

**M. E. AUTOMOBILE ENGINEERING FIRST YEAR SECOND
SEMESTER EXAMINATION, 2018
VEHICLE DESIGN**

Time: 3 hours

Full marks: 100

(Use separate answer script for each part)

(50 marks for Part I and 50 marks for Part II)

(Assume data if required)

PART I

(Answer question no. 1 and any one from the rest)

1. a) Why clearance is provided between the piston and cylinder liner, and how much?
b) What are the advantages of cylinder liner? What are dry and wet cylinder liners? What are the desirable properties of cylinder materials?
c) Would you prefer more number of narrow rings or a few wide shallow rings and why?
d) Discuss the suitability of cast iron and aluminium alloys as materials for construction of pistons.
e) What are the design requirements of piston? Name the materials used for engine piston.
f) What is the function of the cup on the piston head?
g) What is the function of oil scraper rings?

3+6+4+3+3+3+3=25

2. a) A cylinder of a four stroke diesel engine has the following specifications:
Cylinder bore = 150 mm
Max. gas pressure = 3.5 MPa
Cylinder material = Grey cast iron FG 200
Factor of safety = 5
Poisson's ratio = 0.25
Determine thickness of the cylinder wall. Also determine the apparent and net circumferential and longitudinal stresses in the cylinder wall.
b) The following data is given for the piston of a four stroke diesel engine:
Cylinder bore = 225 mm
Material of piston rings = Grey cast iron
Allowable tensile stress = 100 N/mm²
Allowable radial pressure on cylinder wall = 0.03 MPa
Thickness of piston head = 42 mm
Number of piston rings = 4

Calculate:

- (i) Radial width of the piston rings;
- (ii) Axial thickness of the piston rings;
- (iii) Gap between the free ends of the piston rings before assembly;
- (iv) Gap between the free ends of the piston rings after assembly;
- (v) Width of the top land;
- (vi) Width of the ring grooves.

12+13=25

3. a) Name two design criteria for piston pin.
- b) Why is piston pin located at or above the middle of the skirt length?
- c) The following data is given for the cylinder of a four stroke diesel engine:
 Brake power = 5.25 kW
 Speed = 650 rpm
 Indicated mean effective pressure = 0.5 MPa
 Make suitable assumption and 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.

5+4+16=25

PART II

(Answer any two questions from the followings)

1. a) With the help of a neat sketch, explain the self-adjusting feature of a floating-caliper disc brake.
- b) "The force applied at the brake pedal gets highly magnified when the brake drum is pressed by the pads" - Explain.
- c) What is the purpose of using two cylinders in the brake circuit?
- d) Why a proportioning valve is used in case of disc brakes?
- 5+8+8+4=25
2. a) Figure 2 shows a shoe brake. What kind of brake is it? With reference to the Figure 2, explain which one of them is self-energizing shoe. Is it possible to make both the shoes self-energizing?
- b) With the help of a neat sketch, if separately necessary, derive the expression for the frictional moment for an internal expanding brake shoe as shown in Fig. 2 where b , μ , p_{\max} and θ_{\max} are the face width, co-efficient of friction, maximum pressure and point of application of maximum pressure.
- c) An automotive type internal expanding double-shoe brake is shown in Fig. 2. The brake dimensions according to the figure are $\theta_1 = 10^\circ$, $\theta_2 = 120^\circ$, $r = 95 \text{ mm}$, $d_7 = 73 \text{ mm}$, $d_8 = 120 \text{ mm}$, and $d_5 = 30 \text{ mm}$. The brake shoe lining is 38 mm wide, and the maximum allowable contact pressure is 5 MPa. Calculate the braking torque and the fraction of the torque produced from

each brake shoe when the brake force is 5000 N. The co-efficient of friction is 0.29.

5+10+10+25

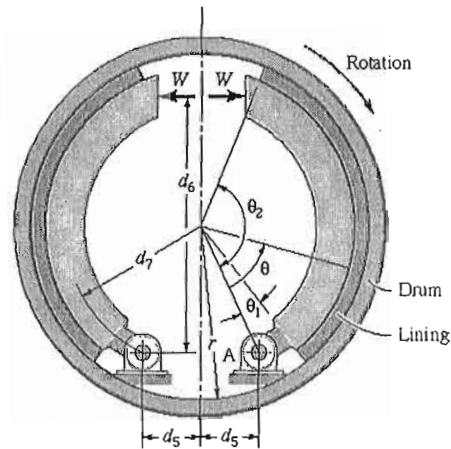


Fig. 2

3. a) Derive the expression for steer angle in terms of cornering stiffness, velocity of the vehicle, mass on the axle and turning radius.
- b) Discuss the following cases that may occur when an automobile turns.
(i) Under steer, (ii) Neutral steer and (iii) Over steer.
- c) What is lateral acceleration gain? How does it change with different values of under steer gradient?

12+8+5=25

4. a) Explain the terms passive, semi active and active suspension system.
- b) Explain the working principle of active suspension system with schematic diagram and related equations.
- c) Explain the function of controller in an active suspension system.

9+8+8=25
