



**B.E DEGREE EXAMINATIONS: NOV/DEC 2024**

(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. Explain the design assumptions considered in the design of a piston.                        | CO1 | [K <sub>2</sub> ] |
| 2. Explain how increasing cylinder pressure affects the material choice for pistons.           | CO1 | [K <sub>2</sub> ] |
| 3. Identify two factors that determine the minimum length of a connecting rod in an IC engine. | CO2 | [K <sub>1</sub> ] |
| 4. Describe why the small end of a connecting rod requires careful design consideration.       | CO2 | [K <sub>2</sub> ] |
| 5. Explain how the firing order of an engine influences crankshaft design.                     | CO3 | [K <sub>2</sub> ] |
| 6. Illustrate the role of counterweights in crankshaft design.                                 | CO3 | [K <sub>3</sub> ] |
| 7. Define the main function of a multi-plate clutch and where it is commonly used.             | CO4 | [K <sub>1</sub> ] |
| 8. Explain how centrifugal force is utilized in a centrifugal clutch.                          | CO4 | [K <sub>2</sub> ] |
| 9. Summarize the design considerations for intake valves compared to exhaust valves.           | CO5 | [K <sub>2</sub> ] |
| 10. Describe the function of the camshaft in the valve train system.                           | CO5 | [K <sub>1</sub> ] |

**Answer any FIVE Questions:-**

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

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

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|---|----|-----|-------------------|
| 11. a) The bore of a cylinder of the four-stroke diesel engine is 150 mm. The maximum gas pressure inside the cylinder is limited to 3.5 MPa. The cylinder head is made of grey cast iron FG 200 ( $S_{ut} = 200 \text{ N/mm}^2$ ) and the factor of safety is 5. Determine the thickness of the cylinder head. Studs are used to fix the cylinder head to the cylinder and obtain a leakproof joint. They are made of steel FeE 250 ( $S_{yt} = 250 \text{ N/mm}^2$ ) and the factor of safety is 5. Calculate.<br>(i) Number of studs<br>(ii) Nominal diameter of studs<br>(iii) Pitch of studs | 16 | CO1 | [K <sub>2</sub> ] |
|---|----|-----|-------------------|

12. Design a cast iron piston for a single acting four-stroke diesel engine with the following data: Cylinder bore = 300 mm; Length of stroke = 450 mm; Speed = 300 rpm ; Indicated mean effective pressure = 0.85 MPa ;Maximum gas pressure = 5 MPa ;Fuel consumption = 0.30 kg per BP per h ; Higher calorific value of fuel = 44 000 kJ/kg Assume suitable data if required and state the assumptions you make. 16 CO2 [K<sub>3</sub>]
13. The following data is given for the cap and bolts of the big end of connecting rod: Engine speed = 1800 rpm ; Length of connecting rod = 350 mm ; Length of stroke = 175 mm ; Mass of reciprocating parts = 2.5 kg ; Length of crank pin = 76 mm ; Diameter of crank pin = 58 mm ; Thickness of bearing bush = 3 mm Permissible tensile stress for bolts = 60 N/mm<sup>2</sup>; Permissible bending stress for cap = 80 N/mm<sup>2</sup> ; Calculate the nominal diameter of bolts and thickness of cap for the big end. 16 CO3 [K<sub>3</sub>]
14. Design an overhung crankshaft for a 300 × 350 mm single cylinder vertical engine using the following data: Maximum gas pressure = 2.5 MPa ; (L/r) ratio = 4.5 ; Weight of flywheel cum belt pulley = 10 kN ; Total belt pull = 5 kN Width of hub for flywheel cum belt pulley = 150 mm ; The torque on the crankshaft is maximum when the crank turns through 35° from the top-dead center and at this position the gas pressure inside the cylinder is 1 MPa. The belts are in the horizontal direction. Assume suitable data and state the assumptions you make. 16 CO4 [K<sub>3</sub>]
15. Briefly discuss the design procedure of IC-Engine Valves with the help of a neat sketch. 16 CO5 [K<sub>2</sub>]
16. An automotive plate clutch consists of two pairs of contacting surfaces with an asbestos friction lining. The torque transmitting capacity of the clutch is 550 N-m. The coefficient of friction is 0.25 and the permissible intensity of pressure is 0.5 N/mm<sup>2</sup>. Due to space limitations, the outer diameter of the friction disk is fixed as 250 mm. Using uniform wear theory, calculate  
(i) the inner diameter of the friction disk; and  
(ii) the spring force required to keep the clutch in an engaged position. 16 CO6 [K<sub>3</sub>]

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