KATHMANDU UNIVERSITY
End Semester Examination [C]
November/December, 2023

Marks Scored:

Level : B.E.
Year : III
Course : MEEG 318
Semester : II

Exam Roll No. :
Time: 30 mins.
F. M. : 10

Registration No.:
Date : 26 NOV 2023

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Mark [X] in the most appropriate option. Use of Data Book is **NOT** allowed for objective.

1. Asbestos has historically been a commonly used material for brake and clutch linings due to its high frictional properties and thermal stability. However, Asbestos has been banned or heavily restricted in many countries due to its harmful health effects, particularly its association with respiratory diseases and cancer. What could be a better alternative to asbestos?
   [ ] Sintered materials [ ] Ceramic fibers
   [ ] Cellulose [ ] All of them

2. What is the key difference between a multiple plate clutch and a single plate clutch?
   [ ] Number of friction plates [ ] Torque transmission capability
   [ ] Engaging mechanism [ ] Size & weight

3. Which one is **INCORRECT** statement for a cone clutch?
   [ ] High torque transmission
   [ ] Compact & lightweight design
   [ ] Difficult engagement and disengagement
   [ ] Precise control of power transmission

4. Which type of key provides the most secure and backlash-free connection between shaft and a mating part?
   [ ] Saddle key [ ] Woodruff key [ ] Taper key [ ] Gib-head key

5. What is the primary advantage of using helical screw gears?
   [ ] Increased load-carrying capacity [ ] Smoother and quieter operation
   [ ] Higher efficiency [ ] Self-locking behavior

6. In an Involute Gear pair, keeping the pitch circle diameter constant and increasing number of teeth will
   [ ] Increase contact ratio between the gears [ ] Increase gear strength
   [ ] Reduce backlash between gears [ ] Reduce gear precision

7. Which of the following factors is most critical in determining the torsional strength of a shaft?
   [ ] Shear strength of the material [ ] Diameter of the shaft
   [ ] Length of the shaft [ ] Surface finish of the shaft

8. What is the advantage of using a larger number of teeth in a spur gear system?
   [ ] Increased torque transmission capability
   [ ] Reduced gear noise

9. What is the primary purpose of using an Ashby chart for material selection?
[ ] To determine the cost-effectiveness of different materials
[ ] To evaluate the aesthetic properties of various materials
[ ] To identify the availability of materials in the market
[ ] To compare and select materials based on their performance and properties

10. How does a differential band brake achieve braking action in a vehicle?
[ ] By applying friciton between two rotating surfaces
[ ] By squeezing brake pads against a rotating drum
[ ] By engaging a gear mechanism to slow down the vehicle
[ ] By using hydraulic pressure to clamp brake discs

11. Which of the following is a key function of a flywheel in a mechanical system?
[ ] To balance the rotational motion
[ ] To control the gear shifting process
[ ] To store and release electrical energy
[ ] To provide additional torque to the engine

12. What is the primary purpose of a brake system in a vehicle?
[ ] To enhance fuel efficiency
[ ] To slow down or stop vehicle
[ ] To transfer power from the engine to the wheels
[ ] To provide stability and balance during cornering

13. Which of the following best describes the function of a clutch in an automotive vehicle?
[ ] To control the vehicle's speed
[ ] To engage or disengage the engine power from the transmission
[ ] to slow down or stop the vehicle
[ ] To provide additional rotational inertia

14. Which of the following statement about spur gears is **TRUE**?
[ ] Spur gears are only used in low-speed applications
[ ] Spur gears have teeth that are parallel to the axis of rotation
[ ] Spur gear are always used in pairs
[ ] Spur gears are only used for transmitting rotational motion

15. Which of the following statement about helical gears is **TRUE**?
[ ] Helical gears have teeth that are parallel to the axis of rotation
[ ] Helical gear are typically used to transmit power between perpendicular shafts
[ ] Helical gears are known for their higher efficiency and noise compared to spur gears
[ ] Helical gears have curved teeth that wrap around the gear axis

16. What is a key characteristic of a work gear?
[ ] it is used to transmit power between parallel shafts
[ ] It has helical teeth that wrap around the gear axis
[ ] It has a high gear ratio, resulting in large speed reduction
[ ] It is the most efficient type of gear for transmitting rotational motion

