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(December 2013 - May 2018)

CONTENTS

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APPLIED MATHEMATICS - III

DECEMBER 2013

Con. 7854-13 (REVISED COURSE) QP Code : GX-12040

(3 Hours) [Total Marks : 80]

N.B.: (1) Question No. 1 is compulsory.
(2) Answer any three questions from Q. 2 to Q. 6.
(3) Each question carry equal marks.
(4) Non-programmable calculator is allowed.

1. (a) Find $L^{-1}\left\{\dfrac{e^{4-3s}}{(s+4)^{5/2}}\right\}$ 5

(b) Find the constant a, b, c, d and e If . 5
$f(z) = (ax^4 + bx^2y^2 + cy^4 + dx^2 - 2y^2) + i(4x^3y - exy^3 + 4xy)$ is analytic.

(c) Obtain half range Fourier cosine series for $f(x) = \sin x,\ x \in (0, \pi)$. 5

(d) If r and $\bar{r}$ have their usual meaning and a is constant vector, prove that $\nabla \times \left[\dfrac{a \times \bar{r}}{r^n}\right] = \dfrac{(2-n)}{r^n}a + \dfrac{n(a.\bar{r})\bar{r}}{r^{n+2}}$ 5

2. (a) Find the analytic function $f(c) = u + iv$, If $3u + 2v = y^2 - x^2 + 16xy$. 6

(b) Find the z - transform of $\left\{a^{|k|}\right\}$ and hence find the z-transform of $\left\{\left(\dfrac{1}{2}\right)^{|k|}\right\}$ 6

(c) Obtain Fourier series expansion for $f(x) = \sqrt{1-\cos x}$, $x \in (0, 2\pi)$ and hence deduce that 8

$$\sum_{n=1}^{\infty}\frac{1}{4n^2-1} = \frac{1}{2}$$

3. (a) Find :- (i) $L^{-1}\left\{\dfrac{s}{(2s+1)^2}\right\}$ (ii) $L^{-1}\left\{\log\dfrac{s^2+a^2}{\sqrt{s+b}}\right\}$ 6

(b) Find the orthogonal trajectories of the family of curves $e^{-x}\cos y + xy = \propto$ where $\propto$ is the real constant in xy - plane. 6

(c) Show that $\bar{F} = (y e^{xy} \cos z) i + (x e^{xy} \cos z) j - (e^{xy} \sin z) k$ is irrotational and find the scalar potential for $\bar{F}$ and evaluate $\int_c \bar{F}.dr$ along the curve joining the points (0, 0, 0) and (–1 , 2, π). 8

4. (a) Evaluate by Green's theorem. $\int e^{-x}\sin y\,dx + e^{-x}\cos y\,dy$ where c is the rectangle whose vertices are $(0, 0)\ (\pi, 0)\ \left(\pi, \dfrac{\pi}{2}\right)$ and $\left(0, \dfrac{\pi}{2}\right)$. 6

(b) Find the half range sine series for the function. 6

$$f(x) = \frac{2kx}{\ell}, \quad 0 \le x \le \ell/2$$
$$= \frac{2k}{\ell}(\ell - x), \quad \frac{\ell}{2} \le x \le \ell$$

(c) Find the inverse z-transform of $\frac{1}{(z-3)(z-2)}$ 8

(i) $|z| < 2$ (ii) $2 < |z| < 3$ (iii) $|z| > 3$.

5. (a) Solve using Laplace transform. $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 3y = e^{-x}$, $y(0) = 1$, $y'(0) = 1$. 6

(b) Express $f(x) = \frac{\pi}{2} e^{-x} \cos x$ for $x > 0$ as Fourier sine integral and show that 6

$$\int_0^\infty \frac{w^3 \sin wx}{w^4 + 4} dw = \frac{\pi}{2} e^{-x} \cos x$$

(c) Evaluate $\iint_s \bar{F} \cdot \hat{n} ds$, where $\bar{F} = xi - yj + (z^2 - 1)k$ and s is the cylinder formed by the surface $z = 0$, $z = 1$, $x^2 + y^2 = 4$, using the Gauss - Divergence theorem. 8

