

SE comp

SE IT III

Applied Mathematics - III 31 May 2014

(CBGS)

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QP Code : NP-18619

(3 Hours)

[ Total Marks : 80

- N.B. : (1) Question No.1 is compulsory.  
(2) Attempt any three questions from Question No.2 to Question No.6.  
(3) Non-programmable calculator is allowed.

1. (a) Find  $L^{-1}\left[\frac{Se^{-\pi s}}{S^2+2S+2}\right]$  5

(b) State true or false with proper justification "There does not exist an analytic function whose real part is  $x^3 - 3x^2y - y^3$ ". 5

(c) Prove that  $f_1(x) = 1$ ,  $f_2(x) = x$ ,  $f_3(x) = \frac{(3x^2-1)}{2}$  are orthogonal over  $(-1, 1)$ . 5

(d) Using Green's theorem in the plane, evaluate  $\int_C (x^2 - y)dx + (2y^2 + x)dy$  around the boundary of the region defined by  $y = x^2$  and  $y = 4$ . 5

2. (a) Find the fourier cosine integral representation of the function  $f(x) = e^{-ax}$ ,  $x > 0$  6

and hence show that  $\int_0^{\infty} \frac{\cos ws}{1+w^2} dw = \frac{\pi}{2} e^{-x}$ ,  $x \geq 0$ .

(b) Verify laplaces equation for  $U = \left(r + \frac{a^2}{r}\right) \cos \theta$  Also find V and  $f(z)$ . 6

(c) Solve the following eqn. by using laplace transform.  $\frac{dy}{dt} + 2y + \int_0^t y dt = \sin t$  given that  $y(0) = 1$ . 8

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3. (a) Expand  $f(x) = \begin{cases} \pi x, & 0 < x < 1 \\ 0, & 1 < x < 2 \end{cases}$  with period 2 into a fourier series. 6

(b) A vector field is given by  $\vec{F} = (x^2 + xy^2)\mathbf{i} + (y^2 + x^2y)\mathbf{j}$  show that  $\vec{F}$  is irrotational and find its scalar potential. 6

(c) Find the inverse z - transform of - 8

$$f(z) = \frac{z+2}{z^2 - 2z + 1}, |z| > 1$$

4. (a) Find the constants 'a' and 'b' so that the surface  $ax^2 - byz = (a + 2)x$  will be orthogonal to the surface  $4x^2y + z^3 = 4$  at (1, -1, 2) 6

(b) Given  $L(\text{erf } \sqrt{t}) = \frac{1}{S\sqrt{S+1}}$ , evaluate  $\int_0^{\infty} t e^{-t} \text{erf}(\sqrt{t}) dt$  6

(c) Obtain the expansion of  $f(x) = x(\pi - x)$ ,  $0 < x < \pi$  as a half-range cosine series. 8

Hence show that - (i)  $\sum_1^{\infty} \frac{(-1)^{n+1}}{n^2} = \frac{\pi^2}{12}$

(ii)  $\sum_1^{\infty} \frac{1}{n^4} = \frac{\pi^4}{90}$

5. (a) If the imaginary part of the analytic function  $W=f(z)$  is  $V = x^2 - y^2 + \frac{x}{x^2 + y^2}$  find the real part U. 6

(b) If  $f(k) = 4^k U(K)$  and  $g(k) = 5^k U(K)$ , then find the z- transform of  $f(k) \cdot g(k)$  6

(c) Use Gauss's Divergence theorem to evaluate  $\iint_S \vec{N} \cdot \vec{F} ds$  where  $\vec{F} = 4x\mathbf{i} + 3y\mathbf{j} - 2z\mathbf{k}$  and S is the surface bounded by  $x = 0, y = 0, z = 0$  and  $2x + 2y + z = 4$ . 8

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6. (a) Obtain complex form of Fourier series for  $f(x) = \cosh 3x + \sinh 3x$  in  $(-3, 3)$ . **6**
- (b) Find the inverse Laplace transform of  $\frac{(s-1)^2}{(s^2 - 2s + 5)^2}$  **6**
- (c) Find the bilinear transformation under which  $1, i, -1$  from the  $z$ -plane are mapped onto  $0, 1, \infty$  of  $w$ -plane. Also show that under this transformation the unit circle in the  $w$ -plane is mapped onto a straight line in the  $z$ -plane. Write the name of this line. **8**
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