National University of Computer and Emerging Sciences
Lahore Campus

0092

Basic Mechanical Engineering (ME2001)

Date: June 1st 2024

Course Instructor(s)

1. Dr. Kashif Saeed
2. Mohsin Yousuf (CM)

Final Exam

Total Time (Hrs): 3
Total Marks: 50
Total Questions: 5

Q1	Q2	Q3	Q4	Q5
10	10	5	10	15

22L-7749 Roll No

4-C Section

Student Signature

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1. **Attempt all the questions, programmable calculators not allowed.**
2. **Attempt all parts of the same question together.**
3. **Show all the steps with the help of diagrams and answers with proper units.**
4. **In questions, hints are mentioned in *italic*.**

CLO # 01: Calculate the moment of a force/couple.

Q1: A bent bar is shown in Fig. 1. **Determine** the resultant moment at *A* by scalar formulation and **verify** by using vector formulation. **[10 marks]**

Remember to mention the support reaction at A in your FBD.

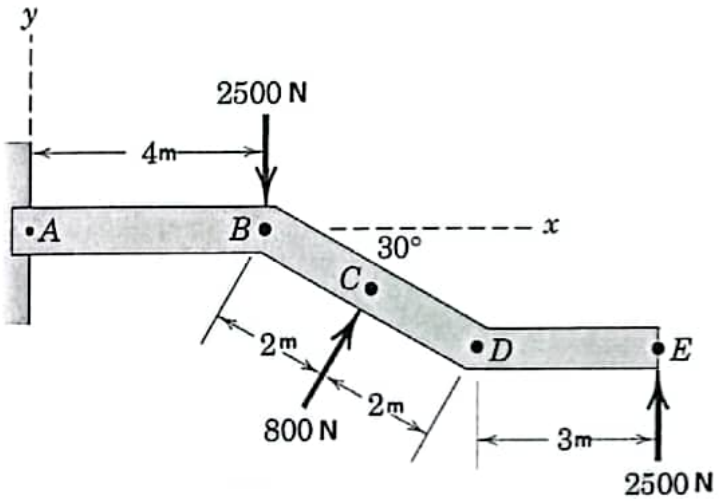

Figure 1. A Bent Bar

CLO # 02: Analyze static equilibrium analysis of a rigid body by applying Newton Laws of Motion and concept of dry friction.

Q2: The man exerts a force P on the car at an angle $\alpha = 20°$. The 1760-kg car has front wheel drive (FWD). The driver spins the front wheels, and the coefficient of kinetic friction is $\mu_k = 0.02$. Snow behind the rear tires exerts a horizontal resisting force S. Getting the car to move requires overcoming a resisting force $S = 420$ N. **Figure out** the force P, the man must exert. **[10 marks]**

The center of gravity point is at 1.62 m *from the rear tire as shown in Fig. 2. Remember to draw its FBD first.*

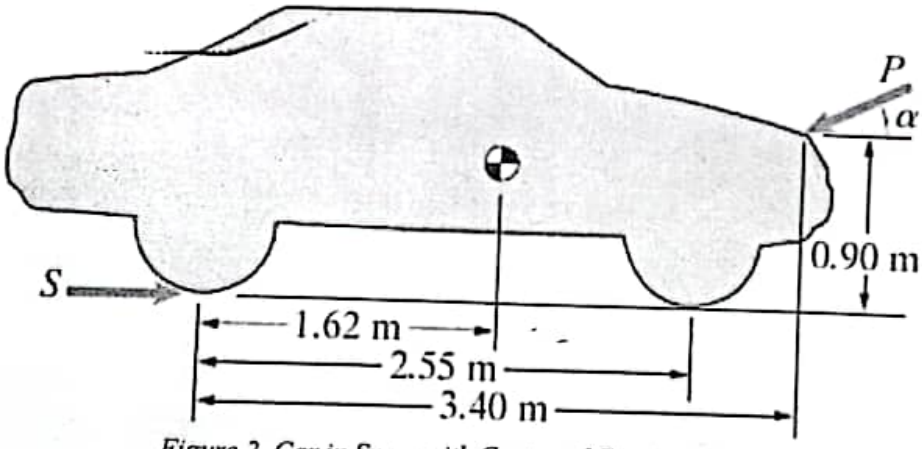

Figure 2. Car in Snow with Centre of Gravity point

CLO # 03: Analyze absolute motion of rigid bodies in general plane motion.