17. What is a common application of bevel gears?
[ ] Transmitting power between parallel shafts
[ ] Speed reduction in high-torque applications
[ ] Transmitting power between intersecting shafts at various angles
[ ] Providing a high gear ratio for increased rotational speed

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18. What is the purpose of a key in a shaft-key connection?
[ ] To prevent axial movement of the shaft
[ ] To transmit torque between the shaft and the mating part
[ ] To increase the shaft diameter
[ ] To align the shaft with the mating part

19. What is the key difference between enveloping and non-enveloping worm gear sets?
[ ] Enveloping worm gears have increased contact area.
[ ] Enveloping worm gears have lower backlash than non-enveloping worm gears.
[ ] Enveloping worm gears have higher efficiency than non-enveloping worm gears.
[ ] Enveloping worm gears have a lower gear ratio than non-enveloping worm gears.

20. What is the key distinguishing feature of hypoid gears compared to other types of gears?
[ ] Higher tooth contact ratio for improved load distribution
[ ] Lower backlash for enhanced precision and accuracy
[ ] Greater torque transmission capability for heavy-duty applications
[ ] Non-parallel and non-intersecting axes of the driving and driven gears

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Year : III
Time : 2 hrs. 30 mins.

Course : MEEG 318
Semester : II
F. M. : 40

SECTION "B"
[4Q × 10 = 40 marks]

Attempt *ALL* questions. Students are **ALLOWED** to bring their own **Machine Design Data Book** for this examination. Assume and/ or select suitable data if not specified.

1 a. Consider we have a set of a spur, helical, worm, and bevel gears with pinion running at 1500 rpm for all four gear trains. Prepare a table comparing noise, vibration, temperature & efficiency. Which one will fail earlier and why? [3]

b. Design a helical gear for the following situation: [7]
Power to be transmitted: 10 kW
Speed of the gear: 1000 rpm
Pressure angle: 20 degrees
Helix angle: 30 degrees
Material: Steel (assume safe bending stress of 200 MPa)

2 a. Conduct a force analysis of the worm gear set to identify the components of tooth force acting on the worm gear set. [5]
Pitch diameter of the worm gear: 50 mm
Lead angle of the worm: 30 degrees
Normal pressure angle: 20 degrees
Coefficient of friction between worm and gear: 0.08
Applied torque on the worm: 100 Nm

b. Design a shaft and square key for the above condition. Do consider the effect of keyway in the shaft. You may use Commercial cold rolled steel for the shaft and key. [5]

3 a. Considering the shaft diameter and key dimensions from above (question no 2.b), design a sleeve coupling and check if the material with safe shearing stress of 70 N/mm^2 and ultimate shearing stress of 140 N/mm^2 can operate safely. [5]

b. The designed system of gear, shaft, and key as designed above were coupled to the motor using a coupling. But after running it for some time, frequent wear or failure of coupling, bearing and mechanical seals were observed. Increased power consumption along with excessive noise and vibration during operation were also experienced. What could have been the issue? Express your views along with proposed solution and justification for your proposed solution. [3]

c. Someone from the design team in this industry suggested adding a flywheel to this system. Can you explain the significance of a flywheel in this type of mechanical systems? [2]

4 a. Design a plate clutch for a power transmission application. The clutch needs to transmit a torque of 500 Nm at a speed of 1200 rpm. The coefficient of friction between the plates is 0.4, and the allowable pressure between the plates is 1 MPa. The inner and outer radii of the clutch plates are 60 mm and 120 mm, respectively. Determine the number of clutch plates required and calculate the axial force and the power capacity of the clutch. [4]
You are required to show all the calculations and assumptions made during the design process.

b. A differential band brake is used to stop a rotating drum with a radius of 0.5 meters. The coefficient of friction between the band and drum is 0.3. The width of the band is 100 mm. Calculate the braking force required to bring the drum to a stop if the torque acting on the drum is 500 Nm. [4]
Note: Assume uniform pressure distribution, neglect the effect of drum deformation, and consider the coefficient of friction as constant.
You are required to show all the calculations and assumptions made during the numerical solution.

c. Considering above brake is to be used in construction equipment, explain the method that you would use to select the material for the brake liner. [2]