CBCS SCHEME

USN | | | | | | | | | |

15ME43

Fourth Semester B.E. Degree Examination, Aug./Sept. 2020
Applied Thermodynamics

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of thermodynamic data book and steam table is permitted.***

Module-1

1 a. Define :
(i) Compression ratio.
(ii) Mean effective pressure.
(iii) Expansion ratio.
(iv) Cut-off ratio. **(08 Marks)**

b. Derive an equation of Air-standard efficiency of diesel cycle with PV and TS diagrams. **(08 Marks)**

OR

2 a. With a neat sketch, explain the working operation of rocket engine. **(06 Marks)**

b. A simple gas turbine plant operating on the brayton cycle has air entering the compressor at 100 KPa and 27°C. The pressure ratio is 9.0 and maximum cycle temperature is 727°C. What will be the percentage change in efficiency and net work output if the expansion in the turbine is divided into two stages each of pressure ratio 3.0 with intermediate reheating to 727°C. Assume compression and expansion are ideal isentropic. **(10 Marks)**

Module-2

3 a. List out the comparison of Rankine cycle and Carnot cycle. **(06 Marks)**

b. What is reheating? With a schematic diagram and PV and TS diagrams, explain the working of reheat cycle and derive an equation of efficiency of the same. **(10 Marks)**

OR

4 a. In a single heater regenerative cycle the steam enters the turbine at 30 bar, 400°C and the exhaust pressure is 0.10 bar. The feedwater heater is a direct contact type which operates at 5 bar. Find (i) The efficiency (ii) steam rate of the cycle. Neglect pump work done. **(12 Marks)**

b. Draw the schematic diagram of Rankine cycle with PV and TS diagrams. **(04 Marks)**

Module-3

5 a. Calculate the theoretical Air-Fuel Ratio [AFR] for the combustion of C_8H_{18} . **(08 Marks)**

b. Define the following:
(i) Combustion efficiency.
(ii) Enthalpy of formation.
(iii) Adiabatic flame temperature.
(iv) Excess air. **(08 Marks)**

OR

6 a. In a test on a three cylinder four stroke I.C.engine with 22 cm bore and 26 cm stroke the following observation were made during a trial period one hour:
Fuel consumption = 8 kg ; Air consumed = 300 kg; Ambient temperature = 30°; Calorific value = 45,000 kJ/kg ; Net load on brake = 1.5 kN; Brake drum dia = 1.8 m;
Rope diameter = 3 cm; Mass of cooling water = 550 kg; Inlet and outlet temperature of water = 27°C and 55°C rescpectively. Exhaust gas temperature = 310°C; Cp = for exhaust gas = 1.1 $\frac{kJ}{kgK}$. Calculate IP, BP, η_m, η_{IT} and draw heat balance sheet in $\frac{kJ}{min}$ and %. **(12 Marks)**

b. What is detonation and explain the factors affecting detonation. **(04 Marks)**

Module-4

7 a. Sketch and explain the Vapor-Compression refrigeration system. With PV and T-S diagram. **(08 Marks)**

b. Compare vapour compression and vapour absorption refrigeration system. **(08 Marks)**

OR

8 a. Define the following:
(i) DBT.
(ii) Relative humidity.
(iii) Specific humidity.
(iv) Degree of saturation. **(08 Marks)**

b. Moisture air at 35°C has a dew point of 15°C. Calculate the relative humidity, specific humidity and enthalpy. **(08 Marks)**

Module-5

9 a. Derive an equation for minimum work by two stage compressor with perfect inter cooling. **(08 Marks)**

b. Air at 1 bar and 27°C is compressed to 7 bar by a single stage reci-procating air compressor according to the law $PV^{1.3} = C$. The free air delivered is 1 m^3/min. Speed of compressor 300 rpm. Stroke to bore ratio 1.5 : 1, Mechanical efficiency 85% and motor efficiency 90% determine,
(i) Indicated power and isothermal efficiency.
(ii) Cylinder dimensions.
(iii) Power of the motor. **(08 Marks)**

OR

10 a. Define critical pressure ratio for maximum discharge and obtain the expression of critical pressure ratio. **(08 Marks)**

b. Steam approaches a nozzle with a velocity of 250 m/s, 3.5 bar absolute pressure and dryness fraction 0.95. If the back pressure is 2 bar, assuming flow to be isentropic, find the final condition and drop in enthalpy of steam. Also find the exit velocity and the area at exit of the nozzle if the flow rate is 2700 kg/hr. **(08 Marks)**

* * * * *