Printed Pages : 4 | 1079 | MME-173

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Paper ID : 240173

M.Tech.

(SEM. I) THEORY EXAMINATION, 2015-16

INTERNAL COMBUSTION ENGINES

[Time:3 hours] [Total Marks:100]

1. Attempt any two. (2*10=20)

   a. With the help of pressure-crank angle (P-ϵ) diagram, explain the stages of combustion in S.I. engine. How the flame propagation is affected by compression ratio, engine load and engine speed?

   b. A CI engine operating on the air-standard Diesel cycle has cylinder conditions at the start of compression of 65°C and 130 kPa. Light diesel fuel is used at an equivalence ratio of 0.8 with combustion efficiency 0.98. Compression ratio is 19. Calculate:

      (a) Temperature at each state of the cycle.

      (b) Pressure at each state of the cycle.

      (c) Cutoff ratio.

      (d) Indicated thermal efficiency.

   c. Describe the phenomenon of detonation in SI engine. On what factors does detonation depends?

2. Attempt any two. (2*10=20)

   a. With the help of suitable diagram, show that for same maximum pressure and work output, efficiency of diesel engine is more than petrol engine.

   b. Explain briefly time loss factor resulting in a lower thermal efficiency of actual cycle compared to air-standard cycle for S.I. engine.

   c. Cylinder conditions at the start of compression in an SI engine operating on an air-standard Otto cycle are 60°C and 98 kPa. The engine has a compression ratio of 9.5:1 and uses gasoline with A/F ratio = 15.5. Combustion efficiency is 96%, and it can be assumed that there is no exhaust residual. Calculate:

      (a) Temperature at all states in the cycle.

      (b) Pressure at all states in the cycle.

      (c) Specific work done during power stroke.

      (d) Indicated thermal efficiency.

3. Attempt any two. (2*10=20)

a. An SI engine operates on an air-standard four-stroke Otto cycle with turbo charging. Air-fuel enters the cylinders at 70°C and 140 kPa, and heat in by combustion equals 1800 kJ/kg. Compression ratio is 8 and exhaust pressure is 100 kPa. Calculate:
   (a) Temperature at each state of the cycle.
   (b) Pressure at each state of the cycle.
   (c) Work produced during expansion stroke.
   (d) Indicated thermal efficiency.

b. Why is the compression ratio of an SI engine often reduced when the engine is redesigned to be used with a turbocharger? Is thermal efficiency increased?

c. Draw typical valve timing diagram for low speed & high speed 4-stroke engines. Explain major difference if any, between these two sets of valve timing diagram.

4. Attempt any two. (2*10=20)

a. A 1500-cm^3, four-stroke cycle, four-cylinder CI engine, operating at 3000 RPM, produces 48 kW of brake power. Volumetric efficiency is 0.92 and air-fuel ratio AF = 21:1 Calculate:
   (a) Rate of air flow into engine.
   (b) Brake specific fuel consumption.
   (c) Mass rate of exhaust flow.

b. Describe the ignition delay and effect of engine variables on ignition delay.

c. List five reasons why there are HC emissions in the exhaust of an automobile. To reduce emissions from an SI engine, should A/F ratio be set at rich, lean, or stoichiometric?

5. Attempt any two. (2*10=20)

a. A six cylinder 4 stroke CI engine develops 13 kW power output at 1800 rpm. The calorific value of the fuel is 42 Mj/kg and its percentage composition by mass is 86% C, 14% H. The volumetric efficiency is 85%, indicated thermal efficiency is 38% and mechanical efficiency is 80%. The relative air fuel ratio is 1.1. Estimate the volumetric composition of dry exhaust gas and determine the bore and stroke of the engine, taking Length/stroke ratio as 1.2.

b. Discuss the use of CNG, Hydrogen and biodiesel as a fuel for internal combustion engine.

c. What are the basic requirements of a good combustion chamber? Briefly explain the design principles governing the good SI engine combustion chamber design.

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