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

Total Number of Pages : 03 **B.Tech**

15BE2103

1st Semester Back Examination 2018-19

THERMODYNAMICS

BRANCH : AEIE, AERO, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CSE, ECE, EEE, EIE, ELECTRICAL, ENV, ETC, FASHION, FAT, IEE, IT, ITE, MANUFAC, MANUTECH, MARINE, MECH, METTA, METTAMIN, MINERAL, MINING, MME, PE, PLASTIC, TEXTILE

Time : 3 Hours

Max Marks : 100

Q.CODE : E904

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

a) Write two reasons 'why carnot cycle is not practically possible'.

b) Under what conditions is the work done is $\int_1^2 PdV$?

c) Explain the principle of thermocouple.

d) Suppose there is a heat engine that operates with 100% thermal efficiency. Does it necessarily violate the First law or second law! Explain.

e) All adiabatic reversible process is Isentropic process or vice versa is true or not. Justify.

f) Distinguish between heat transfer and work transfer. Does the increase in temperature of a system always require a heat transfer? Justify your answer

g) We speak of at times of energy crises, the necessity to conserve energy. So what we can conserve- the quality of energy or quantity of energy

h) A heat pump takes up heat from cold outdoors and transfers it to the warmer indoor space. Is this violation of the second law of thermodynamics? Explain

i) State the difference between a vapour and gas

j) What are the different methods of measurement of quality

Part- II

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

a) A 400-L tank A, contains argon gas at 250kPa, 30°C. Cylinder B, having a frictionless piston of such mass that a pressure of 150kPa will float it, is initially empty. The valve is opened and argon flows into B and eventually reaches a uniform state of 150kPa, 30°C throughout. What is the work done by the argon?

b) Athermal storage device is made with a rock (granite)bed of 2 m3 that is heated to 400 K using solarenergy.Aheat engine receives$Q_H$from the bed andrejects heat to the ambient surroundings at 290 K.The rock bed therefore cools down, and as it reaches290 K the process stops. Find the energy the rockbed can give out. What is the heat engine's efficiencyat the beginning of the process, and what isit at the end of the process?

c) An air conditioner cools a house at TL =20°C with a maximum of 1.2kWpower input. The house gains energy as $\dot{Q} = 0.6(T_H - T_L)$ [kW] and the refrigeration COP is $\beta = 0.6\ \beta_{CARNOT}$. Find the maximum outside temperature, T_H, for which the air conditioner unit provides sufficient cooling.

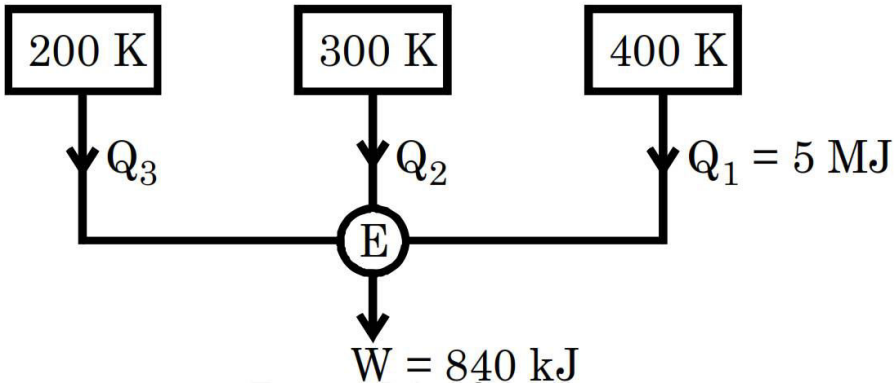
d) A BPUT student runs a heat pump with a motor of 2 kW. He/She should keep his/her class room at 30°C which loses energy at a rate of 0.5 kW per degree difference to the colder ambient. The heat pump has a coefficient of performance that is 50% of a Carnot heat pump. What is the minimum ambient temperature for which the heat pump is sufficient?

e) Steam at 5Mpa and 500°C enters a nozzle steadily at a velocity of 80 m/sec and it leaves at 2 Mpa and 400°C. The inlet area of the nozzle is 38 cm^2 and heat is being lost at a rate of 8Kg/sec. Determine

