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

Total Number of Pages : 02 **B.Tech**
PME3I103

3rd Semester Regular / Back Examination 2018-19
ENGINEERING THERMODYNAMICS
BRANCH : MECH, PT
Time : 3 Hours
Max Marks : 100
Q.CODE : E732

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.Use of Steam table and Refrigeration table are allowed in the examination hall.

Part- I

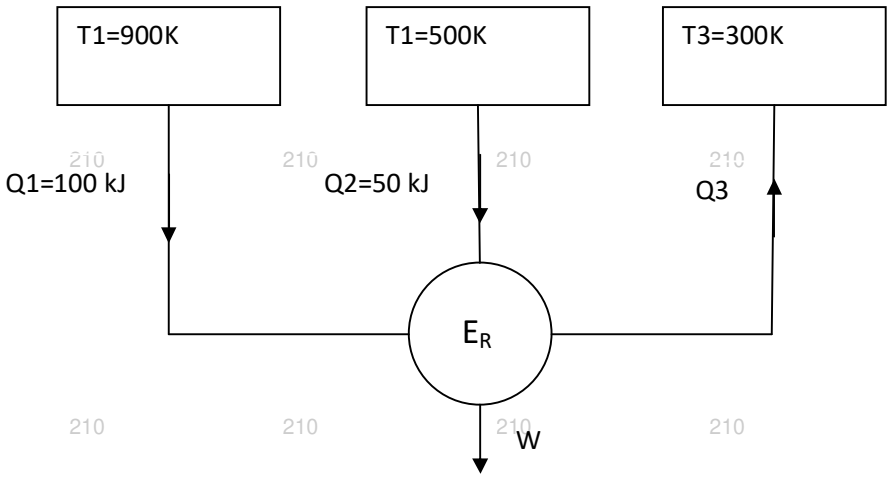
Q1 **Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Mention second law of the thermodynamics (k-p and Clausisus statement)
b) "Isentropic process need not be adiabatic, but if the isentropic process is reversible, it must be adiabatic". Explain the sentence.
c) Differentiate between availability and irreversibility.
d) Compare between Rankine and Carnot cycle.
e) Mention the Maxwell's equations.
f) Write down the refrigerant and absorbents used in Lithium bromide water vapor absorption system.
g) What is a tonne of refrigeration?
h) What is the effect of regeneration on the (i) the cycle efficiency (ii) Specific output (iii) mean temperature of heat addition of a steam power plant?
i) Differentiate between heat pump and refrigerator.
j) What are availability functions for a (i) closed system and (ii) a steady flow system

Part- II

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

a) Explain Available energy, Unavailable energy, Availability, Irreversibility.
b) Write a short note on unsteady flow processes.
c) Figure shown below shows a reversible heat engine E_R having heat interactions with three constant temperature systems. Calculate the thermal efficiency of the heat engine.



d) What is a cogeneration plant? What are the thermodynamic advantages of such a plant?

e) Give a short notes on Air motors.

f) Explain Joule Thompson effect.

g) Compare Otto, diesel and dual cycles on the basis of same compression ratio and same maximum pressure ratio.

h) Briefly discuss Clausius-Clapeyron equation.

i) Draw the p-v and T-s diagram for a reversed carnot cycle.
An inventor claims to have developed a refrigerating device that extracts 50 MJ of heat at 30 K and rejects 60 MJ of heat at 40K and taking in 10 MJ of compressor work. Would you advise investing money to put this device in the market?

j) Air enters an adiabatic compressor at atmospheric conditions of 1 bar, 15°C and leaves at 5.5. bar. The mass flow rate is 0.01 kg/s and the efficiency of the compressor is 75%. After leaving the compressor, the air is cooled to 40°C in an after cooler. Calculate i) the power required to drive the compressor ii) rate of irreversibility for the overall process

k) Derive :

$$\eta_{vol} = 1 + C - C\left(\frac{p_2}{p_1}\right)^{1/n}$$

for air compressor, where C is clearance ratio, p1,p2 are pressures at inlet and exit of compressor and n is compression(=expansion) index.

l) Derive the COP for reversed Bryton cycle.

Part-III

Long Answer Type Questions (Answer Any Two out of Four)

Q3 Draw the Aqua-Ammonia vapor absorption cycle and explain its working. **(16)**
In an aqua-ammonia absorption refrigeration system, heat is supplied to the generator by condensing steam at 2 bar, 90% quality. The temperature to be maintained in the refrigerator -10°C, and the ambient temperature is 30°C. Estimate the maximum COP of the refrigerator. If the actual COP is 40% of maximum COP and the refrigeration load is 20 tonnes, what will the required steam flow rate be?

Q4 Write down the First and Second Tds equations. Based of the Tds equations obtain the Difference in heat capacities as follows **(16)**

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

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

Q5 Show that the overall efficiency of two cycles coupled in series equals the sum of the individual cycle efficiencies minus their product. **(16)**
In a reheat cycle steam at 550°C expands in h.p turbine till it is saturated vapour. It is reheated at constant pressure to 400°C and then expands in l.p. turbine to 40°C. if the moisture content at turbine exhaust is given to be 0.15, find i) the reheat pressure ii) the pressure of the steam at inlet to the h.p. turbine iii) the net work output per kg iv) cycle efficiency. Assume all processes are ideal.

Q6 With the help of p-v and T-s diagrams, show that for the same maximum pressure and temperature of the cycle and the same heat rejection, Diesel cycle efficiency is more than that of Otto cycle efficiency. **(16)**
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.