

國立中山大學九十三年度碩士班招生考試試題

科目：工程概論 機械所碩士在職專班

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一、工程數學部份 (單選題；每題 5 分，共 50 分)

- Which one is the solution of $y' + y = x^2 - 2$
 (A) $y = ce^{-x} + x^2 - 2x$ (B) $y = a \cos x + b \sin x$ (C) $y = e^x + ax^2 + bx + c$ (D) $y = e^{-x}(a \cos x + b \sin x)$
 (E) None
- Which one is the solution of $y'' = e^x$
 (A) $y = ce^{-x} + x^2 - 2x$ (B) $y = a \cos x + b \sin x$ (C) $y = e^x + ax^2 + bx + c$ (D) $y = e^{-x}(a \cos x + b \sin x)$
 (E) None
- Which one in the following differential equations is the nonhomogeneous equation?
 (A) $(1-x^2)y'' - 2xy' + 6y = 0$ (B) $y'' - y = 0$ (C) $y'' + 4y = e^{-x} \sin x$ (D) $x(y''y + y'^2) + 2y'y = 0$ (E) None
- Which one in the following differential equations is nonlinear?
 (A) $(1-x^2)y'' - 2xy' + 6y = 0$ (B) $y'' - y = 0$ (C) $y'' + 4y = e^{-x} \sin x$ (D) $x(y''y + y'^2) + 2y'y = 0$ (E) None
- Which one is the solution of the initial value problem $y'' - y = 0$ with $y(0) = 4$ and $y'(0) = -2$?
 (A) $y = 3x^2 - 2x + 4$ (B) $y = e^x + 3e^{-x}$ (C) $y = 2e^{2x} - \sin x + 2$ (D) $y = 4e^{2x} - 2 \sin x + 2x^2$ (E) None
- If matrices A and B are defined as $A = \begin{bmatrix} 9 & 3 \\ -2 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -4 \\ 2 & 5 \end{bmatrix}$, then the product $C = AB$ is
 (A) $\begin{bmatrix} 15 & -21 \\ -2 & 8 \end{bmatrix}$ (B) $\begin{bmatrix} 15 & -2 \\ -21 & 8 \end{bmatrix}$ (C) $\begin{bmatrix} -15 & 2 \\ -21 & -8 \end{bmatrix}$ (D) $\begin{bmatrix} 15 & -21 \\ 21 & 18 \end{bmatrix}$ (E) None
- If matrices A and B are defined as $A = \begin{bmatrix} 9 & 3 \\ -2 & 0 \end{bmatrix}$, $B = \begin{bmatrix} 1 & -4 \\ 2 & 5 \end{bmatrix}$ and $C = \begin{bmatrix} 2 \\ 1 \end{bmatrix}$, then the product $C = -A^T B C$ is
 (A) $\begin{bmatrix} -21 \\ 8 \end{bmatrix}$ (B) $\begin{bmatrix} 21 \\ 8 \end{bmatrix}$ (C) $\begin{bmatrix} 21 \\ 6 \end{bmatrix}$ (D) $\begin{bmatrix} 36 \\ 6 \end{bmatrix}$ (E) None
- Which one is the eigen value solution pair of the matrix $A = \begin{bmatrix} -40 & 40 \\ -16 & 12 \end{bmatrix}$?
 (A) $(\lambda_1 = 2; \lambda_2 = 4)$ (B) $(\lambda_1 = -2; \lambda_2 = -0.8)$ (C) $(\lambda_1 = -2; \lambda_2 = -4)$ (D) $(\lambda_1 = 2; \lambda_2 = 0.8)$ (E) None
- Consider A, B and C are $n \times n$ matrices, which one in the following matrix operations is wrong?
 (A) $(AC)^T = C^T A^T$ (B) $B(AB)^{-1} = A^{-1}$ (C) $(AC)^{-1} = A^{-1} C^{-1}$ (D) in general, $AB \neq BA$ (E) None
- Let $v(x, y, z) = 3xz\mathbf{i} + 2xy\mathbf{j} - yz^2\mathbf{k}$ be a differentiable vector function, then the divergence of the vector $\nabla \cdot v$ is
 (A) $3z\mathbf{i} + 2x\mathbf{j} - 2yz\mathbf{k}$ (B) $3z\mathbf{i} + 2x\mathbf{j} - yz^2\mathbf{k}$ (C) $3z + 2x - yz^2$ (D) $3z + 2x - 2yz$ (E) None

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工程力學部份 (單選題；每題 10 分，共 50 分)

1. 考慮點 $A(x, y, z)$ 在原點為 $O(0, 0, 0)$ 座標系之位置向量為 $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$ ，若在點 A 處受到一外力向量

$\vec{F} = F_x\vec{i} + F_y\vec{j} + F_z\vec{k}$ ，其產生的力矩可定義為 $\vec{M}_O = \vec{r} \times \vec{F}$ 。試問下列式子中何者為正確？

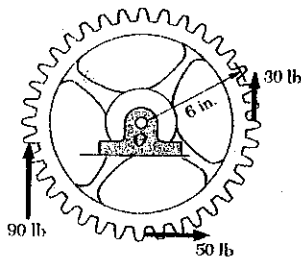
- (A) $\vec{M}_O = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ x & y & z \\ F_x & F_y & F_z \end{vmatrix}$ (B) $\vec{M}_O = xF_x + yF_y + zF_z$ (C) $\vec{M}_O = xF_x\vec{i} + yF_y\vec{j} + zF_z\vec{k}$ (D) $\vec{M}_O = 0$ (E) 以上皆非

2. Determine the moment about the origin O of the force $\vec{F} = 4\vec{i} + 10\vec{j} + 6\vec{k}$ which acts at a point A . Assume that the position vector of A is $\vec{r} = 2\vec{i} - 3\vec{j} + 4\vec{k}$.

- (A) $\vec{M}_O = -58\vec{i} + 4\vec{j} + 32\vec{k}$ (B) $\vec{M}_O = 8\vec{i} - 30\vec{j} + 24\vec{k}$ (C) $\vec{M}_O = 12\vec{i} + 20\vec{j} - 24\vec{k}$ (D) $\vec{M}_O = 0$

(E) 以上皆非

3. The torque introduced by the three forces acting on the gear is



- (A) 60 in-lb (B) 1020 in-lb (C) 540 in-lb (D) 0 in-lb (E) 以上皆非

4. Consider a particle moving in a straight line, and assume that its position is defined by the equation $s = 6t^2 - t^3$ (m) where the time variable t is in second. The acceleration a at $t = 2$ second is

- (A) $a = 12 \text{ m/sec}^2$ (B) $a = 0 \text{ m/sec}^2$ (C) $a = -12 \text{ m/sec}^2$ (D) $a = 9.80 \text{ m/sec}^2$ (E) None

5. The three dimensional motion of a particle is defined by the position vector

$\vec{r} = c\vec{i} + (R + \sin pt)\vec{j} + (R + \cos pt)\vec{k}$ The magnitude of the acceleration a of the particle is

- (A) $a = Rp\sqrt{c^2t + R^2p^2t^2}$ (B) $a = \sqrt{c^2t + R^2p^2}$ (C) $a = Rp^2$ (D) $a = 0$ (E) None