



Name :

Roll No. :

Invigilator's Signature :

**CS/B.Tech(ECE-NEW)/SEM-7/EC-704B/2009-10
2009**

**ADVANCED ENGINEERING MATHEMATICS FOR
ELECTRONIC ENGINEERING**

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$$10 \times 1 = 10$$

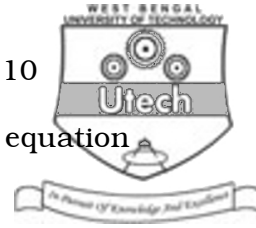
i) The value of $\int_{-1}^1 [P^n(x)]^2 dx$ is equal to

a) 0

b) $\frac{n}{2n+1}$

c) $\frac{n}{2n-1}$

d) $\frac{2}{2n+1}$.



ii) The solution to the partial differential equation

$$Z = px + qy + p^2 + q^2 \text{ is}$$

a) $Z = ax + by + a^2 + b^2$

b) $Z = ax + by$

c) $Z = ax + by + a^2 - b^2$

d) $Z = ax - by.$

iii) The product of the eigenvalues of a matrix A is equal to

a) the trace of A

b) the determinant of A

c) 1

d) 0.

iv) The determinant of a skew-symmetric matrix of even order is

a) 1

b) 0

c) perfect square

d) an odd number.

v) Let $A = \begin{bmatrix} \cos \theta & \sin \theta \\ -\sin \theta & \cos \theta \end{bmatrix}$. Then A is

a) orthogonal

b) symmetric

c) skew-symmetric

d) none of these.

a) Unitary b) Hermitian

c) Skew Hermitian d) Null.

a) 2

b) $n - 1$

c) n

d) none of these.

a) $A^2 - 6A + 9I$ b) $\frac{1}{4} A^2 - \frac{3}{2} A + \frac{9}{4} I$
c) $\frac{1}{4} A^2 - \frac{3}{2} A + \frac{9}{4}$ d) $A^2 - 6A + 9.$

a) -2

b) 2

c) 0

d) $1.$

a) $2\pi i$ b) $2\pi i e^2$
c) πi d) $\pi i e$.

a) 1 b) 3
c) 2 d) i .

$$(D^2 - DD' - DD'^2)z = xy \text{ is}$$

- xiii) The solution of the equation $x \frac{d^2z}{dx^2} = \frac{\partial z}{\partial x}$ is

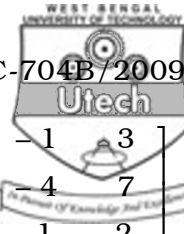
- GROUP – B**

Answer any *three* of the following.

$$3 \times 5 = 15$$

2. Express $f(x) = x^3 - 5x^2 + x + 2$ in terms of Legendre's polynomials.
3. Solve $(x^2 - y^2 - z^2)p + 2xyq = 2xz$.
4. Find the inverse Laplace transform of

$$\frac{2s^2 - 4}{(s + 1)(s - 2)(s - 3)}.$$



5. Find the rank of the matrix $\begin{bmatrix} 1 & 2 & -1 & 3 \\ 2 & 4 & -4 & 7 \\ -1 & -2 & -1 & -2 \end{bmatrix}$ by reducing to the normal form.

6. If $f(z) = u + iv$ is an analytic function of $z = x + iy$ and ψ any function of x and y with differential coefficient of first and second order then prove that

$$\left(\frac{\partial \psi}{\partial x}\right)^2 + \left(\frac{\partial \psi}{\partial y}\right)^2 = \left\{ \left(\frac{\partial \psi}{\partial u}\right)^2 + \left(\frac{\partial \psi}{\partial v}\right)^2 \right\} |f'(z)|^2.$$

7. Show that $u = 3xy^2$ is harmonic and find the corresponding analytic function.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

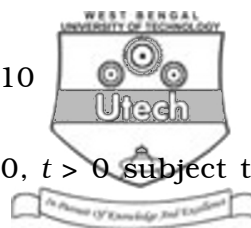
8. a) A voltage Ee^{-at} is applied at $t = 0$ to a circuit of inductance L and resistance R . Using Laplace transformation, show that the current at time t is

$$\frac{E}{R - aL} (e^{-at} - e^{-Rt/L}) \quad 7$$

- b) Using Laplace transform solve the following simultaneous equations :

$$\frac{dx}{dt} - y = e^t ; \frac{dy}{dt} + x = \sin t \text{ given } x(0) = 1,$$

$$y(0) = 0 \quad 8$$



9. a) Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ " $x > 0, t > 0$ subject to the conditions

i) $u = 0$ when $x = 0, t > 0$

ii) $u = \begin{cases} 1, & 0 < x < 1 \\ 0, & x \geq 1 \end{cases}$ when $t = 0$ and

iii) $u(x, t)$ is bounded. 10

- b) Prove that

$$\begin{vmatrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{vmatrix} = (a+b+c)^3.$$
 5

10. a) Prove that $\int_{-1}^1 P_m(x) P_n(x) dx = 0$ if $m \neq n$. 7

- b) Show that the generating function for Bessel's functions of integral order is $e^{\frac{1}{2}x(t - \frac{1}{t})}$. 8

11. a) Define a harmonic function. Show that real and imaginary parts of an analytic function are harmonic functions which satisfy Cauchy-Reimann equations. Also show that if the harmonic functions u and v satisfy these equations, then $u + iv$ is an analytic function. 8

- b) Show that the functions $u(x, y) = e^x \cos y$ is harmonic. Determine the harmonic function $v(x, y)$ and the analytic function $f(z) = u + iv$. 7



12. a) Evaluate $\int_C \frac{zdz}{(9 - z^2)(z + i)}$ where C is the circle $|z| = 2$. 5
- b) Calculate the residue of $\frac{z + 1}{z^2 - 2z}$ at its poles. 5
- c) Evaluate $\int_C |z| \bar{z} dz$ where C is the closed curve consisting of the upper semi-circle $|z| = 1$ and the segment $-1 \leq x \leq 1$. 5

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