6. (a) Find the inverse Laplace transform by using convolution theorem $L^{-1}\left\{\frac{s^2+2s+3}{(s^2+2s+5)(s^2+2s+2)}\right\}$ 6

(b) Find the directional derivative of $\phi = 4e^{2x-y+z}$ at the point $(1, 1, -1)$ in the direction towards the point $(-3, 5, 6)$. 6

(c) Find the image of the circle $x^2 + y^2 = 1$, under the transformation $w = \frac{5-4z}{4z-2}$ 8

MAY 2014

Con.9833-14 (REVISED COURSE) 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 $f(x) = e^{-ax}$, $x > 0$ and hence show that 6

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

(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

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 $\bar{F} = (x^2 + xy^2)\,i + (y^2 + x^2y)\,j$ show that $\bar{F}$ is irrotational and find its scalar potential 6

(c) Find the inverse z - transform of - $f(z) = \frac{z+2}{z^2 - 2z + 1}$, $|z| > 1$ 8

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) . g(k) 6

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

6. (a) Obtain complex form of Fourier series for f(x) = cos h 3x + sin h 3x in (–3, 3). 6

(b) Find the inverse Laplace transform of $L^{-1}\frac{(s-1)^2}{(s^2 - 2s + 5)^2}$ 6

(c) Find the bilinear transformation under which 1, i, –1 from the z-plane are mapped onto 0, 1, ∞ 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

DECEMBER 2014

GN.Con.6452-14 (REVISED COURSE) QP Code : 14544

(3 Hours) [Total Marks : 80]

N.B.: (1) Question no. 1 is compulsory.
(2) Attempt any three from the remaining.
(3) Figures to the right indicate full marks.

1. (a) Find the Laplace Transform of sint cos2t cosht. 5

(b) Find the Fourier series expansion of $f(x) = x^2\ (-\pi, \pi)$ 5

(c) Find the z-transform of $\left(\frac{1}{3}\right)^{|k|}$ 5

(d) Find the directional derivative of $4xz^2 + x^2yz$ at (1, –2, –1) in the direction of $2\bar{i} - \bar{j} - 2\bar{k}$ 5

2. (a) Find an analytic function f(z) whose real part is $e^x(x\cos y - y\sin y)$ 6

(b) Find inverse Laplace Transform by using convolution theorem, $\dfrac{1}{(s-3)(s+4)^2}$ 6

(c) Prove that $\bar{F} = (6xy^2 - 2z^3)\,\bar{i} + (6x^2y + 2yz)\,\bar{j} + (y^2 - 6z^2x)\,\bar{k}$ is a conservative field. Find the scalar potential Φ such that $\nabla\phi = \bar{F}$. Hence find the work done by $\bar{F}$ in displacing a particle from A(1, 0, 2) to B(0, 1, 1) along AB. 8

3. (a) Find the inverse z-transform of $f(z) = \dfrac{z^3}{(z-3)(z-2)^2}$ 6

(i) 2 < |z| < 3 (ii) |z| > 3

(b) Find the image of the real axis under the transformation $w = \dfrac{2}{z+i}$ 6

(c) Obtain the Fourier series expansion of $f(x) = \pi x;\ 0 \le x \le 1$
$= \pi(2 - x);\ 1 \le x \le 2$ 8

Here deduce That $\dfrac{1}{1^2} + \dfrac{1}{3^2} + \ldots = \dfrac{\pi^2}{8}$

4. (a) Find the Laplace Transform of $f(t) = E;\ 0 \le t \le p/2$
$= -E;\ p/2 \le t \le p,$
$f(t + p) = f(t)$ 6

(b) Using Green's theorem evaluate $\int_c \frac{1}{y}dx + \frac{1}{x}dy$ where c is the boundary of the region bounded by $x = 1, x = 4, y = 1, y = \sqrt{x}$ 6

(c) Find the Fourier integral for $f(x) = 1 - x^2,\ 0 \le x \le 1$
$= 0 \qquad x > 1$ 8

Hence evaluate $\displaystyle\int_0^\infty \frac{\lambda\cos\lambda - \sin\lambda}{\lambda^3}\cos\left(\frac{\lambda}{2}\right)d\lambda$

