change for nozzle is 188.37 kJ/kg and its velocity coefficient is 0.96. The fuel-air ratio is 0.012, the combustion efficiency is 0.95 and the lower heating value of the fuel is 44,000kJ/kg. Calculate: i) the thermal efficiency of the engine, ii) the fuel flow rate in kg/h, iii) the propulsion power in kW, iv) the thrust power, v) the propulsive efficiency. [8M]

*****

Code No: R1631035 **R16** SET - 2

III B. Tech I Semester Regular Examinations, October/November - 2018

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. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
4. Use of Steam Tables and Mollier Chart is allowed.

~~~~~~

PART –A

1. a) Discuss briefly the advantages of a regenerative feed heating in steam power cycle. [2M]
   b) Define: equivalent evaporation and boiler efficiency. [2M]
   c) Discuss the effects of friction on the flow through a steam nozzle? [2M]
   d) What do you understand by degree of reaction? [2M]
   e) Draw the T-S diagram of actual gas turbine plant indicating its processes. [3M]
   f) What is the importance of specific impulse in rocket performance? What is its unit? [3M]

PART -B

2. a) Describe the various operations of a Rankine cycle. Derive its expression for the thermal efficiency. [7M]
   b) Compare the Rankine efficiency of a high pressure plant operating from 80bar and 400^0C and a low pressure plant operating from 40bar and 400^0C, if the condenser pressure in both cases is 0.07bar. [7M]

3. a) What do you understand by Boiler Draught? Discuss its classification in detail. [6M]
   b) Explain why the blow-off cock is operated periodically when the boiler is working. Where is it located? Explain its working with a neat sketch. [8M]

4. a) What are the different methods of compounding of steam turbine stages? List the advantages and limitations of velocity compounding. [6M]
   b) A convergent-divergent nozzle is required to discharge 2kg of steam per second. The nozzle is supplied with steam at 10bar and 200^0C and the discharge takes place against a back pressure of 0.34bar. Estimate the throat and exit areas. Assume isentropic flow and take the index n=1.3. If the nozzle efficiency is assumed to be 85%, determine the exit area. [8M]

5. a) Describe the factors which influence the efficiency of a condensing plant. [6M]
   b) In a reaction turbine, the fixed blades and moving blades are of same shape but reversed in direction. The angles of the receiving tips are 35^0 and of the discharging tips are 20^0. Find the power developed per pair of blades for a steam consumption of 2.5 kg/s, when the blade speed is 50m/s. If the heat drop per pair is 10.04 kJ/kg, find the efficiency of the pair. [8M]
~~~~~~

6. a) Sketch and explain the line diagram of a semi closed gas turbine plant. [6M]
   b) In gas turbine plant, the compressor takes air at 15^0C and compresses with pressure ratio of 4 with isentropic efficiency 82%. Then the air is heated in the heat exchanger using 75% of the available heat with exhaust gases and then heated in combustion chamber to 600^0C. Isentropic efficiency of turbine is 70%. Taking the properties of air and gases same, find work developed per kg of air flow and thermal efficiency of the cycle; Take effectiveness of heat exchanger as 0.75. [8M]

7. a) With the help of a T-s diagram, explain the air standard cycle for a jet propulsion plant. [5M]
   b) Write short notes on liquid propellant engines. [4M]
   c) What is meant by thrust augmentation? When is it necessary? Describe any one method of thrust augmentation. [5M]

*****

Code No: R1631035 **R16** SET - 3

III B. Tech I Semester Regular Examinations, October/November - 2018

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. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
4. Use of Steam Tables and Mollier Chart is allowed.

~~~~~~

PART –A

1.	a)	Explain the concept of heat of reaction.	[2M]
	b)	Explain the basic differences between internally fired and externally fired boilers?	[3M]
	c)	Explain what is meant by critical pressure ratio of a nozzle.	[2M]
	d)	State Dalton`s law of partial pressures.	[2M]
	e)	Discuss the advantages and disadvantages of a closed cycle gas turbine over open cycle gas turbine?	[3M]
	f)	Classify jet propulsion systems	[2M]

PART -B

2.	a)	Explain Regenerative Rankine cycle and discuss its advantages and disadvantages of over Simple Rankine cycle.	[6M]
	b)	A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 150bar, 550^0C expands through the high pressure turbine. It is reheated at a constant pressure of 40bar to 550^0C and expands through the low pressure turbine to a condenser at 0.1bar. Draw T-s and h-s diagrams. Find: i) find quality of steam at turbine exhaust; ii) cycle efficiency; iii) steam rate in kg/kWh.	[8M]
3.	a)	Explain the advantages gained by using forced circulation over natural circulation in high pressure boilers.	[6M]
	b)	A steam generator evaporates 1800 kg/h of steam at 12.5 bar and a quality of 0.97 from feed water at 105^0C, when coal is fired at the rate of 2040 kg/h. If the higher calorific value of the coal is 27400 kJ/kg, find i) Equivalent Evaporation and ii) Thermal Efficiency.	[8M]
4.	a)	Write the general energy equation for a steady flow system and from this obtain the energy equation for nozzle. State clearly the assumptions made.	[6M]
	b)	Dry saturated steam at 10bar is expanded in a nozzle to 0.4 bar. The throat area is 7cm and the inlet velocity is negligible. Estimate the mass flow and the exit area. Assume isentropic flow and take the index n=1.135 for dry saturated steam.	[8M]
5.	a)	What is the fundamental difference between the operation of impulse and reaction turbines? Explain the same with neat sketches.	[6M]
	b)	A stage of impulse-reaction turbine is provided with single row wheel whose mean diameter is 100cm and it is rotating at 50 rps. The nozzle angle=20^0 and the velocity of steam coming out of the turbine is 350 m/sec. Determine the power developed if the axial thrust on the end bearings is limited to 118N. Take blade friction factor=0.8. Assume the blades are equi-angular.	[8M]

|''|'''||''||'''||||
~~~~~~

