

[05 - 2102]

III/IV B.E. DEGREE EXAMINATION.

First Semester

ELECTRONICS AND COMMUNICATION
ENGINEERING

MATHEMATICS — III

(Common for all branches Except
Chemical Engineering and Bio-Technology
Common MSEEE)

(w.e.f. the admitted batch of 2004-2005 and
after batches)

Time : Three hours

Maximum : 70 marks

Answer Part A and Four questions from
Part B of Seven questions.

All questions carry equal marks.

Questions of Part A must be answered at one place.

PART A

- (a) If \bar{A} is a constant vector and $\bar{R} = x\bar{i} + y\bar{j} + z\bar{k}$ then find $\text{div}(\bar{A} \times \bar{R})$.

(b) Find the directional derivative of $2x^2y^2 + 5z$ at $(-1, 1, 2)$ in the direction $3\bar{i} - 2\bar{j} - \bar{k}$.

(c) What is meant by flux?

- (d) Form the partial differential equation by eliminating the arbitrary function from $z = y f(x) + x g(y)$.
- (e) Write down the assumptions for one dimensional wave equation.
- (f) Write down the Fourier sine and Fourier cosine integrals.
- (g) Write the relation between Fourier and Laplace transforms.

PART B

2. (a) Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point $(2, -1, 2)$.

- (b) Prove that

$$\operatorname{div}(\bar{A} \times \bar{B}) = \bar{B} \cdot \operatorname{curl} \bar{A} - \bar{A} \cdot \operatorname{curl} \bar{B}.$$

3. (a) Evaluate $\iint_S \bar{F} \cdot \bar{n} dS$ where

$\bar{F} = z i + x j - 3y^2 z k$ where S is the surface of the cylinder $x^2 + y^2 = 16$ in the first octant between $z = 0$ and $z = 5$.

- (b) Using Green's theorem show that

$$\int_C (x y^2 dy - x^2 y dx) = \frac{35}{16} \pi a^4 \text{ where}$$

$$C : r = a(1 - \cos \theta).$$

4. (a) Express the vector field $2y\mathbf{i} - z\mathbf{j} + 3x\mathbf{k}$ in spherical polar coordinate system.

(b) Solve $yzp + zxq = xy$.

5. (a) Solve $(D^2 + 3DD' + 2D'^2)z = x + y$.

(b) Solve $(D^2 - DD' + D' - 1)z = \cos(x + 2y)$.

6. An insulated rod of length L has its ends A and B maintained at 0°C and 100°C respectively until steady state conditions prevail. If B is suddenly reduced to 20°C and maintained at 20°C , find the temperature at a distance x from A at time t .

7. (a) Express the function $f(x) = \begin{cases} 1 & \text{for } |x| \leq 1, \\ 0 & \text{for } |x| > 1, \end{cases}$ as

a Fourier integral. Hence evaluate

$$\int_0^{\infty} \frac{\sin \lambda \cos \lambda x}{\lambda} d\lambda.$$

(b) Find the finite Fourier sine transform of $f(x) = 2x$, $0 < x < 4$.

8. (a) Find the Fourier cosine transform of e^{-x^2} .

(b) Using Parseval's identity show that

$$\int_0^{\infty} \frac{dt}{(t^2 + 1)^2} = \frac{\pi}{4}.$$