



**B.E DEGREE EXAMINATIONS: APRIL / MAY 2023**

(Regulation 2018)

Sixth Semester

**AUTOMOBILE ENGINEERING**

U18AUE0001: Design of Engine Components

**COURSE OUTCOMES**

- CO1:** Understand the design procedure for piston and cylinder  
**CO2:** Apply the design assumption in validating the types of connecting rod used in IC engines.  
**CO3:** Calculate the parameters required for designing the crankshaft  
**CO4:** Understand the steps involved in designing of different types of automotive clutch  
**CO5:** Apply the assumption and design valves and valve train  
**CO6:** Explain design methods for engine components

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 2 = 20 Marks)**

**(Answer not more than 40 words)**

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|---|-----|-------------------|
| 1. Briefly explain the term piston slap and piston seizure.                   | CO1 | [K <sub>2</sub> ] |
| 2. Differentiate under square and over square engines.                        | CO1 | [K <sub>2</sub> ] |
| 3. List out the advantage of using “I” section in crank shaft.                | CO2 | [K <sub>2</sub> ] |
| 4. List down the different types of piston.                                   | CO2 | [K <sub>2</sub> ] |
| 5. Why it is necessary to dissipate the heat generated when clutches operate? | CO3 | [K <sub>2</sub> ] |
| 6. List out the principal parts of IC engine.                                 | CO3 | [K <sub>2</sub> ] |
| 7. Discuss the required properties of engine valves.                          | CO4 | [K <sub>2</sub> ] |
| 8. Identify different types of stress acting in engine cylinder wall.         | CO4 | [K <sub>2</sub> ] |
| 9. Discuss about the role of oil rings in piston.                             | CO5 | [K <sub>2</sub> ] |
| 10. List down the forces acting on the connecting rod.                        | CO6 | [K <sub>2</sub> ] |

**Answer any FIVE Questions:-**

**PART B (5 x 16 = 80 Marks)**

**(Answer not more than 400 words)**

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|--|---|-----|-------------------|
| 11. a) Infer about the design consideration for a piston.                          | 8 | CO1 | [K <sub>2</sub> ] |
| b) Briefly discuss different types of Piston materials and its thermal properties. | 8 | CO1 | [K <sub>2</sub> ] |

12. Design a cast iron piston for a single acting four stroke engine for the following. 16 CO2 [K<sub>3</sub>]  
data:  
Cylinder bore = 100 mm; Stroke = 125 mm ; Maximum gas pressure = 5 N/mm<sup>2</sup> ; Indicated mean effective pressure = 0.75 N/mm<sup>2</sup> ; Mechanical efficiency = 80% ; Fuel consumption = 0.15 kg per brake power per hour ; Higher calorific value of fuel =  $42 \times 10^3$  kJ/kg ; Speed = 2000 r.p.m. Any other data required for the design may be assumed.
13. Design a connecting rod for an I.C. engine running at 1800 r.p.m. and developing 16 CO3 [K<sub>3</sub>]  
a maximum pressure of 3.15 N/mm<sup>2</sup>. The diameter of the piston is 100 mm ; mass of the reciprocating parts per cylinder-2.25 kg; length of connecting rod-380 mm; stroke of piston-190 mm and compression ratio 6 : 1. Take a factor of safety of 6 for the design. Take length to diameter ratio for big end bearing as 1.3 and small end bearing as 2 and the corresponding bearing pressures as 10 N/mm<sup>2</sup> and 15 N/mm<sup>2</sup>. The density of material of the rod may be taken as 8000 kg/m<sup>3</sup> and the allowable stress in the bolts as 60 N/mm<sup>2</sup> and in cap as 80 N/mm<sup>2</sup>. The rod is to be of I-section for which you can choose your own proportions. Draw a neat, dimensioned sketch showing provision for lubrication. Use Rankine formula for which the numerator constant may be taken as 320 N/mm<sup>2</sup> and the denominator constant 1 / 7500.
14. Design a plain carbon steel centre crankshaft for a single acting four stroke 16 CO4 [K<sub>3</sub>]  
single cylinder engine for the following data:  
Bore = 400 mm; Stroke = 600 mm; Engine speed = 200 r.p.m. ; Mean effective pressure = 0.5 N/mm<sup>2</sup>; Maximum combustion pressure = 2.5 N/mm<sup>2</sup>; Weight of flywheel used as a pulley = 50 kN; Total belt pull = 6.5 kN. When the crank has turned through 35° from the top dead centre, the pressure on the piston is 1N/mm<sup>2</sup> and the torque on the crank is maximum. The ratio of the connecting rod length to the crank radius is 5. Assume any other data required for the design.

15. Design a rocker arm, and its bearings, tappet, roller and valve spring for the exhaust valve of a four stroke I.C. engine from the following data: 16 CO5 [K<sub>3</sub>]
- Diameter of the valve head = 80 mm; Lift of the valve = 25 mm; Mass of associated parts with the valve = 0.4 kg ; Angle of action of camshaft = 110°; speed of the crankshaft = 1500 rpm. From the probable indicator diagram, it has been observed that the greatest back pressure when the exhaust valve opens is 0.4 N/mm<sup>2</sup> and the greatest suction pressure is 0.02 N/mm<sup>2</sup> below atmosphere.
- The rocker arm is to be of I-section and the effective length of each arm may be taken as 180 mm ; the angle between the two arms being 135°. The motion of the valve may be assumed S.H.M., without dwell in fully open position. Choose your own materials and suitable values for the stresses. Draw fully dimensioned sketches of the valve gear.
16. Design a single plate automobile clutch to transmit a maximum torque of 250 N-m at 2000 r.p.m. The outside diameter of the clutch is 250 mm and the clutch is engaged at 55 km/h. Find: 16 CO6 [K<sub>3</sub>]
1. the number of revolutions of the clutch slip during engagement; and
  2. heat to be dissipated by the clutch for each engagement.
- The following additional data is available:
- Engine torque during engagement = 100 N-m; Mass of the automobile = 1500 kg; Diameter of the automobile wheel = 0.7 m; Moment of inertia of combined engine rotating parts, flywheel and input side of the clutch = 1 kg-m<sup>2</sup>; Gear reduction ratio at differential = 5; Torque at rear wheels available for accelerating automobile = 175 N-m; Coefficient of friction for the clutch material = 0.3; Permissible pressure = 0.13 N/mm<sup>2</sup>.

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