6. a) Discuss the effect of Compressor inlet temperature and Turbine isentropic efficiency on the specific output and thermal efficiency of the open cycle gas turbine at different pressure ratios. [6M]

   b) In a open cycle gas turbine plant, air enters at 1 bar, 20^0C and compressed to 5 bar. Taking the maximum temperature of the cycle as 680^0C, compressor, turbine and combustion efficiencies as 85%, 80% and 85% respectively, pressure loss in the combustion chamber as 0.1 bar, specific heat (Cp) as 1.02 kJ/kg.K and Υ=1.4 for air and gas. Find the [8M]
   i) Air circulation if power developed by the plant is 1065 kW;
   ii) Thermal efficiency of the cycle. Neglect the mass of the fuel.

7. a) Describe with a sketch a solid propellant rocket. What is gain? What are the applications of solid propellant rockets? [6M]

   b) A turbo jet engine consumes air at the rate of 60 kg/s when flying at a speed of1000 km/h. calculate: [8M]
   i) Exit velocity of the jet when the enthalpy change for the nozzle is 230 kJ/kg and velocity coefficient is 0.96.
   ii) Fuel flow rate in kg/s when air – fuel ratio is 70 : 1.
   iii) Thrust specific fuel consumption.
   iv) Thermal efficiency of the plant when the combustion efficiency is 90% and calorific value is 40000 kJ/kg.
   v) Propulsive power
   vi)propulsive efficiency
   vii) overall efficiency.

*****

Code No: R1631035 **R16** SET - 4

III B. Tech I Semester Regular Examinations, October/November - 2018

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. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
4. Use of Steam Tables and Mollier Chart is allowed.

~~~~~~

PART –A

1.	a)	What do understand by stoichiometric air-fuel ratio? Explain.	[2M]
	b)	Explain the difference between induced and forced draught.	[2M]
	c)	Discuss the principle of operation of steam turbines?	[2M]
	d)	Discuss about the factors which affect the vacuum efficiency of a condenser.	[3M]
	e)	Write the merits of closed cycle gas turbine over open cycle gas turbine.	[3M]
	f)	Define thrust power and propulsion efficiency of a rocket engine.	[2M]

PART -B

2.	a)	Discuss the advantage of reheating the steam in high pressure steam plants.	[6M]
	b)	In a regenerative cycle, the steam pressure at turbine inlet is 30bar and the exhaust is at 0.04bar. The steam is initially saturated. Enough steam is bled off at the optimum pressure to heat the feed water. Determine the cycle efficiency. Neglect pump work.	[8M]
3.	a)	Why mountings are essential in boilers? Name different mountings and give functions of each.	[6M]
	b)	Obtain the expression for draught in mm column of water when the discharge is maximum?	[8M]
4.	a)	Explain the working of a single-stage impulse turbine. Sketch pressure and velocity variations along the axis of the turbine.	[6M]
	b)	Derive an expression for maximum mass flow through a convergent-divergent nozzle when the steam is expanded isentropic ally from rest.	[8M]
5.	a)	Briefly state the effects of air leakage on the performance of a condenser.	[6M]
	b)	In a reaction turbine, the blade tips are inclined at 35^0 and 20^0 in the direction of motion. The guide blades are of same shape as that of the moving blades, but reversed in direction. At a certain place in the turbine, the drum diameter is 1m and the blades are 10 cm high. At this place, the steam has a pressure of 1.75 bar and dryness fraction of 0.935. If the speed of this turbine is 250 rpm and the steam passes through the blades without shock, find the mass of steam flow and power developed in the ring of moving blades.	[8M]
~~~~~~

6. a) What problems are encountered in the design of gas turbine combustion chambers? Draw a neat sketch of a combustion chamber used for an open-cycle plant and name the parts. [7M]
   b) Derive the expression of optimum pressure ratio for maximum net work output in an ideal gas turbine cycle. [7M]

7. a) What is a rocket engine? Explain how is it propelled? [5M]
   b) The following data pertain to a turbo jet flying at an altitude of 9000m: [9M]
   Speed of the jet = 800 km/h
   Propulsive efficiency = 55%
   Overall efficiency = 17%
   Density of air at 9000 m = 0.17 kg/m^3
   Drag on the plane = 6100 N
   Calorific value of the fuel used is 4500 kJ/kg,
   Calculate: i) Absolute velocity of the jet, ii) Volume of air compressed per min, iii) Diameter of the jet, iv) power output of the unit, v Air – fuel ratio.

*****