

**B.TECH**  
**(SEM VI) THEORY EXAMINATION 2022-2023**  
**MACHINE DESIGN**

Time: 3 Hours

Total Marks: 100

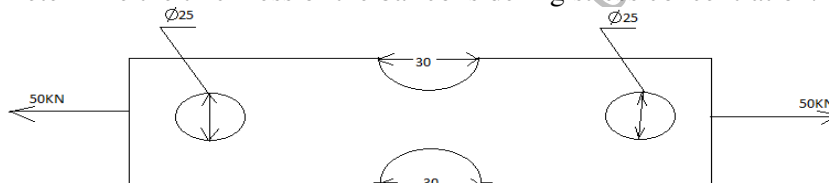
- Note:** 1. Attempt all Sections. If require any missing data; then choose suitably.  
2. Design data hand book is allowed.  
3. Assume suitable data if missing.

**SECTION A**

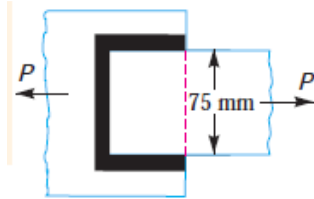
1. Attempt all questions in brief. 2 x 10 = 20
- (a) Define Notch Sensitivity and its significance
  - (b) Define principal stress and principal plane.
  - (c) Differentiate between chalking and fullering.
  - (d) If the tearing efficiency of a riveted joint is 60%, find the ratio of diameter of rivet hole to the pitch of rivets.
  - (e) Discuss the advantages and disadvantages of Helical gear.
  - (f) Define pressure angle for the gear.
  - (g) Define “static load rating” of rolling contact bearing.
  - (h) A self-aligning ball bearing has a basic dynamic load rating  $C = 35$  kN. If the equivalent radial load on the bearing is 45 kN, calculate the expected L10 life in millions of revolution.
  - (i) Differentiate between dry liner and wet liner
  - (j) Discuss advantages of clutch over coupling.

**SECTION B**

2. Attempt any three of the following: 10x3=30
- (a) Explain the design procedure in brief. A flat bar as shown in figure is subjected to an axial load of 50 KN. if the stress in the bar is to be limited 100N/m<sup>2</sup>. Determine the thickness of the bar considering stress concentration.



- (b) A plate 75 mm wide and 12.5 mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld as shown in Fig. The maximum tensile and shear stresses are 70 MPa and 56 MPa respectively. Find the length of each parallel fillet weld.

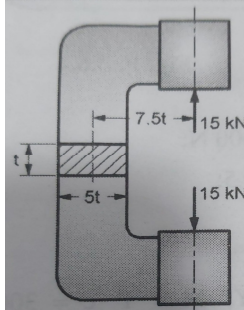


- (c) Define law of gearing and derive the condition for which the law of gear holds good.
- (d) The radial load acting on a ball bearing 2500N for the 1/3 times of its life and 1500 N for rest of the life. The rated life of the bearing is 20 million revolution. Determine the dynamic load capacity of the bearing.
- (e) A plate clutch having a single driving plate with contact surfaces on each side is required to transmit 110 kW at 1250 r.p.m. The outer diameter of the contact surfaces is to be 300 mm. The coefficient of friction is 0.4. (a) Assuming a uniform pressure of  $0.17 \text{ N/mm}^2$ ; determine the inner diameter of the friction surfaces. (b) Assuming the same dimensions and the same total axial thrust, determine the maximum torque that can be transmitted and the maximum intensity of pressure when uniform wear conditions have been reached.

### SECTION C

3. Attempt any *one* part of the following: 10x1=10

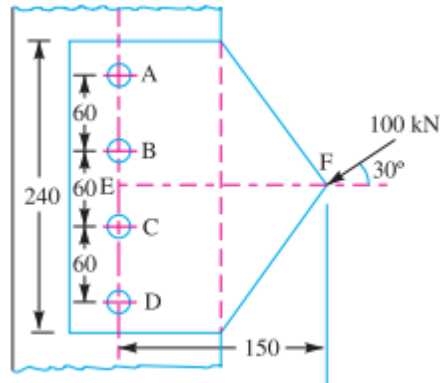
- (a) A C frame subjected to a load of 15 kN is shown in figure .it is made of gray cast iron FG300. If the factor of safety is 2.5, determine the dimension of cross-section of the frame.



