

OPEN BOOK EXAMINATION

ANSWER THE FOLLOWING QUESTIONS:

QUESTION No. (1) [50 marks]

A single cylinder four stroke spark ignition engine operates at speed of 2500 r.p.m., and develops a maximum brake power of 7 KW. The compression ratio is 6.5, the cylinder bore is 96 mm, the stroke is 80 mm, and the maximum in-cylinder gas pressure is 3.5 MPa. Assuming any necessary data, you are required to make detailed design calculations of the following.

- The piston head thickness, the piston barrel and skirt dimensions, the piston pin diameter, the axial thickness and the radial width of the compression rings. [10 marks]
- The forces acting on the connecting rod, the resultant stresses, and the connecting rod section dimensions. Assume that the maximum combined stress occurs at crank angle (Θ) = 30°. [15 marks]
- The forces acting on the crank shaft, the resultant stresses, and the dimensions of the crank arm, crank pin, and crank shaft journal. Consider the case of side crank and assume that the maximum combined stress occurs at crank angle (Θ) = 30°. [15 marks]
- Using a scale of 1:2, draw a cross section in the engine showing the piston, the piston rings, the cylinder, the connecting rod, the crankshaft, and the crankcase. [10 marks]

QUESTION No. (2) [15 marks]

- Explain why the brake mean effective pressure of a naturally aspirated diesel engine is lower than of a naturally aspirated spark ignition engine. Explain why the bmep is lower at the maximum rated power for a given engine than the bmep at the maximum torque.
- You are designing a four stroke cycle diesel engine to provide a brake power of 200 KW naturally aspirated at its maximum rated speed. Based on typical values for brake mean effective pressure and maximum mean piston speed, estimate the required engine displacement, and the bore and stroke for sensible cylinder geometry and number. What is the maximum rated engine speed of your design? What would be the brake torque and the fuel flow rate at this maximum speed? Assume a maximum mean piston speed of 10 m/sec is typical of good engine designs.

QUESTION No. (3) [15 marks]

- Explain briefly the concept of stable lubrication?.
- A journal bearing is 70 mm diameter and 35 mm long and supports a load of 1.8 KN. The journal speed is 800 r. p. m. and the radial clearance is 0.04 mm. Find the minimum oil-film thickness, the power loss, and the oil side flow, and the maximum film pressure for SAE 30 lubricant if the operating temperature is 60 °C.

QUESTION No. (4) [10 marks]

A hydraulic cylinder is made of an aluminum alloy of an outside diameter of 80 mm and 10 mm thickness. For an internal pressure of 2 MPa and zero external pressure, calculate the values and locations of both maximum radial and tangential stresses. If this cylinder is made of two shrink fitted cylinders with the same material and the same inner and outer diameters and 5 mm thickness for each cylinder, calculate the maximum internal pressure can be applied for 0.05 mm interference.

GOOD LUCK

Dr. Hamdi Abdel- Salam