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

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

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.

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PART –A (14 Marks)

1. a) List out the methods to improve the efficiency of Rankine cycle. [2M]
   b) Write the differences between the boiler mountings and accessories. [2M]
   c) State the condition for maximum discharge through the nozzle. [2M]
   d) Define degree of reaction of a reaction turbine. [3M]
   e) Enumerate the requirements of a good combustion chamber for a gas turbine. [3M]
   f) Write the importance of specific impulse in rocket performance. [2M]

PART –B (56 Marks)

2. a) Explain the Regenerative Rankine cycle. Write the advantages of regenerative Rankine cycle over Simple Rankine cycle. [6M]
   b) Compare the Rankine efficiency of a high pressure plant operating from 80 bar and 400^0C and a low pressure plant operating from 40 bar and 400^0C, if the condenser pressure in both cases is 0.07 bar. [8M]

3. a) Derive the expression for draught in mm of column of water when the discharge is maximum? [7M]
   b) Why the blow-off cock is operated periodically when the boiler is working? Explain its working with a neat sketch. [7M]

4. a) What are the different methods of compounding of steam turbine stages? Explain any one method. [6M]
   b) Dry saturated steam at 10 bar is expanded in a nozzle to 0.4 bar. The throat area is 7 cm 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 are the effects of air leakage on the performance of a condenser? Explain. [6M]
   b) Show that for the 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 assumption made. [8M]

6. a) What are the methods in use for the improvement of thermal efficiency of an open cycle gas turbine plant? Describe them. [6M]
   b) In a simple gas turbine plant, air enters at 1 bar and 20^0C and compressed with isentropic efficiency of 80% to 4 bar. 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) Explain the solid propellant rocket with a neat sketch and write its applications. [7M]
   b) Derive expressions for the thrust and propulsion efficiency of rockets and compare with those of turbojet. [7M]

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

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

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.

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PART –A (14 Marks)

1. a) Name any four fuels and write their calorific values. [2M]
   b) What are the differences between external fired and internal fired boilers? [2M]
   c) Write the equation for blade efficiency (or) diagram efficiency of impulse turbine. [2M]
   d) Explain velocity diagram of Parsons reaction turbine with all notations. [3M]
   e) What are the different types of combustion chambers in gas turbines? [2M]
   f) Explain liquid propellant rocket engine. [3M]

PART –B (56 Marks)

2. a) Steam at 30 bar and 200^0C is passed through a turbine. The steam is reheated to its original temperature by passing it through a re-heater at 12 bar. The condenser pressure is 0.07 bar. Determine net workout and thermal efficiency. [7M]
   b) Draw the line diagram and explain the flue gas analysis using Orsat apparatus. [7M]

3. a) Compare and contrast the boiler mountings and accessories. [7M]
   b) Calculate the height of chimney required to produce a draught equivalent to 1.8 cm of water if the flue gas temperature is 250^0C and ambient temperature is 25^0C and minimum amount of air per kg of fuel is 20 kg. [7M]

4. a) 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. [7M]
   b) For single stage impulse turbine steam velocity is 900 m/s. Blade speed is 400 m/s. Nozzle angle is 20^0. Blade outlet angle is 25^0. Steam flow rate is 30 kg/sec. Calculate the power to be developed. [7M]

5. a) Derive the condition for maximum efficiency and blade height of reaction turbine. [6M]
   b) Explain with neat line diagram the working of evaporative steam condenser. [8M]

6. 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=1.005kJ/kg.K and γ = 1.4 for compression process and C_p = 1.11 kJ/kg.K and γ= 1.333 for expansion process. [14M]

7. a) Explain the working of turboprop engine and write its advantages. [8M]
   b) State the fundamental difference between the jet propulsion and rocket propulsion. [6M]

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

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

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.

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PART –A (14 Marks)

1. a) Explain different methods to improve the efficiency of Rankine cycle. [2M]
   b) Differentiate the fire tube and water tube boiler. [2M]
   c) What is the condition for maximum discharge through the nozzle? [2M]
   d) Define vacuum efficiency and explain how it is useful in condensers? [3M]
   e) Draw the layout of an open cycle gas turbine. [3M]
   f) Why propeller engines are not recommended now a days in air craft's? [2M]

PART –B (56 Marks)

2. a) How to calculate the minimum air required and excess air calculation in the complete combustion of gaseous fuel? [7M]
   b) A steam power plant operates on ideal Rankine cycle. The steam enters the turbine at 3 MPa, 350^0C and is condensed in the condenser at 75 kPa, calculate thermal efficiency and work ratio of this cycle. [7M]

