Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.TECH**

PME3I103

3rd Semester Back Examination 2019-20

ENGINEERING THERMODYNAMICS

BRANCH : MECH, PT

Max Marks : 100

Time : 3 Hours

Q.CODE : HB608

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.

The figures in the right hand margin indicate marks.

Part- I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

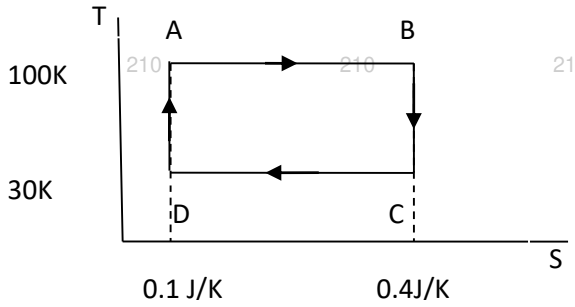
a) Write the mass conservation equation in steady flow case. Mention the nomenclatures used in it.

b) What is the effect of regeneration on the (i) the cycle efficiency (ii) Specific out put (iii) mean temperature of heat addition of a steam power plant?

c) Why is Carnot cycle not practicable for a steam power plant?

d) What are availability functions for a (i) closed system and (ii) a steady flow system

e) Find the heat input and work done for the cycle given below.



f) Write down the Maxwell's equations.

g) What do mean by Entropy generation.

h) Differentiate between Availability and Irreversibility.

i) What is the effect of reheating on the (i) the cycle efficiency (ii) Specific output in the case of Bryton cycle.

j) Write down the effect of reheating and regeneration on Rankine cycle.

Part- II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Can two reversible adiabatic paths intersect each other? Justify.

b) Show that a constant volume line is steeper than a constant pressure line on T-s diagram.

c) A rigid tank of capacity 200m^3 holds some amount of compressed air at 10 bar/300K. determine the work potential of the compressed air system if the surrounding air is 1 bar/300K

d) A steel block weighing 50 kg heated to a uniform temperature of 500K is thrown into a large lake at 285K. The block eventually attains the thermal equilibrium with the lake water. Determine the i) entropy change of the block ii) entropy change of the lake water iii) the entropy generated during the process.

e) The Carnot cycle is an ideal cycle that begets the maximum cycle efficiency. In spite of that, why is the Carnot cycle is not a realistic model to operate steam power plants?

f) Derive volumetric efficiency for a single stage air compressor having clearance ratio 'c', compression/expansion index 'n' and pressure ratio rp

g) Why multi stage compression is required?

h) What is cogeneration? Explain with sketch.

i) JGive a short note on oule-Kelvin effect

j) Describe working of vapor absorption system with sketch.

k) Show that the overall efficiency of two cycles coupled in series equals the sum of the individual cycle efficiencies minus their product.

l) Obtain the Difference in heat capacities as follows

$$C_p - C_v = \frac{TV\beta^2}{k_T}$$

Where β and k_T are the volume expansivity and isothermal compressibility respectively.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four) **(16 x 2)**

Q3 Consider a vapor compression system with R-12 refrigerant. The maximum and minimum pressures are 8 bar and 1.2 bar respectively. At the compressor inlet the vapor temperature is -12°C and temperature at outlet of condenser outlet is 30°C. The required refrigerant load is 2.2 kW. The compressor runs to 600 rpm and has volumetric efficiency is 75%. Find COP and swept volume.

Q4 A single stage reciprocating air compressor has a swept volume of 2000 cm^3 and runs at 800 rpm. It operates on a pressure ratio of 8, with a clearance of 5% of the swept volume. Assume NTP room conditions and inlet (p= 1 bar, t= 15°C) and polytropic compression and expansion with n=1.25. Calculate (a) indicated power (b) volumetric efficiency (c) mass flow rate (d) free air delivery (e) isothermal efficiency (f) the actual power needed to drive the compressor, if the mechanical efficiency is 85%

Q5 A steam power plant operates in a basic Rankine cycle using dry, saturated steam at 10 bar fed to a turbine where it expands isentropically to 0.08 bar. Determine a) heat supplied b) heat rejected c) change of entropy during the heat rejection. d) thermal efficiency e) overall thermal efficiency assuming turbine efficiency of 0.8.

Q6 Derive air standard efficiency of Otto cycle.

An air standard cycle Dual cycle has a compression ratio of 16 and a compression begins at 1 bar, 50°C. The maximum pressure is 70 bar. The heat transferred to the air at constant pressure is equal to that at constant volume. Estimate (i) the pressures and temperatures at cardinal points of the cycle (ii) the cycle efficiency (iii) the m.e.p. of the cycle. Assume Cp=1005 J/kgK and Cv=718 J/kgK.