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Question Paper Code : 10902

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Fifth/Sixth/Seventh/Eighth Semester

Mechanical Engineering

CME331 — AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING

(Common to : Mechanical Engineering (Sandwich))

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the effects of excessive piston clearance in an internal combustion engine?
2. Why is one end of the connecting rod bigger than other?
3. When is a wet liner preferred over a dry liner in engine cylinders?
4. What are the materials generally preferred for gudgeon pins?
5. Why rectangular cross-section of connecting rod is preferred?
6. Enlist the key considerations in crank web design.
7. What are the factors to be considered while designing an inlet valve for motorcycles?
8. What are the usages of a rocker arm in automobiles?
9. List any two key characteristics of Transient Dynamometers.
10. Identify the challenges involved in using a particle counter.

PART B — (5 × 13 = 65 marks)

11. (a) Illustrate with examples how the choice of material for piston pins, valves, and cylinder heads affects the performance and lifespan of automotive engines.

Or

- (b) Explain why flywheel size requirements for the diesel and the petrol engines. Also, discuss the criteria for selecting appropriate materials for flywheels used in both types of engines.

12. (a) A four stroke diesel engine has the following specifications :

Brake power = 5.25 kW

Speed = 1240 rpm

Indicated mean effective pressure = 0.37 N/mm²

Mechanical efficiency = 85 %.

Determine :

- (i) Bore and length of the cylinder
- (ii) Thickness of the cylinder head
- (iii) Size of studs for the cylinder head.

Or

- (b) Discuss the design criteria and factors considered for cylinder and cylinder head design of an internal combustion engine.

13. (a) Determine the dimensions of an I-section connecting rod for a petrol engine from the following data :

Diameter of the piston = 110 mm

Mass of the reciprocating parts = 2.2 kg

Length of the connecting rod from centre to centre = 325 mm

Stroke length = 152 mm

Speed = 1520 rpm with possible over speed of 2500 rpm

Compression ratio = 4:1

Maximum explosion pressure = 2.5 N/mm².

Or

- (b) Design a side crankshaft for a single-cylinder gas engine having a bore 500 mm and stroke 600 mm. The flywheel weight is 81 kN. The maximum explosion pressure is 2.51 N/mm². The gas pressure at the crank angle of maximum torque ($\theta = 30^\circ$) is 0.9 N/mm². The connecting-rod length is 4.5 times the crank radius. Any other data required for the design may be assumed.

14. (a) A load of 2.1 kN is dropped axially on a close coiled helical spring, from a height of 255 mm. The spring has 20 effective turns, and it is made of 25 mm diameter wire. The spring index is 8. Find the maximum shear stress induced in the spring and the amount of compression produced. The modulus of rigidity for the material of the spring wire is 83.99 kN/mm².

Or

- (b) The turning-moment diagram for a petrol engine is drawn to a vertical scale of 1 mm = 500 N.m and a horizontal scale of 1 mm = 3°. The turning-moment diagram repeats itself after every half revolution of the crankshaft. The areas above and below the mean torque line are 260, -580, 80, -380, 870, and -250 mm². The rotating parts have a mass of 52 kg and radius of gyration of 2 m. If the engine speed is 1640 rpm, determine the coefficient of fluctuation of speed.
15. (a) Explain why the Worldwide Harmonized Light Vehicle Test Procedure is considered more realistic than other test cycles in measuring fuel efficiency, and describe the procedures involved in it.

Or

- (b) Discuss why measuring NO_x emissions is more challenging compared to CO and CO₂ emissions in the automotive industry. Explain the commercially available technologies for NO_x measurement and share your insights.

PART C — (1 × 15 = 15 marks)

16. (a) Analyze the suitability, of polymer materials for manufacturing components for heavy-duty automobiles, and compare their performance to equivalent components made from metal alloys. Discuss the expected challenges.

Or

- (b) The pollution level of your city is increased in last five years as per pollution board data. Suggest the tools, techniques and measures to reduce the pollution level.

