Code: 9A03402

1

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

THERMAL ENGINEERING - I

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Explain in detail the effect of exhaust valve opening time on blow down in case of gasoline engine.
(b) Discuss briefly the loss due to gas exchange process in gasoline engine

2 (a) Briefly explain any two methods of fuel injection systems generally employed in C.I engines.
(b) Compare Otto and diesel engines.

3 Briefly explain the effect of different factors on knock in SI engines.

4 What are the factors affecting the delay period? Explain in detail.

5 (a) Define indicated mean effective pressure related to I.C engine and how it can be measured?
(b) A two cylinder four stroke engine runs at 240 rpm developing a torque of 5 kN-m. The bore and stroke of cylinder are 30 cm and 60 cm respectively. Engine runs with gaseous fuel having calorific value of 16.8 MJ/m^3. The gas and air mixture is supplied in proportion of 1:7 by volume. The volumetric efficiency is 0.85. Determine: (i) The brake power. (ii) The mean piston speed in m/s. (iii) The brake mean effective pressure. (iv) The brake thermal efficiency.

6 (a) A single stage double acting air compressor running at 300 rpm, delivers 15 m^3 of free air per minute at 700 kPa and 200^0 C. If the clearance volume is 8% of swept volume and if the index of compression and expansion are same. Find the clearance swept volume of piston and volumetric efficiency. Initial air conditions are 10 kP and 15^0 C.
(b) Draw the T-S diagram for the multi stage compression and show the work saving during the compression in comparison with single stage reciprocating air compression.

7 (a) With the help of neat sketch, explain the working of vane type blower. Also show the compression process in P-V diagram.
(b) A Vaned compressor handles free air of 0.6 m^3/s at 1 bar and compresses to 2.3 bar. There occurs 30% reduction in volume before the back flow occurs. Determine the indicated power required and isentropic efficiency.

8 (a) Derive expression for polytropic efficiency in terms of entry and delivery pressures, temperature and ratio of specific heats.
(b) An axial flow compressor is to have constant axial velocity of 250 m/s and 50% degree of reaction. The mean diameter of blade ring is 45 cm and speed is 18000 r.p.m. The exit angles of the blade are 25^0. Calculate blade angle at inlet and work done per kg of air with the help of velocity triangles.

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B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

THERMAL ENGINEERING - I

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Define volumetric efficiency of engine and discuss the effect of various factors that affect the volumetric efficiency.

(b) Compare the actual and fuel-air cycles of IC engine

2 (a) Sketch the battery ignition system and explain its working.

(b) Explain the various types of cooling systems employed in IC engines.

3 Explain the phenomenon of knocking in S.I engine. What are the effects of knocking?

4 Explain with neat sketch the working principle of combustion chamber used in CI engine.

5 (a) A four stroke four cylinder diesel engine running at 300 rpm produces 250 kW of brake power. The cylinder dimensions are 30 cm bore and 25 cm stroke. Fuel consumption rate is 1 kg/min while air fuel ratio is 10. The average indicated mean effective pressure is 0.8 MPa. Determine indicated power, mechanical efficiency, brake thermal efficiency and volumetric efficiency of engine. The calorific value of fuel is 43 MJ/kg. The ambient conditions are 1.013 bar, 27ºC.

(b) How do you measure air consumption rate of I.C engine in the laboratory?

6 (a) A two stage air compressor compresses air from 1 bar 20^0C to 42 bar. If the law of compression is $pV^{1.35}$ = constant and intercooling is perfect. Find per kg of air (i) the work done in compression. (ii) the mass of cooling water necessary for abstracting the heat in the intercooler, if the temperature rise of the cooling water a 25^0C.

(b) What are power producing and power absorbing machines? List few of them.

7 (a) A roots blower handles free air of 0.5 m^3/s at 1 bar and 27^0C and delivers air at a pressure of 2 bar. Determine the indicated power required to drive compressor and isentropic efficiency.

(b) With the help of neat sketch, explain the working of roots blower. Also show the compression process in p-V diagram.

8 In an axial flow compressor, the overall stagnation pressure ratio achieved is 4 with overall stagnation isentropic efficiency 86%. The inlet stagnation pressure and temperature are 1 bar and 320 K. The mean blade speed is 190 m/s. The degree of reaction is 0.5 at the mean radius with relative air angles of 10^0 and 30^0 respectively. The work done factor is 0.9. Calculate: (i) Stagnation polytropic efficiency. (ii) Number of stages. (iii) Inlet temperature and pressure. (iv) Blade height in the first stage if the hub-tip ratio is 0.4, mass flow rate is 20 kg/sec

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B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

THERMAL ENGINEERING - I

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) What is the use of air-standard cycle? List some air standard cycles.
(b) Discuss the effect of exhaust valve opening time on blow down.

2 (a) What is IC engine? Classify I.C engines.
(b) Compare external combustion and internal combustion engine.

