

Code: DE55 / DC55

Subject: ENGINEERING MATHEMATICS

DiplETE - ET/CS

Time: 3 Hours

JUNE 2013

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. The value of  $\lim_{x \rightarrow 0} \left(\frac{1}{x}\right)^{\tan x}$  is:

- (A) -1 (B) 0  
(C) 1 (D) 2

b. The value of  $\int_0^{\pi/2} \sin^6 x \cos^4 x \, dx$  is:

- (A)  $\frac{3\pi}{512}$  (B)  $\frac{\pi}{128}$   
(C)  $\frac{-\pi}{128}$  (D)  $\frac{-3\pi}{512}$

c. The multiplicative inverse of  $3-4i$  is:

- (A)  $\frac{4}{25} + \frac{3}{25}i$  (B)  $\frac{3}{25} - \frac{4}{25}i$   
(C)  $\frac{3}{25} + \frac{4}{25}i$  (D)  $\frac{4}{25} - \frac{3}{25}i$

d. The area of the parallelogram formed by the vectors  $\vec{a} = 3\hat{i} + 2\hat{j}$ ,  $\vec{b} = 2\hat{j} - 4\hat{k}$  is:

- (A)  $4\sqrt{61}$  sq units (B)  $2\sqrt{61}$  sq units  
(C)  $3\sqrt{61}$  sq units (D)  $\sqrt{61}$  sq units

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e. The value of  $\lambda$  such that the vectors  $\vec{a} = \lambda\hat{i} + 2\hat{j} + \hat{k}$ ,  $\vec{b} = 5\hat{i} - 9\hat{j} + 2\hat{k}$  are perpendicular to each other is:

- (A)  $\frac{5}{16}$  (B)  $\frac{5}{24}$   
 (C)  $\frac{-5}{16}$  (D)  $\frac{16}{5}$

f. If  $\frac{d^2y}{dx^2} - y = 2 + 3x$ , then C.F. is:

- (A)  $C_1e^x + C_2e^{-x}$  (B)  $C_1 \cos x + C_2 \sin 3x$   
 (C)  $e^x(C_1 \cos x + C_2 \sin x)$  (D)  $C_1e^x + C_2e^{2x}$

g. If  $f(x) = x$ , as a Fourier series in the interval  $[-\pi, \pi]$  then the value of  $a_0$  is:

- (A) -1 (B) 2  
 (C) 0 (D) 3

h. Value of  $L[5\sin 2t - 3\cos 2t]$  is:

- (A)  $\frac{3s-10}{s^2+4}, s > 0$  (B)  $\frac{10-3s}{s^2+4}, s > 0$   
 (C)  $\frac{5s+6}{s^2+4}, s > 0$  (D)  $\frac{6-5s}{s^2+4}, s > 0$

i. Value of  $L[e^{3t} \sin 4t]$  is:

- (A)  $\frac{4}{s^2-6s+25}$  (B)  $\frac{4}{s^2+6s+25}$   
 (C)  $\frac{4}{s^2-6s+9}$  (D)  $\frac{4}{s^2+6s+9}$

j. The value of  $L^{-1}\left[\frac{4s+15}{16s^2-25}\right]$  is:

- (A)  $\frac{1}{4} \cosh\left(\frac{5}{4}t\right) + \sinh\left(\frac{4}{5}t\right)$  (B)  $\cosh\left(\frac{4}{5}t\right) + \sinh\left(\frac{4}{5}t\right)$   
 (C)  $\frac{1}{4} \cosh\left(\frac{5}{4}t\right) + \frac{3}{4} \sinh\left(\frac{5}{4}t\right)$  (D)  $\cosh\left(\frac{5}{4}t\right) - \frac{3}{4} \sinh\left(\frac{5}{4}t\right)$

Answer any FIVE Questions out of EIGHT Questions.

Each question carries 16 marks.

Q.2 a. Evaluate  $\lim_{x \rightarrow 0} \frac{\log \sin 2x}{\log \sin x}$  (8)

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b. Expand  $\cos x$  in powers of  $(x - \pi/4)$  upto 4 terms (using Taylor's Expansion).

**Q.3** a. Evaluate  $\int_0^{2a} x^2 \sqrt{2ax - x^2} dx$ . (8)

b. Find the volume generated by revolving the ellipse  $\frac{x^2}{16} + \frac{y^2}{9} = 1$  about the x-axis. (8)

**Q.4** a. If  $x + iy = \sqrt{\frac{a+ib}{c+id}}$ , prove that  $(x^2 + y^2)^2 = \frac{a^2 + b^2}{c^2 + d^2}$ . (8)

b. Prove that

$$(1+i)^n + (1-i)^n = 2^{(n/2)+1} \cos\left(\frac{n\pi}{4}\right) \quad (8)$$

**Q.5** a. What is the unit vector perpendicular to each of the vectors  $2\hat{i} - \hat{j} + \hat{k}$  &  $3\hat{i} + 4\hat{j} - \hat{k}$ ? Calculate the sine of the angle between these two vectors. (8)

b. A force is represented in magnitude and direction by the line joining the point A(1,-2,4) to the point B(5,2,3). Find its moment about the point (-2,3,5). (8)

**Q.6** a. Solve  $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = e^{3x}$  (8)

b. Solve  $\frac{d^2y}{dx^2} - \frac{dy}{dx} - 2y = 2x^2$ , given that  $y(0) = 0$  and  $y'(0) = 0$ . (8)

**Q.7** a. Obtain a Fourier series representation for  $f(x)$  where

$$f(x) = \left(\frac{\pi - x}{2}\right)^2, 0 < x < 2\pi. \quad (8)$$

b. Find the Fourier sine series which represents

$$f(x) = \pi - x \text{ in the interval } (0, \pi) \quad (8)$$

**Q.8** a. Find the Laplace transform of  $t^2 \cos at$  (8)

b. Find Laplace transform of  $\frac{1 - e^{2t}}{t}$  (8)

**Q.9** a. Find  $L^{-1} \left\{ \frac{3s + 9}{(s^2 + 2s + 10)} \right\}$  (8)

b. Use convolution theorem to find  $L^{-1} \left\{ \frac{1}{(s^2 - s - 2)} \right\}$  (8)