Code No: 07A4EC05 **R07** **Set No. 2**

II B.Tech II Semester Examinations,December 2010
THERMAL ENGINEERING - I
Common to Mechanical Engineering, Automobile Engineering
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Write short notes on the following terms pertaining to axial flow air compressor.
   (a) Work done factor.
   (b) Stage loading.
   (c) Static pressure rise.
   (d) stage efficiency. [4+4+4+4]
2. (a) Derive an expression for the optimum inter cooler pressure for a two stage reciprocating air compressor with perfect inter cooling.
   (b) A single stage double acting reciprocating air compressor is driven by a 39 kW electric motor with a transmission efficiency of 95%. Air is drawn in at 0.98 bar and 288 K and compressed according to the law $pV^{1.2} = C$ to 5.8 bar. The compressor runs at 100 rpm with a piston speed of 1.5 m/s. [8+8]
3. (a) Explain in detail ignition delay on p-θ diagram?
   (b) Explain period of rapid combustion in CI engine? [8+8]
4. (a) How do the specific heats vary with temperature? What is the physical explanation for this variation?
   (b) Explain and show with the help of a p-v diagram for an Otto cycle, the effect of dissociation is much similar to that of variation of specific heats. [8+8]
5. (a) Explain the principle of carburetion?
   (b) With a neat sketch explain the working principle of a simple carburetor.[6+10]
6. A nine-cylinder petrol engine of bore 150 mm and stroke 200 mm has a compression ratio 6:1 and develops 360 kW at 2000 rpm when running on a mixture of 20% rich. The fuel used has a calorific value of 43 MJ/kg and contains 85.3% carbon and 14.7% hydrogen. Assuming volumetric efficiency of 70% at 17^0C and mechanical efficiency of 90%, find the indicated thermal efficiency of the engine. [16]
7. Discuss the following factors influencing the flame speed.
   (a) Compression ratio.
   (b) Engine output.
   (c) Engine speed.
   (d) Engine size. [16]

8. The following data refers to a centrifugal compressor: tip diameter of the eye is 250 mm; hub diameter of the eye = 100 mm; speed = 120 rps; mass of air handled = 5 kg/s; inlet stagnation pressure = 102 kPa; inlet total temperature = 335 K. Determine the air angle at inlet of the inducer blade and inlet relative Mach number. [16]

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Code No: 07A4EC05 **R07** **Set No. 4**

II B.Tech II Semester Examinations,December 2010
THERMAL ENGINEERING - I
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. Explain how the following affect the delay period.
   (a) Compression ratio, engine speed
   (b) Output, atomization of fuel and duration of injection. [8+8]
2. (a) What are different losses occurring in the centrifugal compressor due to different blade shapes? Explain.
   (b) Draw the schematic diagram of Lysholm compressor and explain the working. [8+8]
3. Briefly explain combustion with reference to detonation in SI engines? [16]
4. (a) Is the effect of compression ratio on efficiency as same in both air standard and cycles? Explain.
   (b) Explain with the help of p-v diagram the loss due to variation of specific heats in Otto cycle? [8+8]
5. (a) Derive the expression for the pressure ratio in each stage of multi stage axial flow air compressor.
   (b) Determine the stage efficiency and work done factor of an axial flow compressor if the actual pressure developed was 1.35 and the actual temperature rise is 30 K. The blade inlet and outlet angles are 47^0 and 15^0 respectively. The peripheral and axial velocities are 225 m/s and 180 m/s respectively. [8+8]
6. (a) Differentiate between reciprocating and rotary air compressors.
   (b) The delivery pressure of two stage compressor is 17.5 bar and the clearance volume of the LP cylinder is equal to 4% of the swept volume. The atmospheric conditions are 1 bar and 288 K. The starting pressure in the LP cylinder is 1 bar and the temperature at the beginning of the compression in each stage is 326 K and inter cooler pressure of 4 bar. The index of the polytropic law of compression and expansion in both stages is 1.25. Determine the volumetric efficiency, work required per kg of air and the isothermal efficiency. [6+10]
7. A six-cylinder, four-stroke cycle gasoline engine with a bore of 120 mm and a stroke of 200 mm under test was supplied with gasoline of composition C = 82% and H_2 = 18% by mass. The dry exhaust composition by volume was CO_2 = 11.2%, O_2 = 3.6% and N_2 = 85.2%. Determine the mass of air supplied per kg of gasoline at 17^0C and 1 bar which were the conditions for the mixture entering the cylinder during

the test. Also determine the volumetric efficiency of the engine based on intake conditions when the mass of gasoline used per hour was 30 kg and the engine speed was 1400 rpm. The gasoline is completely evaporated before entering the cylinder and the effect of its volume on the volumetric efficiency should be included. Take the density of gasoline vapour as 3.4 times that of air at same temperature and pressure. 1 kg of air at 0^0C and 1 bar occupies 0.783 m^3. [16]

