**ROLL NO. ____________________**

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

# DipIETE – ET/CS (New 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.**

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

a. $\lim\limits_{x \to 0}\left\{\dfrac{\log(1-x^2)}{\log\cos x}\right\}$ is equal to:

**(A)** $\dfrac{1}{2}$ **(B)** $-2$

**(C)** 2 **(D)** $-\dfrac{1}{2}$

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

**(A)** $\dfrac{15}{35}$ **(B)** $\dfrac{34}{37}$

**(C)** $\dfrac{16}{35}$ **(D)** $\dfrac{17}{33}$

c. If $z_1 = 1 + i$, $z_2 = 2 + i$, and $z_3 = 3 + i$ then $z_1 \cdot z_2 \cdot z_3$ is equal to

**(A)** $\left(\dfrac{18}{25}\right)+\left(\dfrac{1}{25}\right)i$ **(B)** $\left(\dfrac{1}{25}\right)+\left(\dfrac{18}{25}\right)i$

**(C)** $\left(\dfrac{18}{25}\right)-\left(\dfrac{1}{25}\right)i$ **(D)** $\left(\dfrac{1}{25}\right)-\left(\dfrac{18}{25}\right)i$

d. If $\vec{a} = 2\hat{i} - \hat{j} + \hat{k}$, $\vec{b} = 3\hat{i} + 4\hat{j} - \hat{k}$ then unit vector perpendicular to $\vec{a}$ and $\vec{b}$ is

**(A)** $\dfrac{(3\hat{i} - 5\hat{j} + 11\hat{k})}{\sqrt{155}}$ **(B)** $\dfrac{(3\hat{i} + 5\hat{j} - 11\hat{k})}{\sqrt{155}}$

**(C)** $\dfrac{(-3\hat{i} + 5\hat{j} + 11\hat{k})}{\sqrt{155}}$ **(D)** $\dfrac{(-3\hat{i} - 5\hat{j} + 11\hat{k})}{\sqrt{155}}$

e. The volume of parallelopiped whose edges are $\vec{a} = \left(2\hat{i} - 3\hat{j} + 4\hat{k}\right)$; $\vec{b} = \left(\hat{i} + 2\hat{j} - \hat{k}\right)$ and $\vec{c} = \left(3\hat{i} - \hat{j} + 2\hat{k}\right)$ is

**(A)** 6 **(B)** 7
**(C)** 8 **(D)** 5

f. Solution of differential equation $D^2y - 8Dy + 15y = 0$ is equal to

**(A)** $y = C_1 e^{3x} + C_2 e^{5x}$ **(B)** $y = C_1 e^{3x} + C_2 e^{-5x}$

**(C)** $y = C_1 e^{-3x} + C_2 e^{5x}$ **(D)** $y = C_1 e^{-3x} + C_2 e^{-5x}$

g. The series $\left(\frac{1}{2^2} + \frac{1}{5^2} + \frac{1}{8^2} + \cdots \cdots\right)$ is

**(A)** Convergent **(B)** Divergent
**(C)** Oscillatory **(D)** None of these

h. The Laplace Transform of $\left(5\cos^3 2t\right)$ is equal to :

**(A)** $\frac{5s(s^2+28)}{(s^2+4)(s^2+36)}$ **(B)** $\frac{25(s^2-28)}{(s^2+4)(s^2-36)}$

**(C)** $\frac{5s(s^2-28)}{(s^2+4)(s^2+36)}$ **(D)** $\frac{5s(s^2-28)}{(s^2-4)(s^2-36)}$

i. $L^{-1}\left[\frac{1}{(s+1)(s+2)}\right]$ is equal to:

**(A)** $\left(e^{-t} + e^{-2t}\right)$ **(B)** $\left(-e^{-t} + e^{-2t}\right)$

**(C)** $\left(e^{-t} - e^{-2t}\right)$ **(D)** $\left(-e^{-t} - e^{-2t}\right)$

j. Maclaurian Series for $f(x) = \frac{e^{x} + e^{-x}}{2}$ is equal to :

**(A)** $1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} \cdots \cdots$ **(B)** $1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} \cdots \cdots$

**(C)** $\frac{x}{1!} + \frac{x^3}{3!} + \frac{x^5}{5!} \cdots \cdots$ **(D)** None

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

**Q.2** a. Expand $f(x) = \sin x$ in powers of $\left(x - \pi/2\right)$. **(8)**

b. Evaluate: $\lim_{x \to \pi/2}\left[\sec x - \tan x\right]$. **(8)**

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

b. Find area of Ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ for a > b. **(8)**

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

$$(1+i)^n + (1-i)^n = (2)^{\frac{n+2}{2}} \cos\left(\frac{n\pi}{4}\right)$$

b. Two impedances $z_1 = (10 - j60)$ and $z_2 = (10 + j20)$ are connected in parallel across 200 volts A.C. supply. Calculate Current in each branch and power consumed in each branch. **(8)**

**Q.5** a. Forces $\vec{F_1} = (2\hat{i} + 7\hat{j})$; $\vec{F_2} = (2\hat{i} - 5\hat{j} + 6\hat{k})$ and $\vec{F_3} = (-\hat{i} + 2\hat{j} - \hat{k})$ act on a point 'P' whose position vector is $(4\hat{i} - 3\hat{j} - 2\hat{k})$. Find vector moment of the resultant of three forces acting on 'P' about the point Q, whose position vector is $(6\hat{i} + \hat{j} - 3\hat{k})$. **(8)**

b. Show that four points whose position vectors are $(3\hat{i} - 2\hat{j} + 4\hat{k})$, $(6\hat{i} + 3\hat{j} + \hat{k})$, $(5\hat{i} + 7\hat{j} + 3\hat{k})$ and $(2\hat{i} + 2\hat{j} + 6\hat{k})$ are coplanar. **(8)**

**Q.6** a. Solve diff. equation: **(8)**

$$D^2 y - 5Dy + 6y = e^x$$

b. A constant E.M.F., E volts is applied to a circuit containing a constant resistance 'R' ohms in series and a constant inductance 'L' henries. If the initial current is zero show that the current builds up to half its theoretical maximum in $\left(\frac{L \log 2}{R}\right)$ seconds. **(8)**

**Q.7** Test for convergence of series given below: **(8+8)**

a. $\sum \left[\frac{1}{2n(2n-1)}\right]$

b. $1 - \frac{1}{3^2} + \frac{1}{5^2} - \frac{1}{7^2} + \cdots \cdots$

**Q.8** Find Laplace Transform of following functions: **(8+8)**

a. $f(t) = e^{-t} \cos t \cos 2t$

b. $f(t) = t^2 \sin at$

**Q.9** a. Find inverse Laplace Transform of $\frac{s+6}{(s+1)(s^2-4)}$ **(8)**

b. Use convolution theorem to show that **(8)**

$$L^{-1}\left[\frac{s^2}{(s^2+p^2)(s^2+q^2)}\right] = \frac{p \sin pt - q \sin qt}{p^2 - q^2}$$