5. (a) If $\bar{F} = x^2\,\bar{i} + (x - y)\,\bar{j} + (y + z)\,\bar{k}$ moves a particle from A (1, 0, 1) to B(2, 1, 2) along line AB. Find the work done. 6

(b) Find the complex form of fourier series f(x) = sinhax $(-\ell, \ell)$ 6

(c) Solve the differential equation using Laplace Transform. $(D^2 + 2D + 5)\,y = e^{-t}\sin t$, y(0) = 0, y'(0)= 1 8

6. (a) If $\displaystyle\int_0^\infty e^{-2t}\sin(t+\alpha)\cos(t-\alpha)\,dt = \frac{3}{8}$ find the value of α. 6

(b) Evaluate $\iint_s (y^2 z^2 \bar{i} + z^2 x^2 \bar{j} + z^2 y^2 \bar{k}) . \bar{n}\, ds$ where s is the hemisphere $x^2 + y^2 + z^2 = 1$ above xy-plane and bounded by this plane. 6

(c) Find Half range sine series for $f(x) = \ell x - x^2\ (0, \ell)$. Hence prove that $\frac{1}{1^6} + \frac{1}{3^6} + ... = \frac{\pi^6}{960}$ 8

MAY 2015

JP-Con.8899-15 (REVISED COURSE) QP Code : 4827

(3 Hours) [Total Marks : 80]

N.B.: (1) Question No.1 is compulsory.
(2) Attempt any three from the remaining six questions.
(3) Figures to the right indicate full marks.

1. (a) Find Laplace Transform of $\frac{\sin t}{t}$ 20

(b) Prove that f(z) = sinh z is analytic and find its derivative

(c) Find Fourier Series for $f(x) = 9 - x^2$ over (–3, 3)

(d) Find Z [f(k)*g(k)] if $f(k) = \frac{1}{3^k}$.$g(k) = \frac{1}{5^k}$

2. (a) Prove that $\bar{F} = ye^{xy} \cos z i + xe^{xy} \cos z j - e^{xy} \sin z k$ is irrotational. Find Scalar Potential for $\bar{F}$ Hence evaluate $\int_C \bar{F}.d\bar{r}$ along the curve C joining the points (0, 0, 0) and (– 1, 2, π) 6

(b) Find the Fourier series for $f(x) = \frac{\pi - x}{2}, 0 \le x \le 2\pi$ 6

(c) Find Inverse Laplace Transform of (i) $\frac{s+29}{(s+4)(s^2+9)}$ (ii) $\frac{e^{-2s}}{s^2+8s+25}$ 8

3. (a) Find the Analytic function f(z) = u + iv if $u + v = \frac{x}{x^2+y^2}$ 6

(b) Find Inverse Z transform of $\frac{1}{(z-1/2)(z-1/3)}$, $1/3 < |z| < 1/2$ 6

(c) Solve the Differential Equation $\frac{d^2y}{dt^2} + y = t$, y(0) = 1, y'(0) = 0, using Laplace Transform 8

4. (a) Find the Orthogonal Trajectory of $3x^2y - y^3 = k$ 6

(b) Using Greens theorem evaluate $\int_c (xy + y^2)\, dx + x^2 dy$, C is closed path formed by y = x, $y = x^2$ 6

(c) Find Fourier Integral of $f(x) = \begin{cases} \sin x & 0 \le x \le \pi \\ 0 & x > \pi \end{cases}$. Hence show that $\int_0^\infty \frac{\cos(\lambda\pi/2)}{1-\lambda^2} d\lambda = \frac{\pi}{2}$ 8

5. (a) Find Inverse Laplace Transform using Convolution theorem $\frac{s}{(s^4+8s^2+16)}$ 6

(b) Find the Bilinear Transformation that maps the points z = 1, i, –1 into w = i, 0, – i. 6

(c) Evaluate $\int_C \bar{F}.d\bar{r}$ where C is the boundary of the plane 2x + y + z = 2 cut off by co-ordinate planes and $\bar{F} = (x+y)i+(y+z)j-xk$. 8

