

**R09**

**Code No: 09A31401**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY, HYDERABAD**

**B.Tech II Year I Semester Examinations, May/June-2013**

**Thermal Science**

**(Mechanical Engineering (Mechatronics))**

**Time: 3 hours**

**Max. Marks: 75**

**Answer any five questions  
All questions carry equal marks**

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- 1.a) What do you understand by path function and point function? What are exact and inexact differentials? Explain.
- b) Explain what do you understand by thermodynamic equilibrium? Explain its significance in the development of temperature measurement. [15]
- 2.a) What is a PMM2? Why is it impossible? How is it linked with Second law of thermodynamics?
- b) A stationary mass of gas is compressed without friction from an initial state of  $0.025 \text{ m}^3$  and  $0.21 \text{ MPa}$  to a final state of  $0.22 \text{ m}^3$  at constant pressure. There is a transfer of  $37.6 \text{ kJ}$  of heat from the gas during the process. It then compressed to initial volume at constant temperature, then calculate net heat transfer and work transfer. [15]
- 3.a) State and explain third law of thermodynamics and discuss the salient points of third law.
- b) The air speed of a turbo jet engine in flight is  $300 \text{ m/s}$  when the ambient air temperature is  $15^\circ\text{C}$  and the gas temperature at outlet of nozzle is  $600^\circ\text{C}$  and the corresponding enthalpy values for air and gas are respectively  $32$  and  $926 \text{ kJ/kg}$  respectively. If the fuel air ratio is  $0.0190$  and chemical energy of the fuel is  $44.5 \text{ MJ/kg}$  and the heat loss from the engine is  $25 \text{ kJ/kg}$  of air then calculate the velocity of the exhaust jet. [15]
4. An ideal Otto cycle has a compression ratio of  $8$ . At the beginning of compression process, air is at  $95 \text{ kPa}$  and  $27^\circ\text{C}$ , and  $750 \text{ kJ/kg}$  of heat is transferred to air during the constant volume heat addition process. Taking into account the variation of specific heat with temperature, determine (a) the pressure and temperature at the end of heat addition process (b) The net work output and (c) Thermal efficiency (d) The mean effective pressure for the cycle. [15]
- 5.a) A Bell-Coleman refrigeration cycle works between  $1 \text{ bar}$  and  $7 \text{ bar}$ . The adiabatic efficiency of compression is  $87\%$  and expansion is  $92\%$ . Find the C.O.P of the system and its tonnage when the air flow rate is  $1 \text{ kg/sec}$ . The ambient temperature is  $32^\circ\text{C}$  and refrigerator temperature is  $5^\circ\text{C}$ .
- b) Draw p-V and T-s diagrams of combined power cycle and explain the salient features. [15]

- 6.a) What is the use of fuel injection system used in diesel engine and explain its functioning?
- b) Why the cooling is necessary in an I.C engine? Explain different methods of cooling systems. [15]
- 7.a) Describe the diesel knock and how to minimize the knocking phenomenon in diesel engine.
- b) Draw the simple carburetor diagram and explain the salient features of the carburetor. [15]
- 8.a) Why inter cooling and regeneration are required in gas turbine power plants? What are the major improvements in the performance?
- b) In a simple gas turbine plant air enters the compressor at 1 bar and  $29^{\circ}\text{C}$  and leaves at 6.3 bar It is then heated in the combustion chamber to  $834^{\circ}\text{C}$  then enters in the turbine and expands to 1 bar. The isentropic efficiency of compressor and turbine are 84% and 83% respectively. Determine (i) Thermal efficiency (ii) Work ratio (iii) Specific fuel consumption (iv) Air fuel ratio. [15]

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