Roll No…….. **Total No. of Printed Pages: [01]**

Total No. of Questions: [09]

B. Tech (Mechanical Engineering) (Semester – 4th)

APPLIED THERMODYNAMICS

Subject Code: BMECS1-404

Paper ID: [18112318]

Time: 03 Hours **Maximum Marks: 60**

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A **(2 marks each)**

Q1. Attempt the following:

a. What do you mean by stoichiometric air-fuel ratio?
b. Define adiabatic flame temperature.
c. Why combined power and heating cycle are used in practice?
d. Discuss the advantages and disadvantages of reheat cycle.
e. Differentiate between a nozzle and diffuser.
f. What is supersaturated low in steam nozzle?
g. What is the difference between the impulse and reaction turbine.
h. Draw T-S diagram for a dual cycle.
i. Difference between reciprocating compressor and rotary compressor.
j. What do you mean by binary vapor cycle?

Section – B **(5 marks each)**

Q2. Explain in details the various methods for improving the Rankine cycle efficiency. Explain in brief. Also discuss the limitations of each method.

Q3. A refrigerator uses R-134a as the working fluid and operates on an ideal vapour compression cycle between 0.14 and 0.8 MPa. If the mass flow rate of the refrigerant is 0.06 kg/s, determine (a) the rate of heat removal from the refrigerated space, (b) the power input to the compressor, (c) the heat rejection rate in the compressor, and (d) the COP.

Q4. The following is the analysis by weight of a chemical fuel:
Carbon = 60%, Hydrogen = 20 % , Oxygen = 5%, Sulphur = 5 % and Nitrogen = 10%.
Find the stoichiometric amount of air required for complete combustion of this fuel.

Q5. Define nozzle efficiency. Explain its significance. What is the difference between the coefficient of discharge and velocity coefficient for a nozzle?

Q6. Air is compressed adiabatically from 101 kPa and 20°C to 750 kPa in a compressor. If the mass flow rate is steady at 0.18 kg/s and the adiabatic efficiency of the compressor is 85 per cent, determine the required power input to the compressor and the exit temperature of the air. Treat air to be an ideal gas.

Section – C **(10 marks each)**

Q7. (a) Why is the Carnot cycle not practicable for a steam power plant?
(b) Define an expression for the air standard efficiency of the Diesel cycle in terms of the compression ratio, cut off ratio and the adiabatic index. (2+8)

Q8. A nozzle is supplied with dry steam at 12 bar and back pressure is 1 bar. Whether the nozzle is convergent or divergent? Calculate throat and exit diameters if it discharges 15 kg steam per minute.

Q9. (a) Why are steam turbines compounded? What are the different method of compounding?
(b) Drive the relation of perfect intercooling and optimum work input required in case of 2-stage reciprocating air compressor. (5+5)