6. (a) Find the Directional derivative of $\phi = x^2 + y^2 + z^2$ in the direction of the line $\frac{x}{3}=\frac{y}{4}=\frac{z}{5}$ at (1, 2, 3) 6

(b) Find Complex Form of Fourier Series for e^{2x}; 0 < x < 2 6

(c) Find Half Range Cosine Series for $f(x)=\begin{cases} kx; & 0 \le x \le \ell/2 \\ k(\ell-x); & \ell/2 \le x \le \ell \end{cases}$ hence find $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\cdots$ 8

DECEMBER 2015

MD-Con.7526-15 (REVISED COURSE) QP Code : 5067

(3 Hours) [Total Marks : 80]

Instructions: (1) Question No. 1 is compulsory.
(2) Attempt any THREE of the remaining.
(3) Figures to the right indicate full marks.

1. (a) Find Laplace of $\{t^5 \cosh t\}$ 5

(b) Find Fourier series for $f(x) = 1 - x^2$ in (–1, 1) 5

(c) Find a, b, c, d, e if, $f(z) = (ax^4 + bx^2y^2 + cy^4 + dx^2 - 2y^2) + i(4x^3y - exy^3 + 4xy)$ is analytic 5

(d) Prove that $\nabla\left(\frac{1}{r}\right)=-\frac{\bar{r}}{r^3}$ 5

2. (a) If f (z) = u + iv is analytic and $u + v = \frac{3\sin 2x}{e^{2y}+e^{-2y}-2\cos 2x}$, find f(z) 6

(b) Find inverse Z-transform of $f(z) = \frac{z+2}{z^2-2z+1}$ for |z| > 1 6

(c) Find Fourier series for $f(x) = \sqrt{1-\cos x}$ in (0, 2π) Hence, deduce that $\frac{1}{2}=\sum_1^{\infty}\frac{1}{4n^2-1}$ 8

3. (a) Find $L^{-1}\left\{\frac{1}{(s-2)+(s+3)}\right\}$ Using Convolution theorem 6

(b) Prove that $f_1(x) = 1$, $f_2(x) = x$, $f_3(x) = (3x^2 - 1)/2$ are orthogonal over (–1, 1) 6

(c) Verify Green's theorem for $\int_c \bar{F}.\overline{dr}$ where $\bar{F} = (x^2-y^2)i+(x+y)j$ and c is the triangle with vertices (0, 0), (1, 1), (2, 1) 8

4. (a) Find Laplace Transform of $f(t) = |\sin pt|, t \ge 0$ 6

(b) Show that $\bar{F} = (y \sin z - \sin x)\, i + (x \sin z + 2yz)\, j + (xy \cos z + y^2)\, k$ is irrotational. Hence, find its scalar potential. 6

(c) Obtain Fourier expansion of $f(x) = x + \frac{\pi}{2}$ where $-\pi < x < 0$ 8

$$= \frac{\pi}{2} - x \text{ where } 0 < x < \pi$$

Hence, deduce that (i) $\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots$ (ii) $\frac{\pi^4}{96} = \frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \ldots$

5. (a) Using Gauss Divergence theorem to evaluate $\iint_S \bar{N} . \bar{F}\, ds$ where $\bar{F} = 4xi - 2y^2 j + z^2 k$ and S is the region bounded by $x^2 + y^2 = 4$, $z = 0$, $z = 3$. 6

(b) Find Z $[2^k \cos (3k + 2)\}$, $k \geq 0$ 6

(c) Solve $(D^2 + 2D + 5)\, y = e^{-t} \sin t$, with $y(0) = 0$ and $y'(0) = 1$ 8

6. (a) Find $L^{-1} \left\{ \tan^{-1}\left(\frac{z}{s^2}\right) \right\}$ 6

(b) Find the bilinear transformation which maps the points 2, i, –2 onto points 1, i, –1 by using cross-ratio property. 6

(c) Find Fourier Sine integral representation for $f(x) = \frac{e^{-ax}}{x}$ 8

MAY 2016

FW-Con.9413-16 (REVISED COURSE) QP Code : 30557

(3 Hours) [Total Marks : 80]

N.B.: (1) Question No. 1 is compulsory.
(2) Attempt any THREE of the remaining.
(3) Figures to the right indicate full marks.

