Code No: R1621033 **R16** SET - 1

II B. Tech I Semester Regular Examinations, October/November - 2017
THERMODYNAMICS
(Com to ME, AE and AME)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A

1. a) Explain what you mean by the thermodynamic property of a system. How will you classify it? (3M)
   b) Define specific heat at constant volume and specific heat at constant pressure. (2M)
   c) Discuss why PMM-II cannot be constructed in practice. (2M)
   d) Define a pure substance. Can air be treated as pure substance? Explain. (3M)
   e) Distinguish between Universal Gas constant and Characteristic Gas constant. (2M)
   f) What are the assumptions made in the analysis of an air standard cycle? (2M)

PART -B

2. a) Explain what do you understand by concept of continuum? How will you define density and pressure using this concept? (6M)
   b) A balloon is filled with air (200 kPa and 300K) such that it becomes as sphere of diameter 1m. It is then gradually heated till the pressure rises to 500 kPa. Determine the amount of work done during the process, assuming that the pressure inside the balloon is proportional to the diameter of the balloon. (8M)

3. a) Discuss the physical significance of the two constants that appear in the Vander Waals equation of state? (6M)
   b) A fluid contained in a cylinder receives 150 kJ of mechanical energy by means of a paddle wheel, together with 50 kJ in the form of heat. At the same time, the piston in the cylinder moves in such a way that the pressure remains constant at 200 kN/m^2 during the fluid expansion from 2 m^3 to 5 m^3. What is the change in internal energy and in enthalpy. (8M)

4. a) Discuss the significance of Gibbs and Helmholtz functions. (6M)
   b) Two blocks of metal, each having a mass of 10 kg and having a specific heat of 0.4 kJ/kg.K, are at a temperature of 40^{0}C. A reversible refrigerator receives heat from one block and rejects heat to the other. Calculate the work required to cause a temperature difference of 100^{0}C between the two blocks. (8M)

5. a) Why cannot a throttling calorimeter measure the quality if the steam is very wet? How is the quality measured then? (7M)
   b) A steam boiler initially contains 5 m^3 of steam and 5 m^3 of water at 1 MPa. Steam is taken out at constant pressure until 4 m^3 of water is left. What is the heat transferred during the process? (7M)
~~~~~~

Code No: R1621033 **R16** SET - 1

6. a) Distinguish between relative humidity and absolute humidity. How can relative humidity be expressed as the ratio of two mole fractions. (7M)
   b) A constant volume chamber of 0.3 m^3 capacity contains 1 kg of air at 5^0C. Heat is transferred to the air until the temperature is 100^0C. Find the work done and the changes in the internal energy, enthalpy and entropy. (7M)

7. a) Show that efficiency of an Otto cycle depends only on the compression ratio. (6M)
   b) A theoretical diesel engine operates at suction conditions of 1 bar and 300 K. At the end of compression stroke, the pressure rises to 24 bar. The maximum temperature limit of the cycle is 1473K. Determine (i) cut-off ratio; (ii) net work output of the cycle and (iii) thermal efficiency of the cycle. For air, assume specific heat at constant pressure and volume as 1.005 kJ/kg.K and 0.717 kJ/kg.K. (8M)

Code No: R1621033 **R16** SET - 2

II B. Tech I Semester Regular Examinations, October/November - 2017
THERMODYNAMICS
(Com to ME, AE and AME)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A

1\. a) Define a quasi-equilibrium process. Explore its importance in engineering. (2M)

b) Discuss the differences between heat and internal energy? (2M)

c) Why is the performance of a heat pump or a refrigerator not measured in terms of thermal efficiency, but in terms of COP? (3M)

d) Explain the difference between saturated liquid and compressed liquid? (2M)

e) How is the partial pressure of a component in a gaseous mixture related to the mole fraction of that component? (3M)

f) Define mean effective pressure and thermal efficiency of an air standard cycle? (2M)

PART -B

2\. a) Explain in detail the working of constant volume gas thermometer. (6M)

b) A fluid contained in a horizontal cylinder fitted with a frictionless leak proof piston, is continuously agitated by means of a stirrer passing through the cylinder cover. The cylinder diameter is 0.4 m. During the stirring process lasting 10 minutes, the piston slowly moves out a distance of 0.485 m against the atmosphere. The net work done by the fluid during the process is 2 kJ. The speed of the electric motor driving the stirrer is 840 rpm. Determine the torque in the shaft and power output of the motor. (8M)

3\. a) Define Compressibility factor 'Z'. Discuss the significance of the compressibility factor. (6M)

b) A 4m x 6m x 6m room is provided with a 150 W fan. A person turns on the fan, closes the door and windows before he leaves the room one hot summer morning with a hope to keep inside the room cool when he will return in the evening, The doors and the windows are all made of wood are tightly closed to render heat transfer negligible. He returns 10 hours later to find that room was hotter than his expectation. Assume the room to be at 100 kPa and 288 K in the morning when he leaves the room. Determine the room temperature when he opens the door on his return. (8M)

4\. a) Derive Maxwell Equations. (6M)

b) A copper ball weighing 0.4536 kg and uniformly heated to 310.7 K is dropped in a cold bath where upon it cools down to 267 K. Calculate the entropy change of the ball for the process. (8M)
~~~~~~