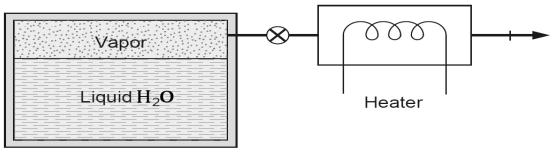
i. Mass flow rate of the steam
ii. The exit velocity of the steam and
iii. The exit area of the nozzle

f) Air flows steadily at the rate of 0.4 kg/sec through an air compressor entering at 6m/sec with a pressure of 1bar and specific volume of 0.85m^3/kg, and leaving at 4.5m/sec. with a pressure of 6.9 bar and a specific volume of 0.16m^3/kg. Internal energy of air leaving is 88 KJ/kg greater than that of air entering. Cooling water in a jacket surrounding the cylinder absorbs heat from the air at a rate of 59 W. calculate the power required to drive the compressor and the area of cross section of inlet and outlet

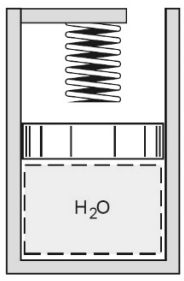
g) A reversible engine, as shown in Figure during a cycle of operations draws 5 MJ from the 400 K reservoir and does 840 kJ of work. Find the amount and direction of heat interaction with other reservoirs.



h) A container with water at 100 K has across-sectional area of 0.5 m^2, as shown in Fig. Due to heat transfer, some of the liquid evaporates, and in 1hour the liquid level drops30 mm. The vapor leaving the container passesthrough a valve and a heater and exits at 500 kPa,260 K. Calculate the volume rate of flowof gas exiting the heater.



i) A cylinder/piston arrangement contains water at105°C, 85% quality, with a volume of 1 L. Thesystem is heated, causing the piston to rise and encountera linear spring, as shown in Fig. Atthis point the volume is 1.5 L, the piston diameteris 150 mm, and the spring constant is 100 N/mm.The heating continues, so the piston compresses the spring. What is the cylindertemperature when the pressure reaches 200 kPa?



j) Considering a Piston- Cylinder device to operate as an I C engine, define the following items:

i. TDC and BDC
ii. Connecting Rod
iii. Crank
iv. Crank Shaft

k) What is heat engine? On what assumption does it operate? How do you distinguish between I C engine and an external combustion engine? Give examples of both

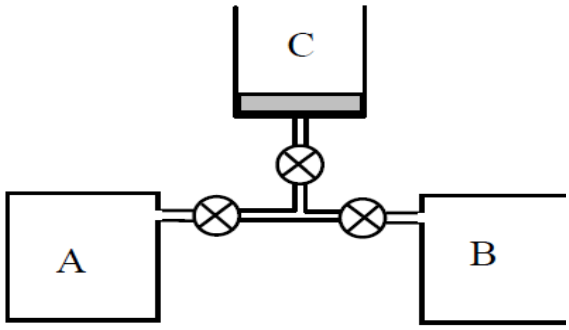
l) What is the basic difference between refrigeration and air conditioning? Draw the schematic diagram and discuss the function of each component of a vapor compression refrigeration system.

Part-III

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

Q3 **(16)**

A rigid tank *A* of volume 0.6 m3 contains 3kg ofwater at 120˚C, and rigid tank *B* is 0.4 m3 with water at 600kPa, 200˚C. They are connected to apiston/cylinder initially empty with closed valves. The pressure in the cylinder should be 800kPa to float the piston.



Now thevalves are slowly opened and heat is transferred so that thewater reaches a uniform state at 250˚C withthe valves open. Find the final volume and pressure,and the work and heat transfer in the process.

Q4 A vessel of 6m^3 capacity contains two gases A & B in proportion of 45% and 55% respectively at 30°C. if the gas constant R for the gases is 0.288 kJ/kg-K and 0.295 kJ/kg-K and total weight of mixture is 2 kg, calculate **(16)**

a) the partial pressure
b) the total pressure
c) the mean value of R for the mixture

Q5 Write down the detail principle of thermal power plant with neat sketch **(16)**

Q6 **Write Short Notes :** **(16)**

a) Combine mode of heat transfer
b) Throttling Calorimeter
c) Clausius inequality
d) Calibration of thermometer