1. (a) If $\int_0^{\infty} e^{-2t} \sin (t + \alpha) \cos (t - \alpha) dt = \frac{1}{4}$ find α. 5

(b) Find half range Fourier cosine series for $f(x) = x$, $0 < x < 2$ 5

(c) If u (x, y) is a harmonic function then prove that $f(z) = u_x - iu_y$ is an analytic function. 5

(d) Prove that $\nabla f(r) = f'(r) \frac{\bar{r}}{r}$ 5

2. (a) If $v = e^x \sin y$, prove that v is a harmonic function. Also find the corresponding analytic function. 6

(b) Find Z-transform of $f(k) = b^k$, $k \geq 0$ 6

(c) Obtain Fourier series for $f(x) = \frac{3x^2 - 6x\pi + 2\pi^2}{12}$ in $(0, 2\pi)$, where $f(x + 2\pi) = f(x)$. 8

Hence deduce that $\frac{\pi^2}{6} = \frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \ldots$

3. (a) Find inverse Laplace of $\frac{(s+3)^2}{(s^2+6s+5)^2}$ using Convolution theorem 6

(b) Show that the set of functions {sin x, sin 3x, sin 5x,... } is orthogonal over $[0, \pi/2]$. Hence construct orthonormal set of functions. 6

(c) Verify Green's theorem for $\int_c \frac{1}{y}dx + \frac{1}{x}dy$ where C is the boundary of region defined by x = 1, x = 4, y = 1 and y = $\sqrt{x}$ 8

4. (a) Find $Z\{k^2 a^{k-1} U(k-1)\}$ 6

(b) Show that the map of the real axis of the z- plane is a circle under the transformation $w = \frac{2}{z+i}$. Find its centre and the radius. 6

(c) Express the function $f(x) = \begin{cases} \sin x & |x| < \pi \\ 0 & |x| > \pi \end{cases}$ as Fourier sine Integral. 8

5. (a) Using Gauss Divergence theorem evaluate $\iint_s \overline{N}.\overline{F}ds$ where $\overline{F} = x^2 i + zj + yzk$ and S is the cube bounded by x = 0, x = 1, y = 0, y = 1, z = 0, z = 1 6

(b) Find inverse Z-transform of $F(z) = \frac{z}{(z-1)(z-2)}$, $|z| > 2$ 6

(c) Solve $(D^2 + 3D + 2)y = e^{-2t}\sin t$, with y(0) = 0 and y'(0) = 0 8

6. (a) Find Fourier expansion of $f(x) = 4 - x^2$ in the interval (0,2) 6

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

(c) Find (i) $L^{-1}\left\{\tan^{-1}\left(\frac{a}{s}\right)\right\}$ (ii) $L^{-1}\left(\frac{e^{-\pi s}}{s^2 - 2s + 2}\right)$ 8

DECEMBER 2016

(REVISED COURSE) QP Code : 540701

(3 Hours) [Total Marks : 80]

N.B.: (1) Question No. 1 is compulsory.
(2) Attempt any three of the remaining.
(3) Figures to the right indicate full marks.

1. (a) Find the Laplace transform of $te^{3t}\sin 4t$. 5

(b) Find half-range cosine series for $f(x) = e^x$, $0 < x < 1$. 5

(c) Is $f(z) = \frac{z}{\bar{z}}$ analytic? 5

(d) Prove that $\nabla \times (\bar{a} \times \nabla \log r) = 2\frac{(\bar{a}.\bar{r})\bar{r}}{r^4}$, where $\bar{a}$ is a constant vector. 5

2. (a) Find the inverse Z-transform of $\frac{1}{(z-5)^3}$ if $|z|< 5$ 6

(b) If $V=3x^2y + 6xy - y^3$, show that V is harmonic & find the corresponding analytic function. 6

(c) Obtain Fourier series for the function $f(x)=\begin{cases} 1+\frac{2x}{\pi}, & -\pi \le x \le 0 \\ 1-\frac{2x}{\pi}, & 0 \le x \le \pi \end{cases}$ 8

hence deduce that $\frac{\pi^2}{8}=\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+\dots$

3. (a) Find $L^{-1}\left[\frac{(s+2)^2}{(s^2+4s+8)^2}\right]$ using convolution theorem. 6

(b) Show that the set of functions 1, $\sin\left(\frac{\pi x}{L}\right), \cos\left(\frac{\pi x}{L}\right), \sin\left(\frac{2\pi x}{L}\right), \cos\left(\frac{2\pi x}{L}\right), \dots\dots$ 6

Form an orthogonal set in $(-L, L)$ and construct an orthonormal set .

