

R17

Code No: 5421AA

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Tech I Semester Examinations, December-2018/January-2019

ADVANCED THERMODYNAMICS

(Thermal Engineering)

Max.Marks:75

Time: 3hrs

Note: This question paper contains two parts A and B. Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

5 × 5 Marks = 25

- 1.a) Derive the Gay Stodal equation and give the significance of the same. [5]
- b) Show that for an ideal gas, the slope of the constant volume line on the T-s diagram is more than that of the constant pressure line. [5]
- c) What is enthalpy of combustion? What is internal energy of combustion? [5]
- d) Explain the importance and applications of a binary vapour cycle. [5]
- e) Compare and contrast between photovoltaic devices and thermoelectric devices. [5]

PART - B

5 × 10 Marks = 50

- 2.a) Explain the concept of entropy and discuss the importance of change in entropy in evaluation of the irreversibility of the process.
 - b) Deduce the expression for available energy from a finite energy source at temperature T when the environmental temperature is T_0 . [5+5]
3. Air at 3 kg , 150 kPa pressure and 360K temperature is compressed polytropically to pressure 750 kPa according to the law $PV^{1.3}=C$. Subsequently the air is cooled to initial temperature at constant pressure. This is followed by expansion at constant temperature till the original pressure of 150 kPa is reached. Sketch the cycle on P-V and T-S plots and determine the workdone, heat transfer and entropy change for each process. [10]
- $C_p=1.005$ kJ/kg, $C_v=0.718$ kJ/kg and $R=0.287$ kJ/kgK.
- 4.a) Explain how enthalpy change and entropy change of a gas can be estimated with the help of an equation of state and explain its significance.
 - b) With basics explain why do the specific heats of an ideal gas depend only on the atomic structure of the gas? [5+5]

OR

- 5.a) Explain the equation of state for real gases. Explain the compressibility charts with salient points.
- b) Derive the equations used for computing the entropy change of an ideal gas isothermally. [5+5]

- 6.a) Discuss enthalpy of formation and entropy of formation and their significance.
b) An engine with gasoline as working fuel delivers 160 KW. The fuel is C_8H_{18} and enters the engine at $26^\circ C$. 160% theoretical air is used and it enters at $45^\circ C$. The products of combustion leave the engine at 760K, and the heat transfer from the engine is 220 kW. Determine the fuel consumption per hour, if complete combustion is achieved. [5+5]

OR

- 7.a) Calculate the adiabatic flame temperature when liquid octane at $25^\circ C$ is burned with 350% theoretical air in a steady flow process.
b) A mixture of 2 Kmol of CO and 3 Kmol of O_2 is heated to 2400 K at a pressure of 315 kPa. Determine the equilibrium composition, assuming the mixture consists of CO_2 , CO and O_2 . [5+5]

- 8.a) Explain the importance of Onsager relations in evaluating the irreversibilities for coupled flows?
b) Derive the second law efficiency of the given refrigeration cycle. [5+5]

OR

- 9.a) Explain the concepts of heat flux and entropy production.
b) How do the second law analysis of Brayton cycle? Explain the method to estimate the second law efficiency and irreversibility of the cycle. [5+5]

- 10.a) Explain the working principle and significance of Fuel cell and relevance for the day.
b) Differentiate between thermoelectric and thermo-ionic direct energy power generation systems. [5+5]

OR

- 11 Draw the circuit diagram of Magneto hydrodynamic direct energy power generation and derive the equation for thermal efficiency. [10]

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