Code No: R1621033 **R16** SET - 2

5. a) What do you understand by degree of superheat and degree of sub-cooling? (6M)

   b) A rigid vessel of capacity 0.2 m^3 holds 10 bar steam at 250^0C. The vessel is slowly cooled till the steam pressure drops to 3.5 bar. Determine the (i) final temperature and dryness fraction of steam; (ii) change in entropy. (8M)

6. a) Prove that partial pressure of water vapour in air remains constant as long as the specific humidity of air remains constant. (6M)

   b) Write about Psychromatric properties of atmospheric air (8M)

7. a) Show that efficiency of a Brayton cycle depends only on the pressure ratio. (6M)

   b) An SI engine operating on Otto cycle, has its inlet parameters as 323 K and 1 bar, while it develops a maximum pressure of 25 bar. Assuming Bore as 250 mm, Stroke as 375 mm and clearance volume as 0.00263 m^3, determine (i) air standard efficiency and (ii) mean effective pressure of the cycle. (8M)

Code No: R1621033 **R16** SET - 3

II B. Tech I Semester Regular Examinations, October/November - 2017
THERMODYNAMICS
(Com to ME, AE and AME)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A

1. a) Distinguish between stored energy and energy in transit. (2M)
   b) Define enthalpy. How is it related to internal energy? (2M)
   c) Explain the term reversibility as applied to thermodynamic process. (2M)
   d) Is it true that water boils at higher temperatures at higher pressures? Explain. (2M)
   e) Distinguish between wet bulb temperature and thermodynamic wet bulb temperature? (3M)
   f) Draw the P-V and T-S diagram of Lenoir cycle. (3M)

PART -B

2. a) Discuss exact and inexact differentials. (7M)
   b) One mole of air is compressed isochorically till its pressure gets doubled. Then it is allowed to expand reversibly and isothermally to regain its original pressure. Thereafter, it is subjected to isobaric cooling whereupon its volume decreases to restore its initial state. Find the net work done. Assume air behaves as an ideal gas. (7M)

3. a) Write down the Vander Waals equation of state. How does it differ from the ideal gas equation of state. (4M)
   b) Discuss why do the specific heats of an ideal gas depend only on the atomic structure of the gas? (4M)
   c) A 4m x 5m x 6m room is provided with a resistance heater having the capacity to raise the room temperature from 280K to 296K in just 15 min. The room is so well sealed with insulation that heat loss is negligible. If the atmospheric pressure is 100 kPa, determine the required power of the heater. Assume constant specific heats at room temperature. (6M)

