Code No: R21032 **R10** SET - 1

II B. Tech I Semester Regular Examinations, March – 2014
THERMODYAMICS
(Com. to ME, AE, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Distinguish between: i) Intensive and extensive properties ii) Homogeneous & heterogeneous systems.
   b) Derive an expression for quasi-static work. (8M+7M)

2. a) Explain Joule's experiments with suitable sketches.
   b) In a turbomachine handling an incompressible fluid with a density of 1000 kg/m^3 the conditions of the fluid at the rotor entry and exit are as given below:

	Inlet	Exit
Pressure	1.15 Mpa	0.05 Mpa
Velocity	30 m/s	15.5 m/s
Height above datum	10 m	2m

   If the volume flow rate of the fluid is 40 m/s, estimate the net energy transfer from the fluid as work. (7M+8M)

3. a) Represent Carnot's cycle on p-v and t-s co-ordinates and explain its working.
   b) Derive the equation: $(\partial C_p / \partial p)_T = - T (\partial^2 V / \partial T^2)_p$ (7M+8M)

4. a) Represent the constant volume process on T-S, h-s and p-v diagrams.
   b) Describe the working of a combined calorimeter with a neat sketch. (6M+9M)

5. a) Explain free expansion and throttling processes with the help of property diagrams.
   b) Derive expression for heat transfer during a process when specific heats are varying as c_p = a + kT and c_v = b+kT, where a, b and k are constants. (7M+8M)

6. a) What are the various psychrometric processes? Show them on a psychrometric chart.
   b) A mixture of air and water – vapor possesses a volume of 700 m^3 at one bar pressure and temperature of 35^{0}C. Its relative humidity is 75%. Find the specific humidity, dew point, air mass and the vapor mass in the mixture. (8M+7M)

7. a) Derive an expression for the thermal efficiency of Sterling cycle and draw P-V & T-S diagrams.
   b) Compare Otto, Diesel & Dual cycles on P-V diagram for the same compression ratio. (8M+7M)

8. a) Represent Brayton cycle on P-V & T-S diagrams and explain the processes.
   b) A simple open cycle gas turbine power plant takes in air at 1 bar & 15^{0}C and compresses the air to 5 bar. This is then heated in a combustion chamber to a temperature of 800^{0}C. The hot air expands in the turbine to 1 bar. Find power developed & the thermal efficiency. (7M+8M)
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Code No: R21032 **R10** SET - 2

II B. Tech I Semester Regular Examinations, March – 2014
THERMODYAMICS
(Com. to ME, AE, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. Distinguish between: a) Closed system & open system b) Heat & Work.
   c) Point functions & path functions d) Enthalpy & Internal energy. (15M)

2. a) What is steady flow process?
   b) A turbo compressor delivers 2.33 m^3 /s at 0.276 Mpa, 43^0C which is heated at this pressure to 430^0C and finally expanded in a turbine which delivers 1860 kW. During the expansion, there is a heat transfer of 0.09 MJ/S to the surroundings. Calculate the turbine exhaust temperature if changes in kinetic and potential energy are negligible. (6M+9M)

3. a) Derive an expression for the availability of an open system.
   b) One kg of ice at – 5^0C is exposed to the atmosphere which is at 25^0C. The ice melts and comes into thermal equilibrium. Find the entropy increase of the Universe. (8M+7M)

4. Steam at 3 bar and 0.9 dry expands in a cylinder till the volume is four times that at the beginning. The law of expansion is $pv^{1.1}$ = constant. Find the change in internal energy, work done and steam condition at the end of the process. (15M)

5. a) Explain the generalized compressibility chart and explain its significance.
   b) Calculate the final temperature, pressure, work done and heat transfer if a fluid is compressed from 6 m^3 to 1m^3. Assume index of compression as 1.3, initial temperature as 20^0c & initial pressure as 1 bar. (7M+8M)

6. a) Define: i) Dry bulb temperature ii) dew point temperature iii) degree of saturation.
   b) The barometer reads 750 mm of Hg. The dry bulb temperature is 33^0C and wet bulb temperature is 23^0C. Calculate the relative humidity, humidity ratio and the dew point temperature. (6M+9M)

7. a) Derive an expression for the thermal efficiency of Dual cycle and draw P-V & T-S diagrams.
   b) Compare Otto, Diesel & Dual cycles on P-V diagram for the same maximum pressure & temperature. (8M+7M)

8. a) Write a note on combined cycles.
   b) Calculate the C.O.P. of a simple saturated vapor compression refrigeration system utilizing Fr-12 for the following data: Evaporator temperature= - 15^0C, condenser temperature = 30^0C. Assume c_p as 0.628 KJ/kgK for superheated refrigerant. (6M+9M)
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Code No: R21032 **R10** SET - 3