8. How does the composition of exhaust gases vary for various fuel-air ratios in a gasoline engine? [16]

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Code No: 07A4EC05 **R07** **Set No. 1**

II B.Tech II Semester Examinations,December 2010
THERMAL ENGINEERING - I
Common to Mechanical Engineering, Automobile Engineering
Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. What are the basic important components of an IC engine? Explain them briefly? [16]

2. (a) Draw the schematic diagram of single cylinder reciprocating air compressor and derive the equation for the estimation of work required to compress the air.
   (b) Air is compressed from 1 bar to 10 bar in one stage. Find the power required for a free air delivery of 0.05 m^3/s and the speed if the swept volume is 14,200 CC. The clearance volume is 6% of the swept volume and the polytropic index of the process is 1.3. [8+8]

3. (a) What are the requirements of combustion chamber in CI engine?
   (b) Explain different types of combustion chambers used in CI engine with suitable sketches. [8+8]

4. (a) What is surging in axial flow air compressor? What are its effects? Describe them.
   (b) Define and derive the term polytropic efficiency of axial flow air compressor. [8+8]

5. In a test on two stroke oil engine, the following results were obtained: speed = 350 rev/min; Net brake load = 600 N; Mean effective pressure = 2.66 bar; Fuel consumption = 3.2 kg/h; cooling water used = 495 kg/h; Temperatures of jacket water at inlet and outlet = 30^0C and 50^0C; Exhaust gases per kg of fuel = 32 kg; Temperature of exhaust gases = 432^0C; specific heat of exhaust gases = 1.005 kJ/kg K; Inlet air temperature = 32^0C. Draw up a heat balance for the engine if its cylinder diameter = 205 mm and stroke = 275 mm; brake drum. diameter = 1.0 m; calorific value of fuel = 40870 kJ/kg. [16]

6. (a) What are different types of dynamic compressor used for compressing the air? What are their limitations with respect to other rotary compressors.
   (b) Explain different uses of diffuser in centrifugal compressor. And explain its role on improving the performance. [8+8]

7. Briefly discuss the influence of the following characteristics with reference to knock in SI and CI engines?
   (a) Ignition temperature of fuel, ignition delay, compression ratio
   (b) Inlet temperature, inlet pressure, combustion wall temperature. [8+8]

8. How is turbulence helpful in SI engines combustion, Explain with suitable sketches how this can be produced with different combustion chambers? [16]

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Code No: 07A4EC05 **R07** **Set No. 3**

II B.Tech II Semester Examinations,December 2010
THERMAL ENGINEERING - I
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Time: 3 hours **Max Marks: 80**

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1. Explain three principle factors that influence engine performance. [16]

2. (a) Classify the air compressors based on their working principle and state their applications.
   (b) A single stage single acting reciprocating air compressor with 0.3 m bore and 0.4 m stroke runs at 400 rpm. The suction pressure is 1 bar at 300 K and the delivery pressure is 5 bar. Find the power required to run it, if the compression is isothermal, adiabatic and compression follow $pv^{1.3} = C$. Also find the isothermal efficiency. [6+10]

3. Show and explain theoretical and practical combustion in SI engines on p-ϕ diagram? [16]

4. (a) The efficiency of axial flow compressor is very sensitive to blade angles. Why?
   (b) Explain the functions of stator blades that are installed in each stage of an axial flow compressor. [8+8]

5. (a) Derive an expression for the efficiency of roots blower in terms of pressure ratio and ratio of specific heats based on p-v and T-s diagrams.
   (b) A rotary vane compressor compresses 4.5 m^3 of air per minute from 1 bar to 2 bar when running at 450 rpm. Find the power required to drive the compressor when.
      i. the ports are so placed that there is no internal compression and.
      ii. the ports are so placed that there is 50% increase in pressure due to compression before the back flow occurs. [8+8]

6. (a) What are homogeneous and heterogeneous mixtures?
   (b) In which engines are these mixtures used? Explain. [8+8]

7. A six-cylinder four-stroke, direct-injection oil engine is to deliver 120 kW at 1600 rpm. The fuel to be used has a calorific value of 43 MJ/kg and its percentage composition by mass is carbon 86%, hydrogen13%, and non combustibles 1%. The absolute volumetric efficiency is assumed to 80%, the indicated thermal efficiency 40% and the mechanical efficiency 80%. The air consumption to be 110% in excess of that required for theoretically correct combustion.
   (a) Estimate the volumetric composition of dry exhaust gas.

(b) Determine the bore and stroke of the engine, taking a stroke to bore ratio as 1.5. Assume the volume of 1 kg of air at the given conditions as 0.77m^3. [16]

8. (a) What is valve overlap in four stroke engine? Why is it provided?

(b) Explain the principle of scavenging and its importance? [8+8]

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