Code No: R059211401 **Set No. 1**

**II B.Tech I Semester Regular Examinations, November 2006**
**THERMAL SCIENCE**
**( Common to Mechatronics and Production Engineering)**

**Time: 3 hours** **Max Marks: 80**

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

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1. (a) What is a quasi-static process? What are its characteristic features
   (b) If a gas of volume 6000 $cm^3$ and at a pressure of 100 KPa is compressed quasistatically according to $PV^2$ = constant until the volume becomes 200 $cm^3$, determine the final pressure and the work transfer. (8+8)

2. A gas flows steadily through a rotary compressor. The gas enters the compressor at a temperature of $16^0$C, a pressure of 100 KPa, and an enthalpy of 391.2 KJ/Kg. The gas leaves the compressor at a temperature of $245^0$C, a pressure of 0.6 MPa, and an enthalpy of 534.5 KJ/Kg. There is no heat transfer between the system and surroundings. (a) evaluate the external work done per unit mass of gas assuming the gas velocities at entry and exit to be negligible. (b) Evaluate the external work done per unit mass of gas when the gas velocity at entry is 80 m/s and that at exit is 160 m/s. (16)

3. (a) With a schematic representation explain briefly about heat engine, refrigerator and heat pump
   (b) Define COP of a refrigerator
   (c) A certain machine works on reversed car not cycle between the temperature limits of -$8^0$C and $25^0$C. Find its COP when working as [9+1+6]
      i. A refrigerating machine
      ii. Heat pump and efficiency when working as heat engine.

4. (a) Discuss the use of air standard cycle analysis for study of Internal Combustion engines?
   (b) An oil engine working on the dual combustion cycle has a compression ratio 14 and the explosion ratio obtained from an indicator card is 1.4. If the cut off occur at 6 percent of stroke. Find the ideal efficiency take for air $\gamma = 1.4$ [6+10]

5. In an open system refrigerating machine working on Bell-coleman cycle, 1200 kg of air is circulated per hour. The suction and compression pressures are 1 bar and 4.5 bar abs. Temperatures before compression and after expansion are 50 C and -750C.assuming compression expansion to be adiabatic. Calculate
   (a) Heat extracted from the cold chamber per hour.
   (b) Heat rejected to the cooler and
   (c) C.O.P. of the system Take Cp = 1.005 kJ / kg K; $\gamma = 1.4$ (16)

6. (a) Explain the working principle of a 4-stroke SI engine. Draw its P-V and valve timing diagrams.
   (b) Compare S.I.engines with C.I.engines. [8+8]

7. (a) What is ignition lag in S.I. Engine combustion? Explain the influence of different operating parameters on ignition lag.
   (b) What are different fuel injectors used in C.I. Engines? Explain briefly. [8+8]

8. (a) What are different parameters influence the performance of gas turbine cycle. Explain.
   (b) In a gas turbine power cycle, the pressure ratio is 6 and the maximum cycle temperature is $650^0$C. The air enters to the cylinder at $15^0$C and the flow rate of air is 12 kg/s. Determine the power developed and thermal efficiency of cycle. [8+8]

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Code No: R059211401 **Set No. 2**

**II B.Tech I Semester Regular Examinations, November 2006**
**THERMAL SCIENCE**
**( Common to Mechatronics and Production Engineering)**

**Time: 3 hours** **Max Marks: 80**

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

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1. 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 torque in the shaft and power output of the motor. (16)

2. A turbine operates under steady flow conditions, receiving steam at the following state: Pressure 1.2 MPa, temperature $188^0$C, enthalpy 2785 KJ/Kg, velocity 33.3 m/s and elevation 3m. The steam leaves the turbine at the following state: Pressure 20 KPa, enthalpy 2512 KJ/kg, velocity 100 m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 KJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in KW? (16)

3. (a) With a schematic representation explain briefly about heat engine, refrigerator and heat pump
   (b) Define COP of a refrigerator
   (c) A certain machine works on reversed car not cycle between the temperature limits of -$8^0$C and $25^0$C. Find its COP when working as [9+1+6]
      i. A refrigerating machine
      ii. Heat pump and efficiency when working as heat engine.

4. (a) Derive an expression for mean effective pressure of the Otto Cycle?
   (b) Show that in an Otto Cycle, the maximum workdone per kg of air is obtained when the temperature after isentropic compression equals the temperature after isentropic expansion, each of them being equal to the geometric mean of the product of the maximum and minimum cycle temperatures. [6+10]

5. (a) State the merits & demerits of regenerative cycle and reheat Rankine cycle.
   (b) Find the C.O.P of a refrigeration system if the work input is 75 kJ/kg and refrigeration effect produced is 160 kJ/kg

6. (a) Discuss the need for lubrication in I.C. engines and explain types of lubrication systems used in I.C.engines.
   (b) Name the various fuels used in I.C. engines and the type of ignition with each one of them. [8+8]

7. (a) What are different methods to control the knocking in S.I. Engine? Explain.
   (b) What is the generally used governing mechanism in controlling the speed of C.I. Engine. Explain with a suitable diagram [8+8]

8. (a) What are essential components required for the operation of gas turbine cycle and explain their functionality.
   (b) What are the advantages and limitations of gas turbine power generation units in comparison with other power generating units. [8+8]

