KATHMANDU UNIVERSITY
End Semester Examination [C]
April/May, 2023

Marks Scored:

Level : B.E.
Year : III

Course : MEEG 315
Semester : I

Exam Roll No.:

Time: 30 mins.

F. M. : 20

Registration No.:

Date : 28 APR 2023

SECTION "A"
[20Q. × 1 = 20 marks]

Choose the most appropriate answer and **mark [X]**. Use of Data Book is **NOT** allowed.

1. What is the primary advantage of using a riveted joint over other types of joints?
   [ ] High strength [ ] Low cost
   [ ] Ease of assembly [ ] All of these

2. Which type of riveted joint is best suited for applications that require high strength and resistance to shear forces?
   [ ] Lab joint [ ] Butt joint [ ] Tee joint [ ] Corner joint

3. What is the primary advantage of using a welded joint over other types of joints?
   [ ] High Strength [ ] Low cost
   [ ] Ease of assembly [ ] All of these

4. Which type of welded joint is best suited for applications requiring high strength and fatigue resistance?
   [ ] Fillet weld [ ] Butt weld [ ] Spot weld [ ] Plug weld

5. Which type of thread is typically used for applications that require high load-bearing capacity?
   [ ] Coarse thread [ ] Fine thread [ ] Unified thread [ ] Metric thread

6. Which type of thread is typically used for applications that require high load-bearing capacity?
   [ ] Hex bolt [ ] Wing nut
   [ ] Set screw [ ] Socket head cap screw

7. Which type of locking device is typically used for applications that require easy assembly and disassembly?
   [ ] Split lock washer [ ] Cotter pin
   [ ] Thread locker [ ] Nylon insert lock nut

8. Which of the following factors determines the stiffness of a helical spring?
   [ ] Number of coils [ ] Spring diameter
   [ ] Spring diameter [ ] All of these

9. What is the primary advantage of using a variable pitch spring over a constant pitch spring?
   [ ] Higher Stiffness [ ] Greater durability
   [ ] Compact design [ ] Greater load bearing

10. Which of the following is not a common material used for journal-bearing bushings?
[ ] Brass [ ] Bronze [ ] Steel [ ] Plastic

11. Which type of journal bearing provides the least amount of friction?
[ ] Hydrodynamic [ ] Hydrostatic
[ ] Rolling element [ ] All of these

12. Which rolling contact bearing type can handle radial and axial loads?
[ ] Deep groove ball bearing [ ] Spherical roller bearing
[ ] Tapered roller bearing [ ] Thrust ball bearing

13. Which of the following is not a common type of rolling element used in rolling contact bearings?
[ ] Balls [ ] Rollers [ ] Needles [ ] Cylinders

14. Which type of rolling contact bearing is typically used to support heavy radial loads and moderate axial loads?
[ ] Deep groove ball bearings [ ] Cylindrical roller bearing
[ ] Tapered roller bearing [ ] Thrust ball bearing

15. Which of the following is a common way to reduce stress concentration in a mechanical component?
[ ] Increase the diameter of the component
[ ] Add a fillet to the component
[ ] Increase the length of the component
[ ] Change material

16. What is the main advantage of a multi-leaf spring compared to a single-leaf spring?
[ ] Higher load capacity [ ] Better ride quality
[ ] Easier to install [ ] Easier maintenance

17. Which of the following is not a factor that influences the notch sensitivity of a material?
[ ] Material strength [ ] Material ductility
[ ] Size and shape of the notch [ ] Temperature of the material

18. In hydrodynamic bearings
[ ] grease is used for lubrication
[ ] do not require external supply of lubricant
[ ] the oil film is maintained by supplying oil under pressure
[ ] the oil film pressure is generated only by the rotation of the journal

19. In hydrostatic bearing
[ ] grease is used for lubrication
[ ] do not require external supply of lubricant
[ ] the oil film is maintained by supplying oil under pressure
[ ] the oil film pressure is generated only by the rotation of the journal

20. Self-locking in a power screw is better achieved by
[ ] decreasing the helix angle and decreasing the coefficient of friction.
[ ] decreasing the helix angle and increasing the coefficient of friction.
[ ] increasing the helix angle and increasing the coefficient of friction.
[ ] increasing the helix angle and decreasing the coefficient of friction.

KATHMANDU UNIVERSITY
End Semester Examination [C]
April/May, 2023

28 APR 2023

Level : B.E.
Year : III
Time : 2 hrs. 30 mins.

