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| SUBJECT NAME           | : Mathematics – II                                 |  |
| SUBJECT CODE           | : MA6251   |   |
| MATERIAL NAME          | : Part – A questions                               |   |
| REGULATION             | : R2013  |   |
| UPDATED ON             | : November 2016                                    |   |
| TEXTBOOK FOR REFERENCE | : Sri Hariganesh Publications (Author: C. Ganesan) |   |

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### Unit – I (Vector Calculus)

- Find the value of  $m$  so that the vector  $\vec{F} = (x + 3y)\vec{i} + (y - 2z)\vec{j} + (x + mz)\vec{k}$  is solenoidal. (Text Book Page No.: 1.49)
- Find  $\lambda$  such that  $\vec{F} = (3x - 2y + z)\vec{i} + (4x + \lambda y - z)\vec{j} + (x - y + 2z)\vec{k}$  is solenoidal. Text Book Page No.: 1.26
- Find the values of  $a, b, c$  so that the vector (Text Book Page No.: 1.26)  
 $\vec{F} = (x + y + az)\vec{i} + (bx + 2y - z)\vec{j} + (-x + cy + 2z)\vec{k}$  may be irrotational.
- Find the directional derivative of  $\phi(x, y, z) = xy^2 + yz^2$  at the point  $(2, -1, 1)$  in the direction of the vector  $\vec{i} + 2\vec{j} + 3\vec{k}$ . (Text Book Page No.: 1.18)
- Find the directional derivative of  $\phi = xyz$  at  $(1, 1, 1)$  in the direction of  $\vec{i} + \vec{j} + \vec{k}$ . Text Book Page No.: 1.16
- Is the position vector  $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$  irrotational? Justify. (Text Book Page No.: 1.49)
- Find  $\text{curl}\vec{F}$  if  $\vec{F} = xy\vec{i} + yz\vec{j} + zx\vec{k}$ .
- Prove that  $\vec{F} = yz\vec{i} + zx\vec{j} + xy\vec{k}$  is irrotational. (Text Book Page No.: 1.25)
- Find  $\text{grad}(r^n)$  where  $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$  and  $r = |\vec{r}|$ . (Text Book Page No.: 1.3)
- Evaluate  $\nabla^2 \log r$ .

11. Find the unit normal to the surface  $x^2 + xy + z^2 = 4$  at  $(1, -1, 2)$ . (Text Book Page No.: 1.4)
12. Find the unit normal vector to the surface  $x^2 + y^2 = z$  at  $(1, -2, 5)$ . (Text Book Page No.: 1.18)
13. Prove that  $\text{div } \vec{r} = 3$  and  $\text{curl } \vec{r} = \mathbf{0}$ . (Text Book Page No.: 1.24)
14. Prove that  $\text{curl}(\text{grad } \phi) = \mathbf{0}$ . (Text Book Page No.: 1.40)
15. State Stoke's theorem. (Text Book Page No.: 1.20)
16. State Green's theorem. (Text Book Page No.: 1.72)
17. State Gauss divergence theorem. (Text Book Page No.: 1.93)
18. Prove by Green's theorem that the area bounded by a simple closed C curve is  $\frac{1}{2} \int_C (x dy - y dx)$ . (Text Book Page No.: 1.90)

## Unit – II (Ordinary Differential Equations)

1. Solve  $\frac{d^2 y}{dx^2} + 2 \frac{dy}{dx} + y = 0$ .
2. Solve  $(D^2 + D + 1)y = 0$ .
3. Solve the equation  $(D^2 - 6D + 13)y = 0$ . (Text Book Page No.: 2.8)
4. Solve  $(D^3 + D^2 + 4D + 4)y = 0$ .
5. Solve  $(D^3 - 3D^2 + 3D - 1)y = 0$ .
6. Find the particular integral of the equation  $(D^2 - 9)y = e^{-3x}$ .
7. Solve  $(D^2 - 4)y = 1$ . (Text Book Page No.: 2.55)
8. If  $1 \pm 2i, 1 \pm 2i$  are the roots of the auxiliary equation corresponding to a fourth order homogenous linear differential equation  $F(D)y = 0$ , find its solution.
9. Find the particular integral of  $(D^2 - 4)y = \cosh 2x$ . (Text Book Page No.: 2.55)

