Roll No. | | | | | | | | | | | |

Total No. of Pages : 03

Total No. of Questions : 08

M.Tech.(ME) (Sem.–3)

ADVANCED INTERNAL COMBUSTION ENGINES

Subject Code : MME-559

M.Code : 38222

Time : 3 Hrs. Max. Marks : 100

INSTRUCTION TO CANDIDATES :

1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWENTY marks.
3. Assume any data missing.

Q.1. a) The two-stroke cycle has twice as many power strokes per crank revolution as the four-stroke cycle. However, two-stroke cycle engine power outputs per unit displaced volume are less than twice the power output of an equivalent four-stroke cycle engine at the same engine speed. Suggest reasons why this potential advantage of the two-stroke cycle is offset in practice.

b) List five important differences between the design and operating characteristics of spark-ignition and compression-ignition engines.

Q.2. a) Two automobile engines have the same total displacement volume and the same total power produced within the cylinders. List the possible advantages of :

(i) A V6 over a straight six.

(ii) A V8 over a V6.

(iii) A V6 over a V8.

(iv) An opposed cylinder four over a straight four.

(v) An in-line six over an in-line four.

b) The Wankel rotary spark-ignition engine, while lighter and more compact than a reciprocating: spark-ignition engine of equal maximum power typically has worse efficiency due to significantly higher gas leakage from the combustion chamber and higher total heat loss from the hot combustion gases to the chamber walls. Based on the design details suggest reasons for these higher losses.

Q.3. Design a six-liter race car engine that operates on a four-stroke cycle. Decide what the design speed will be, and then give the number of cylinders, bore, stroke, piston rod length, average piston speed, imep, brake torque, fuel used, AF, and brake power, all at design speed. All parameter values should be within typical, reasonable values and should be consistent with the other values. State what assumptions you make (e.g., mechanical efficiency, volumetric efficiency, etc.)

Q.4. Cylinder conditions at the start of compression of a four-stroke cycle SI engine are 27°C and 100 kPa. The engine has a compression ratio of r_c = 8:1, and heat addition from combustion is q_{in} = 2000 kj/kg. Calculate :

a) Temperature and pressure at each state of the cycle, using air-standard Otto cycle analysis with constant specific heats.

b) Indicated thermal efficiency in part (a).

c) Temperature and pressure at each state of the cycle, using any standard air tables which are based on variable specific heats as functions of temperature

d) Indicated thermal efficiency in part (c).

Q.5. C4Hs is burned in an engine with a fuel-rich air-fuel ratio. Dry analysis of the exhaust gives the following volume percents: COz = 14.95%, C4Hs = 0.75%, CO = 0%, Hz = 0%, Oz = 0%, with the rest being Nz. Higher heating value of this fuel is Q_{HHV} = 46.9 MJ/kg. Write the balanced chemical equation for one mole of this fuel at these conditions. Calculate:

a) Air-fuel ratio.

b) Equivalence ratio.

c) Lower heating value of fuel.

d) Energy released when one kg of this fuel is burned in the engine with a combustion efficiency of 98%.

Q.6. Design a fuel intake system for a large dual-fuel CI engine to be used in a poor underdeveloped country. The engine is to use only enough diesel oil to promote ignition, while using some less costly main fuel. Draw a schematic, and give engine values of displacement, speed, and volumetric efficiency. Choose an appropriate main fuel and give the flow rates of both fuels. What is the overall air-fuel ratio? State all assumptions you make.

Q.7. a) Explain why constant-volume combustion gives a higher indicated fuel conversion efficiency than constant-pressure combustion for the same compression ratio.

b) Estimate approximately the pressure drop across the inlet valve about halfway through the intake stroke and across the exhaust valve halfway through the exhaust stroke, when the piston speed is at its maximum for a typical four- stroke cycle spark-ignition engine with B = L = 85 mm at 2500 and 5000 rev/min at WOT. Assume appropriate values for any valve and port geometric details required, and for the gas composition and state.

Q.8. Write short notes on :

a) Turbocharger

b) Kadney effect

c) Scavenging

d) Supercharging

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.