A : ENGINEERING MATHEMATICS (COMPULSORY)

Q. 1 – Q. 7 carry one mark each.

Q.1 Considering the matrix

$$\begin{pmatrix} 0 & -1 & 2 \\ 1 & 0 & 3 \\ -2 & -3 & 0 \end{pmatrix}$$

which one of the following statements is **INCORRECT**?

(A) One of its eigenvalues is zero.
(B) It has two purely imaginary eigenvalues.
(C) It has a non-zero real eigenvalue.
(D) The sum of its eigenvalues is zero.

Q.2 The value of x where the function $f(x) = \sin(x) + \cos(x)$, defined over the domain $0 \le x \le 2\pi$, attains a minimum is

Q.3 The radius of convergence of the following power series is

$$\sum_{n=0}^{\infty} \frac{(x-3)^n}{3^n n!}$$

(A) zero (B) 1 (C) 3 (D) ∞

Q.4 For a complex number k and a complex variable z, the complex function $(z+k)^2$ is analytic

(A) for all k.
(B) only for all k whose imaginary component is zero.
(C) only for all k whose real component is zero.
(D) only when k is zero.

Q.5 The divergence of a vector field $\vec{v}(x,y,z) = 2^x\,\vec{i} + 2^y\,\vec{j} + 2^z\,\vec{k}$ at a point (1,1,1) is

Q.6 The type of the differential equation $(1-x)\frac{d^3y}{dx^3} - \sqrt{1+\left(\frac{dy}{dx}\right)^2} + 5y = \cos(x)$ is

(A) linear and first order.
(B) non-linear and first order.
(C) linear and third order.
(D) non-linear and third order.

Q.7 A box has ten light bulbs out of which two are defective. Two light bulbs are drawn from this box one after the other without replacement. The probability that both light bulbs drawn are **NOT DEFECTIVE** is

(A) $\frac{8}{45}$ (B) $\frac{28}{45}$ (C) $\frac{16}{25}$ (D) $\frac{4}{5}$

Q. 8 – Q. 11 carry two marks each.

Q.8 The value of the following limit is

$$\lim_{x\to\infty}\left(\frac{x-\sin(x)}{x+\sin(x)}+\frac{\ln x}{x}\right)$$

(A) zero (B) 1 (C) 2 (D) ∞

Q.9 The value of the Fourier coefficient, A_0, in the series $\left\{A_0+\sum_{n=1}^{\infty}(a_n\cos(nx)+b_n\sin(nx)\right\}$ of a function $f(x)=x^2$ with a period 2π defined over an interval $0\le x\le 2\pi$ is

(A) $\frac{4\pi^2}{3}$ (B) $\frac{2\pi^2}{3}$ (C) $\frac{\pi^2}{3}$ (D) $\frac{\pi^2}{6}$

Q.10 The general solution, $y(x)$, for the differential equation $x\frac{d^2y}{dx^2}-\frac{dy}{dx}-1=0$ is (c_1 and c_2 are real constants)

(A) $c_1\frac{x^2}{2}+2x+c_2$ (B) $c_1\frac{x^2}{2}-x+c_2$

(C) $c_1\frac{x^2}{2}+x+c_2$ (D) $c_1\frac{x^2}{2}-2x+c_2$

Q.11 The minimum number of iterations required to evaluate $\sqrt{28}$, correct up to three decimal places, by the Newton-Raphson method with an initial guess of 5 is

END OF THE QUESTION PAPER