ROLL NO. _____

Code: DE55/DC55 **Subject: ENGINEERING MATHEMATICS - II**

DipIETE – ET/CS (Current Scheme)

Time: 3 Hours **December 2016** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: **(2×10)**

a. $\lim_{x\to 0}\left(\frac{1}{\sin x}-\frac{1}{x}\right)=$

(A) 1 **(B)** 0
(C) ∞ **(D)** -1

b. $\int_0^{\frac{\pi}{2}} \sin^2\theta\cos^3\theta\, d\theta =$

(A) 0 **(B)** π
(C) 2/15 **(D)** 5π

c. The modulus of -4-3i is

(A) 1 **(B)** 5
(C) 7 **(D)** 4+3i

d. If two vectors $2\vec{i}+3\vec{j}-4\vec{k}$ and $\vec{i}+2\vec{j}+a\vec{k}$ are perpendicular then *a* is equal to

(A) 0 **(B)**-2
(C) 2 **(D)** 8

e. The solution of $\frac{d^2y}{dx^2}+4\frac{dy}{dx}+y=0$ is

(A) $Ae^{(-2+\sqrt{3})x}+Be^{(-2-\sqrt{3})x}$ **(B)** $e^{-2x}(A\cos\sqrt{3}x+B\sin\sqrt{3}x)$
(C) $Ae^{-2x}+Be^{(\sqrt{3})x}$ **(D)** $e^{-2x}(A\cos\sqrt{3}x-B\sin\sqrt{3}x)$

f. If $f(x)=\begin{cases}-\pi, & -\pi<x<0\\ x, & 0<x<\pi.\end{cases}$ then f(0) =

(A) –π **(B)** 0
(C) $-\frac{\pi}{2}$ **(D)** π

g. A periodic function is given by a function which

(A) has a period T=2π **(B)** satisfies f(t+T)=f(t)

(C) has a period T=π **(D)** satisfies f(t+T)= -f(t)

h. $\int_0^\infty te^{-3t}sint\ dt =$

(A) 0 **(B)** ∞

(C) 3 **(D)** 3/50

i. $L^{-1}\left[\frac{1}{s-a}\right] =$

(A) e^{at} **(B)** e^{-at}

(C) $\sin at$ **(D)** $\cos at$

j. Which one of the following function is an even function?

(A) sinx **(B)** x^3

(C) xsinx **(D)** xcosx

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Verify Lagrange's Mean value theorem for the function $f(x) = (x-1)(x-2)(x-3)$ in (0,4) and find the appropriate value of c. **(8)**

b. Expand $\log_e x$ in powers of $(x-1)$ and hence evaluate $\log_e 1.1$ correct to 4 decimal places. **(8)**

Q.3 a. Find the entire length of the cardioid $r = a(1+\cos\theta)$. **(8)**

b. Find the surface area of the solid generated by the revolution of the astroid $x = a\cos^3 t, y = a\sin^3 t$, about the y-axis. **(8)**

Q.4 a. Find the real values of x, y so that $-3 + ix^2y$ and $x^2 + y + 4i$ may represent complex conjugate numbers. **(8)**

b. If $2\cos\theta = x + \frac{1}{x}$, prove that $\frac{x^{2n}+1}{x^{2n-1}+x} = \frac{\cos n\theta}{\cos(n-1)\theta}$. **(8)**

Q.5 a. Solve $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 8(e^{2x} + \sin 2x + x^2)$. **(8)**

b. A simple pendulum of length l is oscillating through a small angle θ in a medium in which the resistance is proportional to the velocity. Find the differential equation of its motion. Discuss the motion and find the period of oscillation. **(8)**

Q.6 a. Expand $f(x) = xsinx$ as a Fourier series in the interval $0 < x < 2\pi$. **(8)**

b. Obtain the first three coefficients in the Fourier cosine series for *y*, where *y* is given in the following table: **(8)**

x	0	1	2	3	4	5
y	4	8	15	7	6	2

Q.7 a. Find the Laplace transform of $\frac{\cos at - \cos bt}{t}$. **(8)**

b. Find the Laplace transform of the function **(8)**

$$f(x) = \begin{cases} \sin \omega t, & 0 < t < \frac{\pi}{\omega} \\ 0, & \frac{\pi}{\omega} < t < \frac{2\pi}{\omega}. \end{cases}$$

Q.8 a. Apply Convolution theorem to evaluate $L^{-1}\left(\frac{s}{(s^2+a^2)^2}\right)$. **(8)**

b. Use transform method to solve $\frac{d^2x}{dt^2} + 9x = \cos 2t$, if $x(0) = 1, x\left(\frac{\pi}{2}\right) = -1$. **(8)**

Q.9 a. Constant forces $P = 2I - 5J + K$ and $Q = -I + 2J - K$ act on a particle. Determine the work done when the particle is displaced from A to B, the position vectors of A and B being $4I - 3J - 2K$ and $6I + J - 3K$ respectively. **(8)**

b. A rigid body is spinning with angular velocity 27 radians per second about an axis parallel to $2I + J - 2K$ passing through the point $I + 3J - K$. Find the velocity of the point of the body whose position vector is $4I + 8J + K$. **(8)**