

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026
Design of Automobile Components

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
 2. Use of Design data handbook is permitted.
 3. Missing data may be suitably assumed.*

Module-1

- 1 a. Determine the stress induced in a link shown in Fig.Q1(a). It is required to transmit a tensile load of 60 kN in the link.

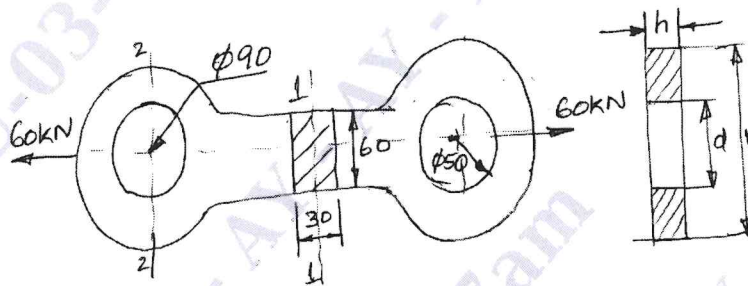


Fig.Q1(a)

(08 Marks)

- b. Explain the failures of ductile and brittle materials in design of mechanical components. (06 Marks)
 c. Explain low and high cycle fatigue sketches with respect to fatigue design of a component. (06 Marks)

OR

- 2 a. A mild steel shaft of 60 mm diameter is subjected to a bending moment of 25×10^5 N-mm and torque M_t . If the yield point of steel in tension is 230 N/mm^2 . Determine the maximum value of this torque M_t according to
 (i) Maximum normal stress theory
 (ii) Maximum shear stress theory (12 Marks)
 b. Define Endurance Limit. Explain the effect of factors on endurance limit. (08 Marks)

Module-2

- 3 a. A square key 12 mm $\times$ 12 mm is used to transmit a power of 100 KW at 560 rpm. The key is made of SAE1045 annealed steel. Design the key length based on shear stress and compressive stress. (08 Marks)
 b. Design a Knuckle Joint to transmit 150 KN. The design stress may be taken 75 MPa in tension, 60 MPa in shear and 150 MPa in crushing. (12 Marks)

OR

- 4 A shaft is supported by two bearings placed 1 m apart. A 500 mm diameter pulley is mounted at 200 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 3000 N. The pulley weighs 1000 N. Another pulley 300 mm diameter is placed 300 mm to the left of right hand bearing is driven with the help of electric motor and the belt which is placed horizontally to the right when viewed from the left bearing. This pulley weighs 500 N. The angle of contact for both the pulley is 180° and $\mu = 0.24$. Determine the suitable diameter for a solid shaft, assuming torque on one pulley is equal to torque on other pulley. Choose C15 steel ($\sigma_y = 235.4$ MPa, $\sigma_u = 425$ MPa) as the shaft material and use ASME code for design of shaft. Assume minor shock condition. (20 Marks)

Module-3

- 5 a. Define Spring. List the types of springs with their applications. (08 Marks)
- b. A multileaf spring with camber is fitted to the chassis of an automobile over a span of 1.2 m to absorb shocks due to a maximum load of 20 kN. The spring material can sustain a maximum stress of 0.4 GPa. All the leaves of the spring were to receive the same stress. The spring is required atleast 2 full length leaves out of 8 leaves. The leaves are assembled with bolts over a span of 150 mm width at the middle. Design the spring for a maximum deflection of 50 mm. (12 Marks)

OR

- 6 a. Derive an expression for torque transmitted by the plate clutch using uniform pressure theory. (08 Marks)
- b. The block type hand brake shown in Fig.Q6(b) has a 400 mm brake drum. It can sustain 200 N-m torque at 500 rpm. Coefficient of friction is 0.25. Determine
- Normal force on the shoe.
 - Required force F to apply the brake for clockwise rotation.
 - Required force F to apply the brake for counter clockwise rotation.
 - The dimension C required to make the brake self-locking, assuming the other dimensions remains the same.
 - Heat generated.

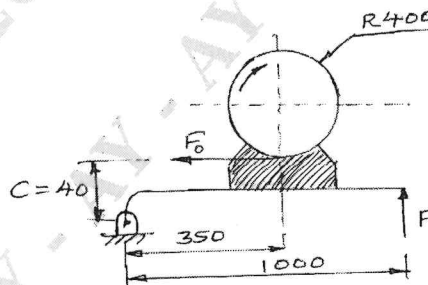


Fig.Q6(b)

(12 Marks)

Module-4

- 7 a. Explain the buckling phenomenon in connecting rod with sketch. Also explain the inertia forces acting in the connecting rod. (08 Marks)

- b. Design a connecting rod for a petrol engine from the following data:
 Cylinder bore = 100 mm , length of stroke = 150 mm ,
 Maximum gas pressure = 3 N/mm^2 , Length of connecting rod = 350 mm ,
 Engine speed = 1500 rpm , Weight of reciprocating parts = 25 N ,
 Compression ratio = 4 : 1
 Assume any further data required for the design.

(12 Marks)

OR

- 8 a. Sketch and explain the main requirements of an I.C. engine crank shaft. Also explain the causes for the failure of the crank shaft. (08 Marks)
- b. Design a centre crank shaft for a single acting four stroke single cylinder to operate at 200 rpm. The particulars of the engine are as given below :
 Cylinder bore = 250 mm
 Maximum gas pressure = 2.5 MPa, Length of stroke = 300 mm ,
 Ratio of length of connecting rod to crank radius = 4.5 ,
 Weight of flywheel cum belt pulley = 2 KN ,
 Total belt pull = 4 KN, Mean effective pressure = 0.5 MPa
 Width of hub for flywheel cum belt pulley is 400 mm.
 The torque on the crank shaft is maximum when the crank turns through 25° from top dead centre and at this position the gas pressure inside the cylinder is 2 MPa. The belts are in the horizontal position. The crank shaft main bearings are 500 mm centre to centre.
 Design the centre shaft at top dead centre position case. (12 Marks)

Module-5

- 9 a. Explain the important design considerations in I.C. engine piston design. (06 Marks)
- b. Differentiate Flat plate type head piston and Cup type head piston with neat sketches. (06 Marks)
- c. The following data refers to a piston of a four stroke diesel engine :
 Cylinder bore = 100 mm
 Material for piston rings = Grey cast iron
 Allowable gas pressure = 5 MPa
 Allowable bending stress for piston pin = 140 N/mm^2
 Bearing pressure at small end of connecting rod = 25 MPa
 Length of piston pin in bush of small end is 0.45 D,
 Mean diameter of piston boss = $1.4 \times$ outer diameter of piston pin.
 Determine (i) Outer diameter of piston pin (ii) Inner diameter of piston pin (iii) Mean diameter of piston boss (iv) Check the design for bending stress. (08 Marks)

OR

- 10 Write a short notes on the following :
 (i) Sodium Cooled valves of IC engines.
 (ii) Valve rotators
 (iii) Valve trains
 (iv) Tappets
 (v) Cam Shafts

(20 Marks)

* * * * *