3. a) Why boiler mountings are installed? Explain the operation of fusible plug with the help of simple diagram. [9M]
   b) Differentiate the induced and forced draught. [5M]

4. a) Draw the line diagram and velocity triangles and explain the working details of impulse turbine. [7M]
   b) Steam leaves the nozzle of a single stage impulse turbine at 850 m/s. The nozzle angle is 18^0 and the blade angles are 29^0 at the inlet and outlet. The friction coefficient is 0.9. Calculate blade velocity and steam mass flow rate in kg/hr to develop 300 W power. [7M]

5. a) Steam enters a condenser at 35^0C. The barometer reading is 760 mm of mercury. If a vacuum of 690 mm is recorded, calculate the vacuum efficiency. [7M]
   b) List the differences between impulse and reaction turbines. [7M]

6. The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1.5 bar and temperature of 25^0C. The pressure of the air after compression is 5 bar. The isentropic efficiencies of compressor and turbine are 80% and 85% respectively. The air fuel ratio used is 85:1. If flow rate of air is 2.5 kg/sec, find: i) Power developed, and ii) Thermal efficiency of the cycle. Assume C p = 1.0 kJ.kg K and ɣ = 1.4 of air and gases, Calorific value of fuel = 41800 kJ/kg. [14M]

7. a) What are the desirable properties of a liquid propellant for a rocket engine? [8M]
   b) The jet velocity from a rocket engine is 3000 m/s. The forward velocity is 1500 m/s and propellant consumption is 80 kg/s. Calculate the thrust, thrust power and propulsive efficiency. [6M]

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

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

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.

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PART –A (14 Marks)

1. a) What is meant by Reheating and write its advantages? [2M]
   b) Compare boiler mountings and accessories. [2M]
   c) Explain the effect of friction on the blade diagram efficiency in steam turbines. [2M]
   d) What is the condition for maximum blade efficiency of a 50% reaction turbine? [3M]
   e) Write down different applications of gas turbine power cycles in power sector industries. [3M]
   f) Write equation for Thrust power and propulsive power. [2M]

PART –B (56 Marks)

2. a) Explain the effect of any two operating variables on Rankine cycle performance. [6M]
   b) A steam power plant operates on the ideal reheat Rankine cycle. Steam enters the high pressure turbine at 6 MPa and 500^0C and leaves at 4 MPa. Steam is then reheated at constant pressure to 500^0C before it expands to 25 kPa in the low pressure turbine. Determine the turbine work output in kJ/kg and the thermal efficiency of the cycle. Also show the cycle on a T-s diagram with respect to the saturation lines. [8M]

3. a) Explain the working of any one type of water tube boiler with neat sketch. [8M]
   b) The following readings are obtained during a boiler trail of 8 hours duration. Mean steam pressure=15 bar, mass of steam generated=45000 kg, mean dryness fraction=0.87, mean feed water temperature=30^0C, coal used=4500 kg, calorific value of coal = 33500 kJ/kg. Determine: i) Factor of equivalent evaporation, ii) Equivalent evaporation from and at 100^0C, iii) Efficiency of the boiler. [6M]

4. a) In a convergent-divergent nozzle, the steam enters at 20 bar and 350^0C and leaves at a pressure of 5 bar. The inlet velocity to the nozzle is 175 m/s. Find the required throat and exit areas for a mass flow rate of 1.5 kg/s. Assume nozzle efficiency to be 90 percent and C_{ps}=2.4 kJ/kg.K. [7M]
   b) What is the need of compounding impulse turbines? Explain any one method in detail. [7M]

5. a) Explain the working of high level jet condenser with a neat sketch. [7M]
   b) In a Parson reaction turbine, the angles of receiving tips are 35^0 and of discharging tips 20^0. The blade speed is 125 m/s. Calculate the tangential force, power developed, diagram efficiency and axial thrust of the turbine, if it steam consumption is 1.5 kg/min. [7M]

6. a) A simple gas turbine cycle works with a pressure ratio of 9. The compressor and turbine inlet temperatures are 300 K and 800 K. If the volume flow rate of the air is 300 m^3 per sec, compute the power output and thermal efficiency. [8M]
   b) Derive the thermal efficiency of an ideal gas turbine power plant. [6M]

7. a) The effective jet velocity from a rocket is 2700 m /sec. The forward flight velocity is 1350 m/sec and the propellant consumption is 78.6 kg /sec. Calculate thrust, thrust power and propulsive efficiency. [8M]
   b) How a rocket propulsion system works? Explain. [6M]

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