Code: 9A03402

1

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

THERMAL ENGINEERING - I

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

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

1 (a) Why actual cycle is different from air standard cycle for I.C engine? Give few reasons.
(b) Explain in detail the effect of time loss in the mixing of fuel and air and also in combustion in case of I.C engine.

2 (a) Explain the working of a two-stroke engine with neat sketch. Also draw the P-V diagram.
(b) What is ignition system in I.C engines and explain battery ignition system used in petrol engines?

3 (a) What is knocking and what are the factors affecting knock?
(b) Differentiate pre-ignition, auto ignition and detonation.

4 What do you understand from fuel requirements and fuel rating of C.I engine? Explain in detail.

5 (a) Define indicated power and how it can be determined experimentally for multi cylinder engine.
(b) A four cylinder, four stroke diesel engines has brake mean effective pressure of 5.5 bar at full load speed of 600 rpm and specific fuel consumption of 0.25 kg/kWh. The cylinder has bore of 25 cm and stroke length of 35 cm. The air fuel ratio is measured as 26 from the exhaust gas analysis. The ambient conditions are 1 bar, 27ºC. Assuming the calorific value of fuel as 44 MJ/kg. Determine the brake thermal efficiency and the volumetric efficiency. Also find out brake power.

6 (a) Estimate the minimum work required to compress 1 kg of air from 1 bar 300 K to 16 bar in two stages if the law of compression is $pV^{1.3}$ = constant and inter cooling is perfect.
(b) Explain the working of blower and compressor.

7 (a) How does the pressure rise in a centrifugal compressor? Where the compressed air is used?
(b) A centrifugal compressor delivers free air of 20 kg/min. Air is sucked at static states of 1 bar, 27^{o} C with inlet velocity of 100 m/s. The total head pressure ratio is 6 and isentropic efficiency of compressor is 82%. The mechanical efficiency of motor attached is 90%. Determine total temperature of air at exit o compressor and power required to drive compressor.

8 (a) Explain the working of an axial flow compressor with the help of neat sketch.
(b) Derive expression for polytropic efficiency in terms of entry and delivery pressures, temperature and ratio of specific heats.

*****

Code: 9A03402

2

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

THERMAL ENGINEERING - I

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

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

1 (a) List out few actual and air standard cycles.
(b) List the major losses in actual cycles and air standard cycles.

2 (a) What is I.C engine and briefly explain how they are classified?
(b) Explain with neat sketch the construction and working of fuel pump.

3 (a) Briefly explain the importance of flame speed on combustion.
(b) What are the requirements of combustion chamber?

4 (a) What is delay period in C.I engine? What is the difference between physical delay and chemical delay?
(b) Enlist the various methods of controlling diesel knock.

5 (a) A diesel engine has a bore of 0.1 m, stroke of 0.11 m and a compression ratio of 19 running at 2000 rpm. Each cycle takes two revolutions and had a mean effective pressure of 1400 kPa. With total of six cylinders, find the indicated power.
(b) What are the methods to measure the fuel consumption of I.C engine? Explain any one method with the help of diagram.

6 (a) Define volumetric efficiency and explain the effect of clearance volume and pressure ratio on volumetric efficiency.
(b) Estimate the minimum work required to compress 2 kg of air from 1 bar 330 K to 18 bar in two stages if the law of compression is $pV^{1.25}$ = constant and inter cooling is perfect.

7 (a) A gas turbine utilizes a two-stage centrifugal compressor. The pressure ratios for the first and second stages are 2.5:1 and 2.1:1 respectively. The flow of air is 1.5 kg/s, and is being at 1.013 bar and 283 K. If the temperature drop in the intercooler is 50^{o}C and isentropic efficiency is 0.85 for each stage. Calculate: (i) the actual temperature at end of each stage, (ii) the total compressor power. Take γ =1.4 and C_p = 1.005 kJ/kg k.
(b) What are the different shapes of impeller blades used in the centrifugal compressor?

8 (a) Compare the axial flow compressor with centrifugal compressors
(b) An axial flow compressor stage has a mean diameter of 600 mm and runs at 12000 rpm. mass flow rate through the compressor is 60 kg/s. Determine the power required to drive the compressor and degree of reaction if the air angle is 15^{o}. The vane angle at inlet and exit are equal to 45^{o} and 25^{o} respectively.