10. Find the particular integral of  $(D^2 + 4)y = \sin 2x$ .
11. Find the particular integral of  $(D^2 + 1)y = \sin x$ . (Text Book Page No.:2.56)
12. Find the particular integral of  $(D^2 + 2D + 1)y = e^{-x} \cos x$ .
13. Find the particular integral of  $(D + 1)^2 y = e^{-x} \cos x$ . (Text Book Page No.:2.40)
14. Find the particular integral of  $(D^2 + 2D + 2)y = e^{-x} \sin 2x$ .
15. Find the particular integral of  $(D^2 - 4D + 4)y = x^2 e^{2x}$ .
16. Solve the equation  $x^2 y'' - xy' + y = 0$ .
17. Solve  $x^2 \frac{d^2 y}{dx^2} + 4x \frac{dy}{dx} + 2y = 0$ . (Text Book Page No.:2.59)
18. Transform the equation  $x^2 y'' + xy' = x$  into a linear differential equation with constant coefficients. (Text Book Page No.:2.58)
19. Convert  $(3x^2 D^2 + 5xD + 7)y = 2/x \log x$  into an equation with constant coefficients.  
Text Book Page No.:2.92
20. Transform the equation  $(2x + 3)^2 \frac{d^2 y}{dx^2} - 2(2x + 3) \frac{dy}{dx} - 12y = 6x$  into a differential equation with constant coefficients.

### Unit – III (Laplace Transform)

1. State the conditions under which Laplace transform of  $f(t)$  exists. (Text Book Page No.:3.1)
2. Find the Laplace transform of unit step function. (Text Book Page No.:3.9)
3. State the first shifting theorem on Laplace transforms. (Text Book Page No.:3.9)
4. Evaluate  $\int_0^{\infty} t e^{-2t} \sin t dt$  using Laplace transform.
5. Find  $L(e^{-3t} \sin t \cos t)$ . (Text Book Page No.:3.14)
6. Find the Laplace transform of  $e^{-t} \sin 2t$ . (Text Book Page No.:3.12)

7. Find the Laplace transform of  $\frac{t}{e^t}$ . (Text Book Page No.:3.13)
8. Find the Laplace transform of  $\frac{1 - \cos t}{t}$ . (Text Book Page No.:3.18)
9. Find  $L\left[\frac{\sin t}{t}\right]$ . (Text Book Page No.:3.19)
10. Find Laplace transform of  $t \sin 2t$ . (Text Book Page No.:3.15)
11. State initial and final value theorem. (Text Book Page No.:3.36)
12. State convolution theorem on Laplace transforms. (Text Book Page No.:3.99)
13. Verify the final value theorem for  $f(t) = 3e^{-t}$ . (Text Book Page No.:3.30)
14. Verify initial value theorem for the function  $f(t) = ae^{-bt}$ . (Text Book Page No.:3.38)
15. Find  $L^{-1}\left[\frac{1}{s^2 + 4s + 4}\right]$ . (Text Book Page No.:3.62)
16. Find  $L^{-1}\left[\frac{1}{s^2 + 6s + 13}\right]$ . (Text Book Page No.:3.63)
17. Find the inverse Laplace transform of  $\frac{1}{(s+1)(s+2)}$ . (Text Book Page No.:3.65)
18. Find  $f(t)$  if the Laplace transform of  $f(t)$  is  $\frac{s}{(s+1)^2}$ . (Text Book Page No.:3.63)
19. Find  $L^{-1}\{\cot^{-1}(s)\}$ . (Text Book Page No.:3.88)
20. Find  $L^{-1}\left(\log \frac{s}{s-a}\right)$ .

#### Unit – IV (Analytic Functions)

1. Verify  $f(z) = z^3$  is analytic or not. (Text Book Page No.:4.10)
2. Show that  $|z|^2$  is not analytic at any point. (Text Book Page No.:4.11)