II B. Tech I Semester Regular Examinations, March – 2014
THERMODYAMICS
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Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. a) What do you mean by phase of a system? State whether the following properties of a system are intensive or extensive: i) Mass ii) weight iii) volume iv) pressure v) surface area
   b) A piston-cylinder arrangement is containing a fluid at 10 bar, the initial volume being $0.05m^3$. Find the work done by the fluid when it expands reversibly according to the law pv^3 = constant to final volume of $0.06m^3$. (7M+8M)

2. a) Sketch and explain the working of a mercury thermometer. What are the limitations of liquid in glass thermometers?
   b) During one cycle the working fluid in an engine engages in two work interactions: 15 kJ to the fluid and 44 kJ from the fluid, and three heat interactions: two of which are known: 75 kJ to the fluid and 40 kJ from the fluid. Evaluate the magnitude and direction of the third heat transfer. (8M+7M)

3. a) Establish equivalence of Kelvin-Planck and Clausius statements of II law of thermodynamics.
   b) Using an engine of 30% thermal efficiency to drive a refrigerator having a COP of 5, what is the heat input into the engine for each MJ removed from the cold body by the refrigerator? (8M+7M)

4. Steam at a pressure of 5 bar and 0.8 dry expands in a cylinder according to the law $pv^{1.35}$ = constant to 2 bar. Find the interchange of heat between the steam and the cylinder per kg of steam and work done. (15M)

5. a) In a centrifugal compressor air is compressed from p_1 = 1 bar and T_1 = 300 K to p_2 = 5 bar. Calculate the final temperature of air and the changes in enthalpy and internal energy.
   b) Derive expression for internal energy during a process when specific heats are varying as $c_p = a + kT$ and $c_v = b+kT$, where a, b and k are constants. (8M+7M)

6. a) Explain Dalton's law of additive pressure.
   b) Air at 1 bar has a dry bulb temperature of 25^0C and wet bulb temperature of 15^0C. Calculate vapor pressure, relative humidity, vapor density and dew point temperature. (7M+8M)

7. a) Derive an expression for the thermal efficiency of Diesel cycle and draw P-V & T-S diagrams.
   b) An air standard diesel cycle has a compression ratio of 16. The pressure at the beginning of compression stroke is 1 bar and the temperature is 25°C. The maximum temperature is 1400°C. Determine the thermal efficiency and mean effective pressure for this cycle. Take γ=1.4. (8M+7M)

8. a) Explain working of Bell-Coleman cycle using T-S diagram & derive an expression for its C.O.P.
   b) A Bell-Coleman cycle, with air as working medium, is to maintain a refrigerated space at –18^0C while rejecting heat to the surroundings at 27^0C. The pressure ratio of the compressor is 4. Find (1) the maximum & minimum temperatures in the cycle (2) The C.O.P. of the cycle. (8M+7M)
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Code No: R21032

R10

SET - 4

II B. Tech I Semester Regular Examinations, March – 2014
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1. a) Show that heat is a path function and not a property of the system.
   b) Derive expressions for reversible work for Isothermal & adiabatic processes. (7M+8M)

2. a) Define concept of equality of temperature, zeroth law of thermodynamics and PMM1.
   b) Sketch and explain the working of an electrical resistance thermometer. (8M+7M)

3. a) Air in a cylinder is compressed reversibly and isothermally from 85 Kpa, 29^0C to 380 Kpa. The initial volume is 0.423 m^3. Find the heat transfer and the entropy change of the air.
   b) Derive: $(\partial\beta / \partial p)_T = - (\partial K / \partial T)_p$ (8M+7M)

4. Four kg of steam expands adiabatically from 16 bar and 250^0C to 0.6 bar in a steam turbine such that the steam is dry and saturated at the end of the expansion. Calculate the work done by the steam and the work lost due to the irreversibility. (15M)

5. a) Show the inversion curve on a T-P diagram and explain the constant enthalpy process.
   b) Explain the Van der Waal's equation of state and describe its limitations. (8M+7M)

6. Explain the adiabatic saturation process with the help of T-S diagram and derive an expression for the absolute humidity. (15M)

7. a) Derive an expression for the thermal efficiency of Lenoir cycle and draw P-V & T-S diagrams.
   b) A 4-stroke cylinder Diesel engine has a compression ratio of 20:1 and expansion ratio of 10:1. Find the cut-off ratio and air standard efficiency. (8M+7M)

8. a) Explain the working of Rankine cycle with the help of T- S diagram.
   b) Steam at 20 bar, 360^0C is expanded in a steam turbine to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assuming ideal processes, find net work per kg of steam and the cycle efficiency. (7M+8M)
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