*****

Code: 9A03402

3

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

THERMAL ENGINEERING - I

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

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

1 (a) What are the components of four-stroke IC engine and explain its functions?
(b) What is the necessity of carburetor in S.I engine and explain its working principle?

2 (a) What do you understand from gas exchange process in an engine and how it affects the performance of I.C engine?
(b) What do you understand from air standard cycle? What are the assumptions made for accurate analysis of internal combustion engine process?

3 (a) What do you understand from normal combustion and what are the factors affecting normal combustion in S.I engines?
(b) Explain the difference between pre-ignition, auto ignition and detonation.

4 (a) What do you mean by Octane number and Cetane number of fuels?
(b) What is supercharging of IC engine? Write few applications.

5 (a) A petrol engine develops 20 kW of brake power. If the brake thermal efficiency and mechanical efficiencies of the engine are 25% and 80% respectively, calculate the indicated thermal efficiency.
(b) Define indicated mean effective pressure related to I.C engine and how it can be measured?

6 (a) Derive the expression for the reversible work of compression with and without clearance, when the compression process is polytropic.
(b) Differentiate positive displacement and non-positive displacement compressor.

7 (a) What is vane type compressor? Briefly explain its operating principle.
(b) Estimate the efficiency of the vane compressor when it handles 0.15 m^3 of air per second from 1 bar to 3 bar. The pressure rise due to compression in the compressor is limited to 1.9 bar. Also calculate the power required to run the compressor if mechanical efficiency is 85%.

8 (a) Explain the mechanical details and working principle of an axial flow compressor.
(b) An axial flow compressor draws air at 1 bar and 20^o C. Assuming 50% degree of reaction, find the velocity of flow if the blade velocity is 100 m/s. Take air angle, vane angle at inlet are 10^o and 40^o respectively. Estimate the work done per kg of air and power developed if the flow area is 0.2 m^2.

*****

Code: 9A03402

4

II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

THERMAL ENGINEERING - I

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

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

1 (a) What is volumetric efficiency? Explain different factors which affect the volumetric efficiency of any engine.
(b) Explain the optimum opening position of exhaust valve to reduce the exhaust blow down loss in gasoline engine.

2 (a) Draw the valve-timing diagram of four-stroke engine and mark the various processes on it
(b) What is fuel supply system and explain methods of fuel system generally employed in spark ignition engines.

3 (a) Write short notes on pre-ignition and knocking.
(b) What are homogeneous and heterogeneous mixtures? Explain in which engines these mixtures are used.

4 What are the different methods used in C.I engines to create turbulence in the mixture? Explain its effect on power output and thermal efficiency of the engine.

5 (a) Briefly explain the measurement of brake power of IC engine by using prony brake dynamometer.
(b) A two stroke two cylinder engine runs with speed of 2000 rpm and fuel consumption of 3 liters/hr. The fuel has specific gravity of 0.8 and air-fuel ratio is 18. The piston speed is 500 m/min and indicated mean effective pressure is 5 bar. The ambient conditions are 1.013 bar, 15ºC. The volumetric efficiency is 0.7 and mechanical efficiency is 0.8. Determine brake power output considering R for gas = 0.287 kJ/kg K.

6 (a) What is the function of a compressor and what are the different types of compressors?
(b) Derive the expression for work of compression without clearance, when the compression process is reversible adiabatic and reversible isothermal.

7 (a) Derive expression for roots blower efficiency.
(b) A centrifugal compressor running at 3000 rpm has internal and external diameters of impeller as 425 mm and 625 mm respectively. The vane angles at inlet and outlet are 25^o and 45^o respectively. The air enters the impeller radially. Determine work done by the compressor per kg of air and degree of reaction.

8 (a) An axial flow compressor stage has a mean diameter of 600 mm and runs at 250 rps. Mass flow rate through the compressor is 50 kg/s. Determine the power required to drive the compressor and degree of reaction if the air angle is 12^o. The vane angle at inlet and exit are equal to 35^o and 27^o respectively.
(b) What do you understand by 50% reaction balding?

*****