4. a) Is the Third law of thermodynamics, an extension of second law? Is it an independent law of nature? Explain? (6M)
   b) Two bodies of equal heat capacities C and temperatures T_1 and T_2 from an adiabatically closed system. What will be the final temperature be if one lets this system come to equilibrium (i) freely; (ii) reversibly. (8M)
~~~~~~

Code No: R1621033 **R16** SET - 3

5. a) What is critical state? Explain the terms critical pressure, critical volume and critical temperature of water? (6M)
   b) A steam pressure of holding capacity 4 m^3 contains a mixture of saturated water and saturated steam at 250^0C. The mass of the liquid present is 1 ton. Determine (i) Quality; (ii) Specific Volume; (iii) Specific Enthalpy; (iv) Specific Entropy and (v) Specific Internal Energy of steam. (8M)

6. a) Justify whether the enthalpy of the humid air will remain constant along a wet bulb temperature line in the psychrometric chart. (6M)
   b) A gaseous mixture consists of 1 kg of oxygen and 2 kg of nitrogen at a pressure of 150 kPa and a temperature of 20^0C. Determine the changes in internal energy, enthalpy and entropy of the mixture when the mixture is heated to a temperature of 100^0C (i) at constant volume and (ii) at constant pressure. (8M)

7. a) For the same compression ratio and heat rejection, which cycle is more efficient: Otto, Diesel or Dual cycle. Explain with P-V and T-s diagrams. (6M)
   b) For an air standard dual cycle, having air intake as 1 bar and 323 K, maximum pressure as 70 bar, heat addition at constant volume is same as the heat addition at constant volume, determine the (i) mean effective pressure and (ii) thermal efficiency of the cycle. (8M)

Code No: R1621033

R16

SET - 4

II B. Tech I Semester Regular Examinations, October/November - 2017
THERMODYNAMICS
(Com to ME, AE and AME)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A

1. a) Discuss the similarities and dissimilarities between heat and work. (2M)
   b) What is PMM-I. Justify with reason whether it is feasible or not? (2M)
   c) A heat pump takes up heat from cold outdoors and transfers it to warmer indoor space. Is this a violation of second law of thermodynamics? Explain. (3M)
   d) What is the difference between critical point and triple point? (2M)
   e) Define the degree of saturation. What are its limiting values? (2M)
   f) Compare Otto and Dual cycle for the same maximum pressure and Temperature. (3M)

PART -B

2. a) Explain what you understand by (i) Macroscopic and Microscopic view points; (ii) Thermodynamic Equilibrium. (6M)
   b) A new scale N of temperature is divided in such a way that the freezing point of ice is 100^0N and the boiling point is 400^0N. What is the temperature reading on this new scale when the temperature is 150^0C? At what temperature both the Celsius and the new scale reading would be the same? (8M)

3. a) Explain the generalized compressibility chart. (4M)
   b) Discuss why free expansion has zero work transfer. (4M)
   c) A spherical balloon holds 5 kg of air at 200 kPa and 450 K. If the air pressure inside is always proportional to the square of the balloon diameter, determine the work done when the balloon volume doubles due to heating. (6M)

4. a) What do you understand by internal irreversibility and external irreversibility? (6M)
   b) An Aluminium block of specific heat 400 J/kg.K with a mass of 5 kg is initially at 40^0C in room air at 20^0C. It is cooled reversibly by transferring heat to a completely reversible cyclic heat engine until the block reaches 20^0C. The 20^0C room air serves as a constant temperature sink for the engine. Compute (i) the change in entropy for the block; (ii) the change in entropy for the room air; (iii) work done by the engine. (8M)
~~~~~~

Code No: R1621033 **R16** SET - 4

5. a) Write short notes on "Mollier diagram". Why do isobars on the Mollier diagram diverge from one another. (6M)
   b) A pressure cooker holding 2 kg of steam at 5 bar and 90% dry is being cooled slowly. What quantity of heat has to be extracted so as to reduce the steam quality down to 60%? Also calculate the pressure and temperature of the steam that remains in the pressure cooker after the heat rejection. (8M)

6. a) What is enthalpy of air-vapour mixture? Discuss why does the enthalpy of air – vapour mixture remains constant during an adiabatic saturation process. (6M)
   b) A mass of 0.25 kg of an ideal gas has a pressure of 300 kPa, a temperature of 80^0C, and a volume of 0.07m^3. The gas undergoes an irreversible adiabatic process to a final pressure of 300 kPa and a final volume of 0.1 m^3, during which the work done on the gas is 25 kJ. Evaluate the specific heat at constant pressure and constant volume of the gas and the increase in entropy of the gas. (8M)

7. a) Explain a vapour compression refrigeration cycle using T-S and P-h diagrams. (6M)
   b) A Gas turbine plant working on air standard Brayton cycle takes up air at 100 kPa and 300 K, develops a pressure ratio of 8. If the maximum permissible temperature is 1300 K, Determine (i) Pressure and Temperature at each state in the cycle; (ii) cycle efficiency. (8M)