Q3: The slender bar AB in the Fig. 3 shown below is tied to a drum which is rotating with angular velocity ω_0. **Figure out** the angular velocity ω_{AB} of the slender bar as a function of the distance x and ω_0. **[5 marks]**

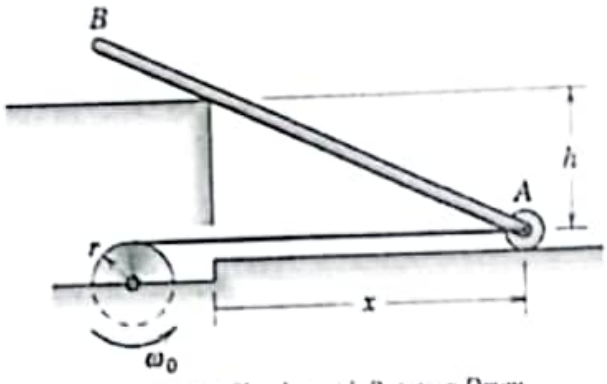

Figure 3. A Slender with Rotating Drum

CLO # 04: Analyze relative motion of rigid bodies in rotation and/or translation.

Q4: Two rotor blades of 800-mm radius rotate counterclockwise about the shaft at O mounted in the sliding block as shown in Fig. 4. The blade with point A completes 200 revolutions in one minute and has an angular acceleration of $3\ rad/s^2$. The block moves toward right-hand side with a velocity and acceleration of $4\ m/s$ and $5\ m/s^2$, respectively. **Figure out** the magnitude of the velocity and acceleration of the tip A of the blade when $\theta = 30°$. **[10 marks]**

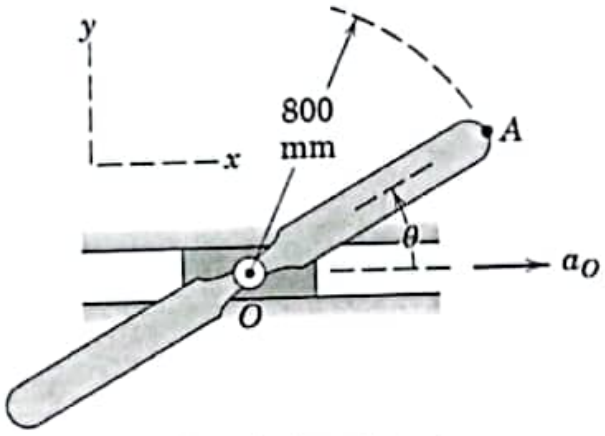

Figure 4. Rotating Blades

CLO # 05: Evaluate the internal forces in the members of a loaded truss and assess safety of the structure.

Q5: A plane truss is shown in the Fig. 5 below. Use the method of joints to **evaluate** the force supported by each member of the truss. **Verify** the force in member BD using method of sections. **[15 marks]**

There is pin at A and rocker support at E.

All members have a square cross-section having a perimeter of 20 cm. The ultimate tensile/compressive stress of the material used is $2N/mm^2$. **Comment** on the safety of the member BD.

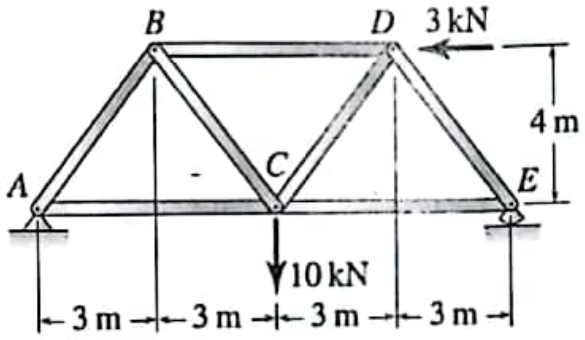

Figure 5. A Plane Truss