Course : MEEG 315
Semester : I
F. M. : 55

SECTION "B"
[5Q × 11 = 55 marks]

Attempt *ALL* questions. Use of Data Book is **ALLOWED** for this examination. Assume and/or select suitable data if not specified

1. a. What are the advantages and disadvantages of welded joints compared to other types of joints in terms of strength, durability, and cost? Provide an example of a structural application where welded joints are commonly used. [3]

   b. What are the stages involved in the mechanical design cycle? Provide a brief description of each stage and explain the importance of each stage in the design process. Also, provide an example of a product that underwent the mechanical design cycle and discuss how each stage was implemented in the design of the product [3]

   c. A welded joint is subjected to an eccentric load of 10 kN at a distance of 30 mm from its centerline. The joint has a thickness of 8 mm and a width of 40 mm. If the yield strength of the material is 400 MPa, design the joint for both in-plane and out-of-plane eccentricity. Assume that the joint is fully restrained against rotation and displacement at its ends. [5]

2. a. How does stress concentration occur in materials and what are the common factors that lead to its development? Provide an example of a design feature that can mitigate stress concentration in a mechanical component. [3]

   b. A boiler needs to be made of a 20 mm thick mild steel plate with ultimate tension, crushing, and shear strength as 60 N/mm^2, 100 N/mm^2, and 45 N/mm^2 respectively. Design the longitudinal joint for a boiler considering a triple-riveted, single-cover plate butt joint with a joint efficiency of 72 %. [4]

   c. An angle of size 200 mm × 150 mm × 20 mm is welded to a flat plate with the long side of the angle along the length of the plate, as shown in Figure 1 with an Axial load of 15 kN. The allowable shear stress for static loading may be taken as 70 MPa. Design the joint. [4]

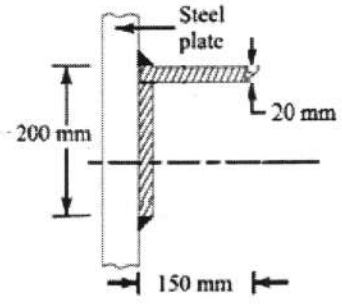

Figure 1

3. a. What is a buttress thread and how does it differ from other types of threads in terms of its shape and function? Provide an example of an application where buttress threads are commonly used. [3]

b. A power screw is used to transmit a force of 5 kN along its axis. The screw has a pitch of 6 mm, a diameter of 20 mm, and a length of 100 mm. The coefficient of friction between the screw and the nut is 0.15. Determine the torque required to raise the load and the efficiency of the screw. Assume a lead angle of 10 degrees and a thread angle of 60 degrees. [4]

c. A journal bearing supports a shaft rotating at 3000 rpm with a radial load of 1000 N and an axial load of 500 N. The bearing diameter is 150 mm, and the length is 300 mm. The bearing material is bronze with a static coefficient of friction of 0.2. The viscosity of the lubricant is 0.02 Pa·s, and the clearance between the shaft and the bearing is 0.05 mm. Determine the minimum oil film thickness required to prevent direct contact between the shaft and the bearing. [4]

4. a. "Spherical roller bearings are used to support the shafts that drive belts in a conveyor system". Provide your arguments to support this statement. [3]

b. What are the different types of journal bearings and how do they differ in terms of their design and application? Provide an example of an industrial application where a particular type of journal bearing is commonly used and explain why it is preferred over other types in that application [3]

c. A shaft rotating at 2500 rpm requires a deep groove ball bearing to support a radial load of 2 kN and an axial load of 1 kN. The bearing will be mounted on a shaft with a diameter of 25 mm. Select an appropriate deep groove ball bearing for this application and justify your selection. Assume a safety factor of 2 and a bearing life of 20,000 hours. [5]

5. a. Explain the application of disc spring. [2]

b. A helical compression spring is required to support a load of 500 N when compressed to a solid height of 50 mm. The spring must have a minimum of 10 mm clearance when fully compressed, and a maximum of 100 mm free length when not loaded. The spring will be made of oil-tempered wire with a diameter of 10 mm and a shear modulus of 80 GPa. Determine the number of active coils required, the spring rate, and the stress in the wire. Also, provide a sketch of the spring indicating its dimensions and parameters. [5]

c. Considering a composite spring (two springs in series) with load 10kN, find the maximum shear stress developed in both springs when they are compressed to 10 mm. Both springs has outer diameter of 50 mm, wire diameter of 5 mm and stiffness of 15 N/mm^2. [4]