3 What are the factors which affects the ignition lag, flame propagation in S.I engines?

4 Explain any three important phases of combustion in C.I engine.

5 (a) Define the terms: brake power, piston speed, brake mean effective pressure and brake thermal efficiency.
(b) A two cylinder four stroke engine runs at 240 r.p.m developing a torque of 5.16 kN- m. The bore and stroke of cylinder are 30 cm and 58.5 cm respectively. Engine runs with gaseous fuel having calorific value of 16.8 MJ/m^3. The gas and air mixture is supplied in proportion of 1:7 by volume. The volumetric efficiency is 0.85. Determine (i) The brake power. (ii) The mean piston speed in m/s. (iii) The brake mean effective pressure. (iv) The brake thermal efficiency.

6 (a) With the help of neat sketch explain the working principle of single stage single acing reciprocating air compressor.
(b) A single-stage, double acting compressor has a free air delivery of 14 m^3/min, measured at 1.013 bar and 15^0C. The pressure and temperature in the cylinder during induction are 0.95 bar 15^0C. The delivery pressure is 7 bar and index of compression and expansion is 1.3. The clearance volume is 5% of the swept volume. Calculate: (i) Indicated power required. (ii) Volumetric efficiency.

7 (a) Define and explain the terms: pressure coefficient and adiabatic coefficient of a centrifugal compressor.
(b) A single sided centrifugal compressor is to deliver 14 kg/s of air when operating at a pressure ratio of 4:1 and a speed of 200 rev/s. The inlet stagnation conditions are 288 K and 1.0 bar. The slip factor and power input factor may be taken as 0.9 and 1.04 respectively. The overall isentropic efficiency is 0.80. Determine the overall diameter of the impeller.

8 (a) Define polytropic efficiency of an axial flow compressor and write the expression.
(b) A multi stage axial compressor is required for compressing air at 300 K, through a pressure ratio of 4.5 to 1. Each stage is to be a 50% reaction and the mean blade speed of 300 m/s, flow coefficient 0.5, and the stage loading factor 0.3 are taken, for simplicity, as constant for all stages. Determine the flow angles and the total number of stages required if the polytropic efficiency is 85%. Take C_p = 1.005 kJ/kg K and γ = 1.4 for air.

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B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

THERMAL ENGINEERING - I

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Discuss the effect of exhaust valve opening time on blow down.
(b) What are the factors that affect the volumetric efficiency of an engine?

2 (a) What are the various components to be lubricated in an engine and explain how it is accomplished?
(b) What are the various characteristics of an efficient cooling system in an engine?

3 (a) What do you understand from abnormal combustion in S.I engines?
(b) Explain different stages of combustion in S.I engine.

4 (a) What are the factors that affect the combustion process in C.I engines?
(b) What is knocking in diesel engine? Explain in detail.

5 (a) A gas engine having a cylinder 250 mm bore and 450 mm stroke has a volumetric efficiency of 80%. Air-gas ratio equals 9:1, calorific value of fuel 21000 kJ/m^3 at NTP. Calculate the heat supplied to the engine per working cycle. If the compression ratio is 5:1, what is the heat value of the mixture per working stroke per m^3 of total cylinder volume?
(b) Explain the performance test of an IC engine. Why is it carried out?

6 (a) Derive an expression for minimum work required for two stage reciprocating air compressor with perfect inter-cooling and neglect clearance volume.
(b) A single stage single acting air compressor delivers 14 m^3 of free air from 1 bar to 7 bar. The speed of the compressor is 300 r.p.m. Assuming the compression and expansion is $pV^{1.35}$ = constant and clearance is 5% of the swept volume, find the diameter and stroke of the compressor. Take stroke length is 1.5 times the bore diameter.

7 (a) What is power input factor and slip factor?
(b) A centrifugal compressor running at 9000 r.p.m delivers 600 m^3/min of free air. The air is compressed from 1 bar and 20^0C to a pressure ratio of 4 with an isentropic efficiency of 0.82. Blades are radial at outlet of impeller and the flow velocity of 62 m/s may be assumes throughout constant. The outer radius of the impeller is twice the inner and the slip factor may be assumed as 0.9. The blade area coefficient may be assumed as 0.9 at the inlet. Calculate, (i) Final temperature of air. (ii) Theoretical power. (iii) Impeller diameters at inlet and outlet. (iv) Breadth of the impeller at inlet. (v) Impeller blade angle at inlet. (vi) Diffuse blade angle at inlet.

8 (a) Define degree of reaction and write the expression for degree of reaction.
(b) An axial flow compressor is to have constant axial velocity of 150 m/s and 50% degree of reaction. The mean diameter of blade ring is 35 cm and speed is 15000 rpm. The exit angles of the blade are 27^0. Calculate blade angle at inlet and work done per kg of air with the help of velocity triangles.

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