(c) Verify Green's theorem for $\int_c \{e^{2x} - xy^2)\, dx + (ye^x + y^2)\, dy$ Where C is the closed curve bounded by 8

$y^2 = x$ & $x^2 = y$.

4. (a) Find Laplace transform of $f(x) = K\frac{t}{T}$ for $0 < t < T$ & $f(t) = f(t + T)$. 6

(b) Show that the vector, $\overline{F}=(x^2-yz)i+(y^2-zx)j+(z^2-xy)k$ is irrotational and hence, find ϕ such that $\overline{F}=\nabla\phi$ 6

(c) Find Fourier series for f(x) in $(0, 2\pi)$, $f(x)=\begin{cases} x, & 0\le x\le\pi \\ 2\pi-x, & \pi\le x\le 2\pi \end{cases}$ hence deduce that 8

$\frac{\pi^4}{96}=\frac{1}{1^4}+\frac{1}{3^4}+\frac{1}{5^4}+\dots\dots\dots$

5. (a) Use Gauss's Divergence theorem to evaluate $\iint_s \overline{N}.\overline{F}ds$ where $\overline{F}=2xi+xyj+zk$ over the region bounded by the cylinder $x^2 + y^2 = 4$, $z = 0$, $z = 6$. 6

(b) Find inverse Z - transform of $f(x)=\frac{z}{(z-1)(z-2)}$, $|z| > 2$ 6

(c) (i) Find $L^{-1}\left[\log\left(\frac{s+1}{s-1}\right)\right]$ (ii) $L^{-1}\left[\frac{s+2}{s^2-4s+13}\right]$ 8

6. (a) Solve $(D^2 + 3D + 2)\, y = 2(t^2 + t + 1)$ with $y(0) = 2$ & $y'(0) = 0$. 6

(b) Find the bilinear transformation which maps the points 0, i, –2i of z-plane onto the points –4i, ∞, 0 respectively of w-plane. Also obtain fixed points of the transformation. 6

(c) Find Fourier sine integral of $f(x)=\begin{cases} x, & 0<x<1 \\ 2-x, & 1<x<2 \\ 0, & x>2 \end{cases}$ 8

MAY 2017

(REVISED COURSE) QP Code : 540702

(3 Hours) [Total Marks : 80]

N.B.: (1) Question No. 1 is compulsory

(2) Attempt any three from the remaining six questions

(3) Figures to thc right indicate full marks

1. (a) Find the Laplace Transform of $e^{-t}\int_0^t u\cos 2u\,du$ 20

(b) Prove that f (z) = sinh z is analytic and find its derivative

(c) Obtain Half range Sine Series for $f(x) = x + 1$ in $(0, \pi)$

(d) Find a unit vector normal to the surface $x^2y + 2xz = 4$ at $(2, -2, 3)$

2. (a) Prove that $\overline{F}=\left(2xy^2+yz\right)i+\left(2x^2y+xz+2yz^2\right)j-\left(2y^2z+xy\right)k$ is Irrotational. Find Scalar Potential for $\overline{F}$ 6

(b) Find the inverse Laplace Transform using Convolution theorem $\frac{(s-1)^2}{(s^2-2s+5)^2}$ 6

(c) Find Fourier Series of $f(x)=\begin{cases} \pi x; 0\le x\le 1 \\ \pi(2-x); 1\le x\le 2 \end{cases}$ 8

3. (a) Find the Analytic function f(z) = u +iv if $v=\frac{x}{x^2+y^2}+\cosh x\cos y$ 6

(b) Find Inverse Z transform of $\frac{\left(3z^2-18z+26\right)}{(z-2)(z-3)(z-4)}$, $3 < |z| < 4$ 6