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Code No: R059211401 **Set No. 3**

**II B.Tech I Semester Regular Examinations, November 2006**
**THERMAL SCIENCE**
**( Common to Mechatronics and Production Engineering)**

**Time: 3 hours** **Max Marks: 80**

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

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1. (a) State whether the following properties of a system are intensive or extensive. Give justification:
pressure, temperature, mass, density, volume, specific volume, energy and velocity.
   (b) A mass of 2.5 kg of air is compressed in a quasi static process from 0.1 MPa to 0.7 MPa for which PV = constant. The initial specific volume is 0.80 $m^3$/kg. Find the work done by the piston to compress the air (8+8)

2. A thermodynamic system operates under steady flow conditions, the fluid entering at 2 bar and leaving at 10 bar. The entry velocity is 30 m/s and exit velocity is 10 m/s. During the process 25 MJ/hr of heat is supplied and the increase in enthalpy is 5 KJ/kg. The exit point is 20 m above the entry point. Determine the work from the system if fluid flow rate is 45 Kg/min. (16)

3. (a) Define availability and irreversibility of a system.
   (b) Two kg of air at 500kpa, $80^0$C expands adiabatically in a closed system until its volume is doubled and its temperature becomes equal to that of the surroundings which is at 100 Kpa, $5^0$C. For this process, determine [4+12]
      i. the Maximum work,
      ii. the change in availability, and
      iii. the irreversibility for air, take $C_v$ = 0.718 kJ/kg K, u = $C_v$T where $C_v$ is constant and PV = MRT where P is pressure in Kpa, V Volume in $M^z$, M Mass in kg, R a constant equal to 0.287 kJ/kg $K_1$ and T temperature in K.

4. It is true or false to say that the Otto Cycle has more efficiency than the diesel cycle for a given compression ratio? Mathematically prove your answer? [16]

5. (a) Write the differences between refrigerator and heat pump? Derive the COP for both of them?
   (b) The capacity of refrigerator is 280 tons. Determine the quantity of ice produced at $0^0$ C with in 24 hours when water is supplied at a temperature of $20^0$C (8+8)

6. (a) Explain the working of a four-stroke C.I. engine with a neat sketch.
   (b) Explain the mechanism for load control in C.I.engines. [10+6]

7. (a) What are different ill effects of knocking in S.I.engines and suggest the methods to minimize knocking.
   (b) Explain the influence of different operating parameters on ignition delay during combustion process in C.I.Engine. [8+8]

8. (a) Explain the working principle of gas turbine along with p-v and T-s diagrams.
   (b) Describe the differences between closed cycle gas turbine and open cycle gas turbine. [8+8]

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Code No: R059211401 **Set No. 4**

**II B.Tech I Semester Regular Examinations, November 2006**
**THERMAL SCIENCE**
**( Common to Mechatronics and Production Engineering)**

**Time: 3 hours** **Max Marks: 80**

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

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1. A gas undergoes two processes that are in series. The first process is an expansion that is carried out according to the law PV = constant, and the second process is a Constant pressure process that returns the gas to the initial volume of the first process. The start of the first process is at 400 KPa and 0.025 $m^3$with the expansion to 200 KPa. Sketch the process on a P-V diagram, and determine the work of the combined process. (16)

2. (a) Make an energy analysis of the steam turbine and rotary compressor.
   (b) Refrigerant vapour enters the condenser of a refrigeration plant with enthalpy 223.75 KJ/kg and leaves with enthalpy 64.6 KJ/kg. Cooling water enters at $15^0$C and leaves at $20^0$C. Calculate the mass flow rate of water per unit flow rate of refrigerant. Take for water Cp = 4.186 KJ/Kg-K (6+10)

3. (a) Explain thermodynamic Temperature scale?
   (b) A reversible carnot engine takes in heat from three reservoirs at 1000K, 800K and book and rejects heat to a reservoir at 300K. The engine develops 10 kW power and rejects 410 kJ of heat per minute. If the heat supplied to the reservoir at 1000k is 60% of the heat supplied by reservoir at book. Find out the quantities of heat supplied by each reservoir. [4+12]

4. (a) Discuss the use of air standard cycle analysis for study of Internal Combustion engines?
   (b) An oil engine working on the dual combustion cycle has a compression ratio 14 and the explosion ratio obtained from an indicator card is 1.4. If the cut off occur at 6 percent of stroke. Find the ideal efficiency take for air $\gamma = 1.4$ [6+10]

5. (a) Explain the important components of a simple vapour compression refrigeration system. Also discuss the functions of each component.
   (b) Discuss the effect of sub cooling on C.O.P. of the vapour compression refrigeration cycle. Would you derive large sub cooling and why? (8+8)

6. (a) Discuss the functions of lubricants in an engine.
   (b) What do you understand by thermo-syphon cooling? What are its advantages? [8+8]

7. (a) Explain the phenomena of detonation in S.I. Engine? How it is different from C.I. Engine

(b) What are different uses of cooling in I. C. Engines? [8+8]

8. (a) Draw the schematic diagram of open cycle gas turbine unit and explain its working.

(b) What is the effect of pressure ratio during compression on the performance of gas turbine cycle. [8+8]

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