

**PARUL UNIVERSITY**  
**FACULTY OF ENGINEERING & TECHNOLOGY**  
**B.Tech Mid Semester Exam**

Semester: 6

Subject Code: 203102353

Subject Name: Automobile Components Design

Date: 29/01/2024

Time: (1hr: 30min)

Total Marks: 40

Sr. No.		Marks
Q.1	<p>(A) Five One line Questions</p> <p>1) Preferred numbers in automobile design are primarily used for:            A) Determining vehicle dimensions B) Standardizing component sizes            C) Regulating engine power D) Controlling manufacturing costs</p> <p>2) The process used for shaping metal components by applying compressive forces is:            A) Casting B) Forging C) Welding D) Machining</p> <p>3) In automobile assembly, which component is commonly designed using casting techniques?            A) Piston B) Cylinder head C) Connecting rod D) Flywheel</p> <p>4) Which type of consideration is crucial in designing components to endure prolonged use without failure due to repeated loading?            A) Fatigue consideration B) Thermal consideration            C) Wear consideration D) Human factors consideration</p> <p>5) The primary function of piston rings in an engine is to:            A) Seal the combustion chamber B) Connect the piston to the crankshaft            C) Support the piston within the cylinder D) Direct the flow of engine oil</p>	05
	<p>(B) Five Fill in the blanks</p> <p>1) Preferred numbers and series are essential for achieving _____ in design, providing a consistent and uniform approach to component sizes and specifications.</p> <p>2) When designing components for _____, careful consideration is needed to accommodate the molding and casting processes.</p> <p>3) Amplitude ratio = _____</p> <p>4) Stress range = _____</p> <p>5) If in the stress cycle <math>\sigma_{max} = 100\text{MPa}</math> and <math>\sigma_{min} = 40\text{ MPa}</math> than it is _____ stress cycle.</p>	05
Q.2	<p>Attempt any four(Short Questions)</p> <p>(1) It is required to standardize load-carrying capacities of dumpers in a manufacturing unit. The maximum and minimum capacities of such dumpers are 40 and 630 kN, respectively. The company is interested in developing seven models in this range. Specify their load carrying capacities.</p> <p>(2) What are the functions of engine cylinder? What are the desirable properties of cylinder materials?</p>	12

(3) Name the materials used for engine piston. What are the advantages and disadvantages of aluminum piston over cast iron piston?

(4) Explain Design considerations for the Casting.

(5) Explain Design considerations for the Forging.

Q.3 Attempt any two questions

08

(1) The cylinder of a four-stroke diesel engine has the following specifications:

Brake power = 3.75 kW, Speed = 1000 rpm, Indicated mean effective pressure = 0.35 MPa, Mechanical efficiency = 80%

Determine the bore and length of the cylinder liner.

(2) The following data is given for the piston of a four-stroke diesel engine:

Cylinder bore = 250 mm, Maximum gas pressure = 4 MPa, Allowable bearing pressure for skirt = 0.4 MPa, Ratio of side thrust on liner to maximum gas load on piston = 0.1, Width of top land = 45 mm, Width of ring grooves = 6 mm, Total number of piston rings = 4, Axial thickness of piston rings = 7 mm Calculate: (i) length of the skirt; and (ii) length of the piston.

(3) Determine the dimensions of cross-section of the connecting rod for a diesel engine with the following data:

Cylinder bore = 100 mm, Length of connecting rod = 350 mm, Maximum gas pressure = 4 MPa, Factor of safety = 6

Q.4 (A) The cylinder of a four-stroke diesel engine has the following specifications:

05

Brake power = 7.5 kW, Speed = 1400 rpm, Indicated mean effective pressure = 0.35 MPa

Mechanical efficiency = 80%, Maximum gas pressure = 3.5 MPa, The cylinder liner and head are made of grey cast iron FG 260 ( $S_{ut} = 260 \text{ N/mm}^2$  and  $m = 0.25$ ). The studs are made of plain-carbon steel 40C8 ( $S_{yt} = 380 \text{ N/mm}^2$ ). The factor of safety for all parts is 6.

Calculate: (i) bore and length of the cylinder liner (ii) thickness of the cylinder liner

(iii) thickness of the cylinder head (iv) size, number and pitch of studs

(B) The following data is given for the piston of a four-stroke diesel engine:

05

Cylinder bore = 250 mm, Maximum gas pressure = 4 MPa, Bearing pressure at small end of connecting rod = 15 MPa, Length of piston pin in bush of small end =  $0.45D$ , Ratio of inner to outer diameter of piston pin = 0.6, Mean diameter of piston boss =  $1.4 \times$  outer diameter of piston pin, Allowable bending stress for piston pin =  $84 \text{ N/mm}^2$ .

Calculate: (i) outer diameter of the piston pin; (ii) inner diameter of the piston pin;

(iii) mean diameter of the piston boss; and (iv) check the design for bending stresses.

OR

(B) The following data is given for a four-stroke diesel engine:

05

Cylinder bore = 250 mm, Length of stroke = 300 mm, Speed = 600 rpm

Indicated mean effective pressure = 0.6 MPa, Mechanical efficiency = 80%

Maximum gas pressure = 4 MPa, Fuel consumption = 0.25 kg per BP per h

Higher calorific value of fuel = 44 000 kJ/kg

Assume that 5% of the total heat developed in the cylinder is transmitted by the piston. The piston is made of grey cast iron FG 200 ( $S_{ut} = 200 \text{ N/mm}^2$  and  $k = 46.6 \text{ W/m/}^\circ\text{C}$ ) and the factor of safety is 5. The temperature difference between the centre and the edge of the piston head is  $220^\circ\text{C}$ .

(i) Calculate the thickness of piston head by strength consideration.

(ii) Calculate the thickness of piston head by thermal consideration.

(iii) Which criterion decides the thickness of piston head?

(iv) State whether the ribs are required.

(v) If so, calculate the number and thickness of piston ribs.

(vi) State whether a cup is required in the top of the piston head.

(vii) If so, calculate the radius of the cup.