3. Define harmonic function. (Text Book Page No.:4.21)
4. Show that  $u = 2x - x^3 + 3xy^2$  is harmonic. (Text Book Page No.:4.35)
5. Verify whether the function  $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$  is harmonic.  
Text Book Page No.:4.37
6. Define Conformal mapping. (Text Book Page No.:4.59)
7. Find the map of the circle  $|z| = 3$  under the transformation  $w = 2z$ . (Text Book Page No.:4.59)
8. Find the image of the line  $x = k$  under the transformation  $w = \frac{1}{z}$ . (Text Book Page No.:4.61)
9. State the Cauchy-Riemann equation in polar coordinates satisfied by an analytic function.  
Text Book Page No.:4.7
10. Prove that a bilinear transformation has at most two fixed points. (Text Book Page No.:4.82)
11. Find the fixed points of mapping  $w = \frac{6z-9}{z}$ . (Text Book Page No.:4.83)
12. Find the invariant points of the transformation  $w = \frac{2z+6}{z+7}$ . (Text Book Page No.:4.83)
13. Find the invariant points of the transformation  $w = \frac{z-1}{z+1}$ . (Text Book Page No.:4.84)
14. Find the invariant points of a function  $f(z) = \frac{z^3+7z}{7-6zi}$ .
15. Find the invariant points of  $f(z) = z^2$ . (Text Book Page No.:4.82)
16. Find the critical points of the transformation  $w = 1 + \frac{2}{z}$ . (Text Book Page No.:4.78)
17. Find the critical points of the transformation  $w^2 = (z-\alpha)(z-\beta)$ . (Text Book Page No.:4.79)
18. Find the constants  $a, b$  if  $f(z) = x + 2ay + i(3x + by)$  is analytic. (Text Book Page No.:4.18)
19. Verify whether  $f(z) = \bar{z}$  is analytic function or not. (Text Book Page No.:4.8)

20. Are  $|z|$ ,  $\text{Re}(z)$ ,  $\text{Im}(z)$  analytic? Give reason.

(Text Book Page No.:4.8)

### Unit – V (Complex Integration)

1. Define Singular point.

2. Define and give an example of essential singular points.

(Text Book Page No.:5.65)

3. Expand  $f(z) = \frac{1}{z^2}$  as a Taylor series about the point  $z = 2$ .

4. Expand  $f(z) = \sin z$  in a Taylor series about origin.

(Text Book Page No.:5.63)

5. Evaluate  $\int_C \tan z \, dz$  where  $C$  is  $|z| = 2$ .

(Text Book Page No.:5.34)

6. Find the Taylor series for  $f(z) = \sin z$  about  $z = \frac{\pi}{4}$ .

(Text Book Page No.:5.38)

7. State Cauchy's integral theorem.

(Text Book Page No.:5.5)

8. State Cauchy's residue theorem.

(Text Book Page No.:5.83)

9. Evaluate  $\int_C \left( \frac{3z^2 + 7z + 1}{z + 1} \right) dz$ , where  $C$  is  $|z| = \frac{1}{2}$ .

(Text Book Page No.:5.8)

10. Evaluate  $\int_C \frac{z \, dz}{(z-1)(z-2)}$ , where  $C$  is the circle  $|z| = 1/2$ .

11. Using Cauchy's integral formula, evaluate  $\int_C \frac{\sin \pi z^2 + \cos \pi z^2}{(z+1)(z+2)} dz$ , where  $C$  is  $|z| = \frac{1}{2}$ .

12. Evaluate  $\int_C \frac{z+4}{z^2+2z} dz$ , where  $C$  is the circle  $|z - \frac{1}{2}| = \frac{1}{3}$ .

(Text Book Page No.:5.8)

13. Evaluate  $\int_C \frac{z}{z-2} dz$ , where  $C$  is (a)  $|z| = 1$  (b)  $|z| = 3$ .

(Text Book Page No.:5.34)

14. If  $f(z) = \frac{-1}{z-1} - 2[1 + (z-1) + (z-1)^2 + \dots]$ , find the residue of  $f(z)$  at  $z = 1$ .

Text Book Page No.:5.71

15. Identify the type of singularities of the following function:  $f(z) = e^{\frac{1}{z-1}}$ .

Text Book Page No.:5.71

16. Identify the type of singularity of function  $\sin\left(\frac{1}{1-z}\right)$ . (Text Book Page No.:5.72)

17. Calculate the residue of  $f(z) = \frac{e^{2z}}{(z+1)^2}$  at its pole. (Text Book Page No.:5.69)

18. Find the residue of the function  $f(z) = \frac{4}{z^3(z-2)}$  at a simple pole. (Text Book Page No.:5.67)

19. Find the residue of  $f(z) = \frac{z^2}{(z-2)(z+1)^2}$  at  $z = 2$ . (Text Book Page No.:5.68)

20. Find the residue of  $\frac{1-e^{2z}}{z^4}$  at  $z = 0$ . (Text Book Page No.:5.70)

### **Textbook for Reference:**

“ENGINEERING MATHEMATICS - II”

**Publication:** Sri Hariganesh Publications

**Author:** C. Ganesan

**Mobile:** 9841168917, 8939331876

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