(c) Solve the Differential Equation $\frac{d^2y}{dt^2}+2\frac{dy}{dx}+2y=5\sin t$, $y(0) = 0$, $y'(0) = 0$ using LaplaceTransform 8

4. (a) Find the Orthogonal Trajectory of $3x^2y - y^3 = k$ 6

(b) Find the z-transform of $2^K \sinh 3K$, $K \ge 0$ 6

(c) Express the function $f(x)=\begin{cases} 1 : |x|<1 \\ 0 : |x|>1 \end{cases}$ as Fourier Integral. Hence evaluate $\int_0^\infty \frac{\sin\lambda}{\lambda}.\cos(\lambda x)d\lambda$ 8

5. (a) Evaluate using Stoke's theorem $\int_c (2x-y)dx - yz^2dy - y^2zdz$ where C is the circle $x^2 + y^2 = 1$ corresponding to the sphere $x^2 + y^2 + z^2 = 1$ above the XY plane 6

(b) Show that $w = \dfrac{2z+3}{z-4}$ maps the circle $x^2 + y^2 - 4x = 0$ into straight line $4u + 3 = 0$ 6

(c) Find Inverse Laplace Transform (i) $e^{-s}\tanh^{-1}s$ (ii) $\dfrac{6}{(2s+1)^3}$ 8

6. (a) Find the Laplace transform of $f(t) = \dfrac{2t}{3}, 0 \le t \le 3, f(t+3) = f(t)$ 6

(b) Find Complex Form of Fourier Series for $\sin(\alpha x)$; $(-\pi, \pi)$, α is not an integer 6

(c) Verify Green's theorem for $\int_c (2x^2 - y^2)dx + (x^2 + y^2)dy$ where C is the boundary of the surface enclosed by lines x = 0, y = 0 , x = 2 , y = 2. 8

APPLIED MATHEMATICS - III

DECEMBER 2017

(REVISED COURSE) QP Code : 24510

(3 Hours) [Total Marks : 80]

N.B.: (1) Question no.1 is compulsory.
(2) Attempt any three questions from Q.2 to Q.6
(3) Figures to the right indicate full marks.

1. (a) Find the Laplace transform of $\frac{1}{t}e^{-t}\sin t$ 5

(b) Find the inverse Laplace transform of $\frac{1}{\sqrt{2s+1}}$ 5

(c) Show that the function f(z) = sinh z is analytic and find f'(z) in terms of z. 5

(d) Find the Fourier series for f(x) = x in (0, 2π)

2. (a) Use Laplace transform to prove $\int_0^\infty e^{-t}\frac{\sin^2 t}{t}dt = \frac{1}{4}\log 5$ 6

(b) If $\{f(k)\} = \begin{cases} 4^k, k < 0 \\ 3^k, k \geq 0 \end{cases}$ find Z{f(k)} 6

(c) Show that the function u = cos x cosh y is a harmonic function. Find its harmonic congjugate and corresponding analytic function 8

3. (a) Find the equation of the line of regression of Y on X for the following data : 6

X	5	6	7	8	9	10	11
Y	11	14	14	15	12	17	16

(b) Find the billinear transformation which maps the points 1 , –i , 2 on z-plane onto 0, 2 , –i respectively of w-plane 6

(c) Find half range sine series for $f(x) = \begin{cases} x, & 0 < x < \frac{\pi}{2} \\ \pi - x, & \frac{\pi}{2} < x < \pi \end{cases}$. Hence find the sum of $\sum_{(2n-1)}^{\infty}\frac{1}{n^4}$ 8

4. (a) Find the inverse Laplace transform by using convolution theorem $\frac{1}{(s-a)(s+a)^2}$ 6

(b) Calculate the coefficient of correlation between X and Y from the following data 6

X	8	8	7	5	6	2
Y	3	4	10	13	22	8

(c) Find the inverse Z - transform of 8

(i) $\frac{1}{(z-a)^2} \; |z| < a$ (ii) $\frac{1}{(z-3)(z-2)} \; |z| > 3$

5. (a) Using Laplace transform evaluate $\int_0^\infty e^{-t}\left(1+2t-t^2+t^3\right)H(t-1)\,dt$ 6