- (b) A machine component is subjected to a flexural stress which fluctuates between  $+ 300 \text{ MN/m}^2$  and  $- 150 \text{ MN/m}^2$ . Determine the value of minimum ultimate strength according to 1. Modified Goodman relation; and 2. Soderberg relation. Take yield strength = 0.55 Ultimate strength; Endurance strength = 0.5 Ultimate strength; and factor of safety = 2.

4. Attempt any *one* part of the following: 10x1=10

- (a) A bracket in the form of a plate is fitted to a column by means of four rivets A, B, C and D in the same vertical line, as shown in Fig. 9.33.  $AB = BC = CD = 60 \text{ mm}$ . E is the mid-point of BC. A load of 100 kN is applied to the bracket at a point F which is at a horizontal distance of 150 mm from E. The load acts at an angle of  $30^\circ$  to the horizontal. Determine the diameter of the rivets which are made of steel having a yield stress in shear of 240 MPa. Take a factor of safety of 1.5.



- (b) A pulley is mounted on a shaft midway between two bearings. The bending moment varies from 200 KN –mm to 600 KN –mm and torsional moment varies from 60 KN –mm to 180 KN –mm. The shaft material has ultimate strength of 550 MPa and yield strength 400 MPa. If the factor of safety is 1.5 and the stress concentration for key way in the pulley in bending and torsion are 1.5 and 1.2 respectively, determine the shaft diameter and also design the rectangular key for the shaft.

**5. Attempt any one part of the following: 10x1=10**

- (a) A gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1:2 and r.p.m. of the pinion is 200. The approximate center distance between the shafts may be taken as 600 mm. The teeth have 20° stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear. From static strength considerations and check the gears for wear.
- (b) A helical cast steel gear with 30° helix angle has to transmit 35 kW at 1500 r.p.m. If the gear has 24 teeth, determine the necessary module, pitch diameter and face width for 20° full depth teeth. The static stress for cast steel may be taken as 56 MPa. The width of face may be taken as 3 times the normal pitch. What would be the end thrust on the gear?

**6. Attempt any one part of the following: 10x1=10**

- (a) Design a journal bearing for a centrifugal pump from the following data : Load on the journal = 20 000 N; Speed of the journal = 900 r.p.m.; Type of oil is SAE 10, for which the absolute viscosity at 55°C = 0.017 kg / m-s; Ambient temperature of oil = 15.5°C ; Maximum bearing pressure for the pump = 1.5 N / mm<sup>2</sup>. Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m<sup>2</sup>/°C.
- (b) Select the suitable bearing rolling contact bearing for the following application:
- Shaft diameter=50mm
  - Speed=600 RPM
  - Radial load Fr=2KN
  - Axial load Fa=0.5 KN
  - Required life with 95% reliability=12000 hr.
  - Operating temp=45oC

Rotating Race= Inner

**7. Attempt any one part of the following: 10x1=10**

- (a) A four-stroke diesel engine has the following specifications: Brake power = 5 kW; Speed = 1200 r.p.m. ; Indicated mean effective pressure

= 0.35 N / mm<sup>2</sup>; Mechanical efficiency = 80 %. Determine: 1. bore and length of the cylinder; 2. thickness of the cylinder head ; and 3. size of studs for the cylinder head.

- (b) Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore=100mm; Stroke=125mm; Maximum gas pressure = 5N/mm<sup>2</sup>; Indicated mean effective pressure = 0.75N/mm<sup>2</sup>; Mechanical efficiency = 80%; Fuel consumption = 0.15 kg per brake power per hour; Higher calorific value of fuel = 42×10<sup>3</sup>kJ/kg; speed = 2000 r.p.m. Any other data required for the design may be assumed. Thermal conductivity for C.I is 46 J/sec. m°C and allowable temperature difference is 222 °C.

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