一、選擇題 40%

1. Resolve force vector \( F \) along \( x \) and \( y \) axes and write it in vector form. \( F = \{ \ \} \) N
   A) \( 80 \cos (30°) i - 80 \sin (30°) j \)
   B) \( 80 \sin (30°) i + 80 \cos (30°) j \)
   C) \( 80 \sin (30°) i - 80 \cos (30°) j \)
   D) \( 80 \cos (30°) i + 80 \sin (30°) j \)

   ![Fig. 1](image)

2. Find the dot product of the two vectors \( P \) and \( Q \).
   \( P = \{ 5i + 2j + 3k \} \) m
   \( Q = \{-2i + 5j + 4k \} \) m
   A) -12 m  
   B) 12 m  
   C) 12 m²  
   D) -12 m²  
   E) 10 m²

3. For a frictionless pulley and cable, tensions in the cable (\( T1 \) and \( T2 \))
   are related as _____ .
   A) \( T1 > T2 \)
   B) \( T1 = T2 \)
   C) \( T1 < T2 \)
   D) \( T1 = T2 \sin \theta \)

   ![Fig. 2](image)

4. In statics, a couple is defined as __________ separated by a perpendicular distance.
   A) two forces in the same direction.
   B) two forces of equal magnitude.
C) two forces of equal magnitude acting in the same direction.
D) two forces of equal magnitude acting in opposite directions.

5. If \( \mathbf{r} = \{ 5 \mathbf{j} \} \) m and \( \mathbf{F} = \{ 10 \mathbf{k} \} \) N, the moment \( \mathbf{r} \times \mathbf{F} \) equals \{ _______ \} N·m.
   A) 50 \( \mathbf{i} \)  B) 50 \( \mathbf{j} \)  C) –50 \( \mathbf{i} \)
   D) –50 \( \mathbf{j} \)  E) 0

6. Two points in 3 – D space have coordinates of P (1, 2, 3) and Q (4, 5, 6) meters. The position vector \( \mathbf{r}_{QP} \) (from Q to P) is given by
   A) \{3 \( \mathbf{i} \) + 3 \( \mathbf{j} \) + 3 \( \mathbf{k} \} \) m
   B) \{-3 \( \mathbf{i} \) – 3 \( \mathbf{j} \) – 3 \( \mathbf{k} \} \) m
   C) \{5 \( \mathbf{i} \) + 7 \( \mathbf{j} \) + 9 \( \mathbf{k} \} \) m
   D) \{-3 \( \mathbf{i} \) + 3 \( \mathbf{j} \) + 3 \( \mathbf{k} \} \) m
   E) \{4 \( \mathbf{i} \) + 5 \( \mathbf{j} \) + 6 \( \mathbf{k} \} \) m

7. 在 SI 單位系統下, 1MPa 代表
   (A) \( 10^6 \) N/ mm\(^2\)
   (B) \( 10^3 \) N/ m\(^2\)
   (C) 1 N/ m\(^2\)
   (D) 1 N/ mm\(^2\)

8. 下列有關材料比例限度 (proportional limit) 的敘述，何者錯誤？
   (A) 各種材料之比例限度皆相等
   (B) 在比例限度以下，應力與應變成正比關係
   (C) 材料之比例限度小於其降伏強度
   (D) 在比例限度以下，當受力物體之外力去除後，該物體可以完全恢復原狀

二、計算題 60%

1. The force \( \mathbf{F} = 450 \text{ lb} \) acts on the frame shown in Fig. 3. Resolve this force into components acting along members AB and AC, and determine the magnitude of each component.
2. The solid steel shaft shown in Fig. 4 has a diameter of 20 mm. If it is subjected to a torque at C, determine the reactions at the fixed supports A and B. 20%

![Fig. 4](image)

3. The Plate is deformed into the dashed shape shown in Fig. 5. If in this deformed shape horizontal lines on the plate remain horizontal and do not change their length, determine (a) the average normal strain along the side AB, (b) the average shear strain in the plate relative to the x and y axes.

![Fig. 5](image)