

**II B.Tech. I Semester(R07) Supplementary Examinations, May/June 2010**  
**THERMODYNAMICS**  
**(Mechanical Engineering)**

Time: 3 hours

Max Marks: 80

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

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1. (a) Property is an exact differential. Explain.  
(b) Derive the equations for workdone in various quasistatic processes. [6+10]
2. (a) Define and explain the zeroth law of thermodynamics.  
(b) Explain gas thermometers and write in detail the working of constant volume gas thermometer. [6+10]
3. (a) Write the general energy equation for a variable flow process.  
(b) Reduce the steady flow energy equation for steam condenser and comment on it. [8+8]
4. (a) Define pure substance and why it is called so?  
(b) A vessel of 1 m<sup>3</sup> capacity contains steam at 20 bar and 0.85 dryness fraction. Steam is blown off until the pressure drops to 10 bar. The valve is then closed. Calculate the mass of steam blown off. Assume the process as throttling. [6+10]
5. (a) Derive the expression of heat transfer for an ideal gas in a polytropic process  
(b) 0.6 kg of air, initially at 28°C, is heated reversibly at constant pressure until the volume is doubled, and is then heated reversibly at constant volume until the pressure is doubled. For the total path, find the work transfer and the heat transfer.
6. (a) What is relative humidity? How is it defined as the ratio of two mole fractions?  
(b) Calculate the amount of heat removed per kg of dry air if the initial condition of air is 40 °C, 80% RH, and the final condition is 20°C, 50% RH. [6+10]
7. (a) Explain the Sterling cycle with the help of P-V and T-S diagrams  
(b) Show that the regenerative Stirling cycle has the same efficiency as the Carnot cycle. [8+8]
8. (a) What is refrigeration? How is ice and dry ice used for the purpose of refrigeration?  
(b) A refrigeration plant produces 0.14 kg/s of the ice at -5°C from water at 33°C. If the power required to drive the plant is 24 kW, determine the capacity of the ice plant in tonnes and the actual COP ( $c_p$  of ice = 2.2 kJ/kg K). [6+10]

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