(b) Show that set of functions cos x, cos 2x, cos 3x... Is a set orthogonal functions over $[-\pi, \pi]$. Hence construct a set of orthonormal functions. 6

(c) Solve using Laplace transform
$(D^3 - 2D^2 + 5D)y - 0$, with $y(0) = 0, y'(0) = 0, y''(0) = 1$

6. (a) Find the complex form of Fourier series for $f(x) = 2x$ in $(0, 2\pi)$ 6

(b) If $f(z)$ and $\overline{f(z)}$ are both analytic, prove that $f(z)$ is constant 6

(c) Fit a curve of the form $y = ab^x$ to the following data 8

X	1	2	3	4	5	6
Y	151	100	61	50	20	8

MAY 2018

(REVISED COURSE) QP Code : 21236

(3 Hours) [Total Marks : 80]

N.B.: (1) Q.1 is COMPULSORY.
(2) Attempt ANY 3 questions from Q.2 to Q.6
(3) Use of scientific calculators allowed.
(4) Figures to right indicate marks.

1. (a) Find the Laplace transform of $e^{-2t}\, t \cos t$ 5

(b) Find the inverse Laplace transform of $\frac{3s+7}{s^2-2s-3}$ 5

(c) Determine whether the function $f(z) = (x^3 + 3xy^2 - 3x) + i(3x^2y - y^3 + 3y)$ is analytic and if so find its derivative. 5

(d) Find the Fourier series for $f(x) = x^2$ in the interval $(-\pi,\pi)$. 5

2. (a) Evaluate $\int_0^\infty \left(\frac{\sin 2t + \sin 3t}{te^t}\right)dt = \frac{3\pi}{4}$ 6

(b) Find the Z-Transform of $\left\{\left(\frac{1}{4}\right)^{|k|}\right\}$ 6

(c) Show that the function $v = e^x(x \sin y + y \cos y)$ is a harmonic function. Find its harmonic conjugate and corresponding analytic function. 8

3. (a) From 8 observations the following results were obtained. 6
$\Sigma x = 59$; $\Sigma y = 40$; $\Sigma x^2 = 524$; $\Sigma y^2 = 256$; $\Sigma xy = 364$.
Find the equation of the line of regression of x on y and the coefficient of correlation.

(b) Find the bilinear transformation which maps the points $z = -1, 0, 1$ onto the points $w = -1, -i, 1$. 6

(c) Obtain half-range sine series for $f(x) = (x-1)^2$ in $0 < x < 1$. Hence find $\sum_{n=1}^{\infty}\frac{1}{n^2}$ 8

4. (a) Find the inverse Laplace Transform by using convolution theorem $\frac{1}{\left(s^2+a^2\right)\left(s^2+b^2\right)}$ 6

(b) Compute Spearman's Rank correlation coefficient for the following data: 6

X	85	74	85	50	65	78	74	60	74	90
Y	78	91	78	58	60	72	80	55	68	70

(c) Find the inverse Z-transform for the following; 8

(i) $\frac{1}{(z-5)^2}$, $|z| < 5$ (ii) $\frac{\pi}{(z-2)(z-3)}$, $|z| > 3$

5. (a) Using Laplace Transform evaluate $\int_0^{\infty} e^{-t}\left(1+3t+t^2\right)H(t-2)\,dt$ 6

(b) Prove that $f_1(x) = 1$; $f_2(x) = x$; $f_3(x) = \left(\frac{3x^2-1}{2}\right)$ are orthogonal over $(-1, 1)$. 6

(c) Solve using Laplace transform $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = 2e^{3x}$, $y = 2$, $y' = 3$ at $x = 0$ 8

6. (a) Find the complex form of Fourier series for $f(x) = e^x$, $(-\pi,\pi)$ 6

(b) If u , v are harmonic conjugate functions, show that uv is a harmonic function. 6

(c) Fit a straight line of the form $y = a + bx$ to the following data and estimate the value of y for $x = 3.5$ 8

x	0	1	2	3	4
Y	1	1.8	3.3	4.5	6.3

ACADEMY

SET TIME SET TARGET

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