ROLL NO. ____________________

Code: DE105/DC105 **Subject: ENGINEERING MATHEMATICS II**

DipIETE – ET/CS (New Scheme)

Time: 3 Hours **JUNE 2018** **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. If $f(x) = x^3 + x,\ a = 0,\ b = 1$, and $\frac{f(b)-f(a)}{b-a} = f(c),\ a < c < b$ then 'c' is equal to :

(A) $-\frac{1}{\sqrt{3}}$ **(B)** $\sqrt{3}$

(C) $-\sqrt{3}$ **(D)** $\frac{1}{\sqrt{3}}$

b. The value of $\int_0^{\pi/2} cos^7 x\, dx$ is equal to :

(A) $\frac{16}{35}$ **(B)** $\frac{8}{35}$

(C) $-\frac{16}{35}$ **(D)** $\frac{32}{35}$

c. If $Z_1 = (2+3i)$ and $Z_2 = (3-2i)$ be two complex numbers, then $\overline{\left(\frac{Z_1}{Z_2}\right)}$ is equal to

(A) $\frac{12i}{13}$ **(B)** $-i$

(C) i **(D)** $\frac{-12i}{13}$

d. If $\vec{a} = (2\hat{i} + \hat{j} + \hat{k})$ and $\vec{b} = (\hat{i} - 2\hat{j} + 2\hat{k})$ be two vectors, then unit vector perpendicular to both $\vec{a}$ and $\vec{b}$ is equal to:

(A) $\left[\frac{4\hat{i} - 3\hat{j} + 5\hat{k}}{5\sqrt{2}}\right]$ **(B)** $\left[\frac{4\hat{i} + 3\hat{j} - 5\hat{k}}{5\sqrt{2}}\right]$

(C) $\left[\frac{4\hat{i} - 3\hat{j} - 5\hat{k}}{5\sqrt{2}}\right]$ **(D)** $\left[-\frac{4\hat{i} - 3\hat{j} - 5\hat{k}}{5\sqrt{2}}\right]$

e. The solution of differential equation $\left(D^2+4\right)y=\cos 2x$ is:

(A) $y=c_1\cos 2x+c_2\sin 2x+\dfrac{x}{4}\cos 2x$

(B) $y=c_1\cos 2x+c_2\sin 2x+\dfrac{x}{4}\sin 2x$

(C) $y=c_1\cos 2x+c_2\sin 2x-\dfrac{x}{4}\sin 2x$

(D) $y=c_1\cos 2x+c_2\sin 2x-\dfrac{x}{4}\cos 2x$

f. The series:

$1+\dfrac{1}{1!}+\dfrac{1}{2!}+\dfrac{1}{3!}+\cdots\ \cdots+\dfrac{1}{(\mathrm{n}-1)!}+\cdots$ is

(A) Convergent **(B)** Divergent
(C) Oscillatory **(D)** Conditional divergence

g. The Laplace Transform of $\left(e^t.\sin 4t\right)$ is :

(A) $\dfrac{4}{s^2-2s+15}$ **(B)** $\dfrac{4}{s^2-2s+17}$

(C) $\dfrac{-4}{s^2+2s+17}$ **(D)** $\dfrac{4}{s^2+2s-15}$

h. If $\vec{a}=\left(\hat{i}-2\hat{j}\right)$; $\vec{b}=\left(\hat{i}+2\hat{j}-4\hat{k}\right)$ and $\vec{c}=\left(2\hat{i}-3\hat{j}\right)$ then value of $\vec{a}\cdot\left(\vec{b}\times\vec{c}\right)$ is equal to:

(A) –4 **(B)** –3
(C) 3 **(D)** 4

i. The inverse Laplace transform of $\left[\dfrac{1}{s^2-5s+6}\right]$ is equal to:

(A) $(e^{3t}+e^{2t})$ **(B)** $(-e^{3t}-e^{2t})$
(C) $(-e^{3t}+e^{2t})$ **(D)** $(-e^{2t}+e^{3t})$

j. For $n\in N$ and $i=\sqrt{-1}$,

$\left(\dfrac{\cos nx+i\sin nx}{\cos nx-i\sin nx}\right)$ is equal to:

(A) $\cos 2nx+i\sin 2nx$ **(B)** $\cos 2nx-i\sin 2nx$
(C) $\sin 2nx+i\cos 2nx$ **(D)** $\sin 2nx-i\cos 2nx$

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

Q.2 a. Expand $\log(1+e^x)$ in ascending powers of 'x' as far as the term containing x^4 by using Maclaurin's Theorem. **(8)**

b. Evaluate: $\lim\limits_{x\to 0}\left[\frac{1}{x}-\frac{1}{x^2}\log(1+x)\right]$ **(8)**

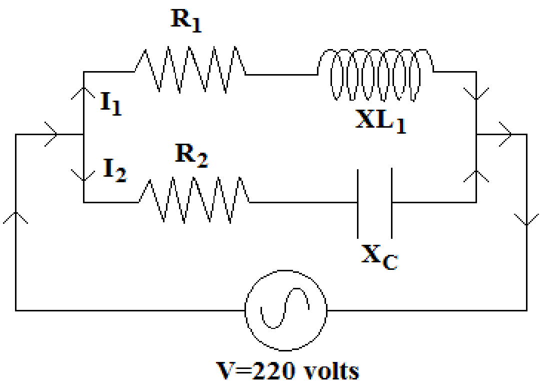
Q.3 a. Evaluate $\int_0^{\pi/2} \sin^3 x \cos^4 x \, dx$ by using "Reduction Formula". **(8)**

b. The area bounded by the parabola $y^2 = 4x$ and the straight line $4x-3y+2=0$ is rotated about y-axis. Find the volume of solid so formed. **(8)**

Q.4 a. If 'n' is a positive integer, then show that: **(8)**

$$\left[\frac{1+\cos\theta+i\sin\theta}{1+\cos\theta-i\sin\theta}\right]^n = \cos n\theta + i\sin n\theta$$

b. A coil of resistance of 4 ohms and inductive resistance of 42 ohms is connected in parallel with a resistance of 15 ohms and capacitive reactance of 18 ohms. This parallel circuit is connected across 220 volts mains as shown in figure, belwo. Find (i) current taken by each circuit (ii) total current. **(8)**



Q.5 a. If $\vec{a}=\left(a_1\hat{i}+a_2\hat{j}+a_3\hat{k}\right)$; $\vec{b}=\left(b_1\hat{i}+b_2\hat{j}+b_3\hat{k}\right)$ and $\vec{c}=\left(c_1\hat{i}+c_2\hat{j}+c_3\hat{k}\right)$, then show that: **(8)**

$$\vec{a}\cdot\left(\vec{b}\times\vec{c}\right)=\begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$$

b. The point of application of the force $\left(\vec{F}\right)=5\hat{i}+10\hat{j}+\hat{k}$ is displaced from the point A(2,1,3) to the point B(4,0,-5), find work done by the force $\left(\vec{F}\right)$. **(8)**

Q.6 a. Solve differential equation: **(8)**
$D^2 y - 2Dy + 3y = x + \cos x$

b. An inductance of 2 henries and a resistance of 20 ohms are connected in series with an e.m.f. $100 \sin 150t$. If the current is zero, when $t = 0$, find the current at the end of 0.01 sec. **(8)**

Q.7 a. Test the convergence of the series **(8)**
$$\sum_{n=1}^{\infty} \left[\sqrt{\left(\frac{n}{n+1} \right)} \right] x^n$$

b. Test the convergence of the series **(8)**
$$\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} + \dots \dots$$

Q.8 Find Laplace transform of following: **(8+8)**
a. $f(t) = \sin^2 t$

b. $f(t) = \left(\frac{\sin t}{t} \right)$

Q.9 a. Find inverse Laplace transform of **(8)**
$$\left[\frac{s}{(s+3)^2 + 4} \right]$$

b. Using Laplace transform, find solution of initial value problem: **(8)**
$y'' + 9y = 6\cos 3x$; $y(0) = 2$, $y'(0) = 0$