Birla Institute of Technology & Science, Pilani

Second Semester 2015-2016
Comprehensive Examination
IC Engines (ME F242)

Dated: - 09/05/2016 **MM- 30** **Time- 90 min.**

Part (A) – Closed Book

Note: Write to the point only.
Each question carries three marks

Q1: Differentiate the major and minor thrust side of piston by means of suitable sketch.

Q2: Draw the line diagram of air box method. Also mention the function use of large sized air box.

Q3: Explain the Willian's line method with suitable diagram and mention two limitations of this method.

Q4: Draw a schematic diagram of forced circulation system and explain the functional advantage of thermostat.

Q5: What do you mean by firing order? Mention the three main factors for deciding the firing order.

Q6: A 2 liter four stroke SI engine develops a brake power of 60 kW. At this condition, air-fuel ratio is 15:1, volumetric efficiency is 80%, indicated thermal efficiency is 35%, mechanical efficiency is 85%, CV of fuel is 44 MJ/kg and density of air is 1.181 kg/m^3. Determine the engine speed.

Q7: What do you mean by Viscosity Index? What does a high viscosity index number indicates?

Q8: Explain the function difference between a flywheel and governor.

Q9: Draw a common T-s diagram showing the comparison of Otto, Diesel and Dual cycles on a for the same compression ratio and heat addition. Also mention the order of efficiency.

Q10: Determine the quantity of fuel injected (in c.c.) per cycle per cylinder for a 6 cylinder four stroke diesel engine having bsfc of 0.245 kh/kWh and developing 89 kW at 2500 rpm. Take specific gravity of fuel as 0.84.

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Dated: - 09/05/2016 **MM- 50** **Time- 90 min.**

Part (B) – Open Book

Note: Only Text Book and Hand Written Class Notes are allowed

Q 1 A 3 liter V6 SI engine operating on four stroke cycle at 3000 rpm. The compression ratio is 9, the length of connecting road is 17.2 cm and the engine is square. The skirt length of piston is 6.2 cm. The spark plug is fired at 15 before TDC and it takes 8 degree of engine rotation for the flame to develop. Flame termination occurs at 20 degree after TDC. At that moment the pressure inside the combustion chamber is 3000 kPa and the compressive force in the connecting road is 8 kN. The clearance between the piston and cylinder walls is 0.004 mm. The dynamic viscosity of the lubricating oil is 0.006 Pa.s. Bore diameter is to be used while calculating: (a) the contact area between piston and cylinder walls, and (b) surface area on which combustion pressure acts. At the moment of flame termination, calculate: (i) the friction force on the piston (ii) thrust on the cylinder walls and (iii) the net force in the direction of piston movement. ***[20M]***

Q 2 A six-cylinder four stroke SI engine of 100 mm bore and 110 mm stroke is tested at 2500 rpm on a dynamometer which measure a brake power of 67.5 kW. Clearance volume of each cylinder is 70 cc. Time for 100 cc of fuel consumption is 18 sec. The fuel density and the CV of fuel is 780 kg/m^3 and 44 MJ/kg respectively. The air consumption is measured by an air-box with sharp orifice system. The following observations are made:

Orifice diameter = 30 mm
Coefficient of discharge = 0.6
Pressure drop across the orifice = 14 cm of Hg
Ambient temperature and pressure are 300 K and 1 bar respectively
Density of Hg = 13600 kg/m^3
Calculate: (i) Volumetric efficiency, (ii) bmep (iii) torque (iv) bsfc (v) brake thermal efficiency and (vi) relative efficiency. ***[15M]***

Q 3

(a) A six cylinder 4.5 liter four stroke supercharged engine operating at 4000 rpm has an overall volumetric efficiency of 150%. The compressor (supercharger) has an isentropic efficiency of 90% and mechanical efficiency of 85% in its link with the engine. The compressed air passes through an inter-cooler before entering the engine. The temperature and pressure of air at engine entry are 330K and 1.8 bar respectively. The ambient conditions are 290 K and 1 bar respectively. Calculate: (i) The rate of heat rejection from the inter-cooler assuming the intercooler to be 100 % efficient, (ii) the power absorbed by the supercharger from the engine. ***[10M]***

(b) A single two stroke square engine with indicated thermal efficiency of 25% and mechanical efficiency of 75% consumes 25 kg/hr of fuel at fixed speed. The bmep is 5 bar and mean piston speed is 15 m/s. Determine the crank radius and speed in rpm. Take CV of fuel = 42 MJ/kg. ***[5M]***