SRM INSTITUTE OF SCIENCE AND TECHNOLOGY RAMAPURAM CAMPUS DEPARTMENT OF MATHEMATICS CONTINUOUS ASSESSMENT – 2

* Required

Answer ALL Questions

Each question carries ONE mark.

1. *

If $\varphi(x,y,z) = xyz$, then $\nabla\varphi =$

(A) $yz\,\vec{i} + zx\,\vec{j} + xy\,\vec{k}$ (B) $xy\,\vec{i} + yz\,\vec{j} + xz\,\vec{k}$

(C) $xz\,\vec{i} + zy\,\vec{j} + xy\,\vec{k}$ (D) $x\,\vec{i} + y\,\vec{j} + z\,\vec{k}$

- (●) A
- ( ) B
- ( ) C
- ( ) D

2. *

The magnitude of maximum directional derivative of $\varphi(x, y, z) = x^2 + y^2 + z^2$ at $(1,1,1)$ is

(A) 0	(B) 3
(C) 2	(D) $2\sqrt{3}$

- ○ A
- ○ B
- ○ C
- ◉ D

3. *

The unit normal vector to the surface $x^2 + y^2 - z^2 = 1$ at the point $(1,1,1)$ is

(A) $\frac{\vec{i}+\vec{j}+\vec{k}}{\sqrt{3}}$	(B) $\frac{\vec{i}+\vec{j}-\vec{k}}{\sqrt{3}}$
(C) $\frac{\vec{i}-\vec{j}-\vec{k}}{\sqrt{3}}$	(D) $\frac{\vec{i}+\vec{j}+\vec{k}}{\sqrt{2}}$

- ○ A
- ◉ B
- ○ C
- ○ D

4. *

Angle between two level surfaces $\varphi_1 = C_1$ and $\varphi_2 = C_2$ is given by

(A) $\sin\theta = \dfrac{\nabla\varphi_1 \bullet \nabla\varphi_2}{|\nabla\varphi_1|\,|\nabla\varphi_2|}$ (B) $\cos\theta = \dfrac{\nabla\varphi_1 \bullet \nabla\varphi_2}{|\nabla\varphi_1|\,|\nabla\varphi_2|}$

(C) $\tan\theta = \dfrac{\nabla\varphi_1 \bullet \nabla\varphi_2}{|\nabla\varphi_1|\,|\nabla\varphi_2|}$ (D) $\tan\theta = \dfrac{\nabla\varphi_1 \times \nabla\varphi_2}{|\nabla\varphi_1|\,|\nabla\varphi_2|}$

- ( ) A
- (•) B
- ( ) C
- ( ) D

5. *

The condition for vector $\vec{F}$ to be solenoidal is

(A) $div\,\vec{F} = 0$ (B) $curl\,\vec{F} = 0$

(C) $div\,\vec{F} \neq 0$ (D) $curl\,\vec{F} \neq 0$

- (•) A
- ( ) B
- ( ) C
- ( ) D

6. *

If $\vec{u}$ and $\vec{v}$ are irrotational, then $\vec{u} \times \vec{v}$ is

(A) irrotational	(B) solenoidal
(C) zero vector	(D) constant

- A
- B
- C
- D

7. *

The formula to find the directional derivative of a scalar field φ at a point P (x, y, z) in the direction of vector $\vec{a}$ is

(A) $D.D. = \dfrac{\nabla\varphi \bullet \vec{a}}{\lvert \vec{a} \rvert}$	(B) $D.D. = \dfrac{\nabla\varphi \times \vec{a}}{\lvert \vec{a} \rvert}$
(C) $D.D. = \dfrac{\nabla\varphi + \vec{a}}{\lvert \vec{a} \rvert}$	(D) $D.D. = \dfrac{\nabla\varphi - \vec{a}}{\lvert \vec{a} \rvert}$

- A
- B
- C
- D

8. *

If $\vec{F} = 3\,x\,z\,\vec{i} + 4\,y\,z\,\vec{j} - \,z\,\vec{k}$, then $curl\,\vec{F}$ at $(1,1,1) =$

(A) $-4\,\vec{i} + 3\,\vec{j}$ (B) $-4\,\vec{i} - 3\,\vec{j}$

(C) $-4\,\vec{i} + 3\,\vec{j} + \vec{k}$ (D) $-4\,\vec{i} - 3\,\vec{j} - \vec{k}$

- (●) A
- ( ) B
- ( ) C
- ( ) D

9. *

The relation between line integral and surface integral is given by

(A) Gauss divergence theorem (B) Cauchy's theorem

(C) Stoke's theorem (D) Convolution theorem

- ( ) A
- ( ) B
- (●) C
- ( ) D

10. *

If $\vec{F}$ represents the variable force acting on a particle along arc AB, then the work done is given by

(A) $\int_A^B \vec{F} \bullet d\vec{r}$ (B) $\int_A^B \vec{F} \times d\vec{r}$

(C) $\int_A^B \vec{F} \bullet d\vec{r} = 0$ (D) $\int_A^B \vec{F} \times d\vec{r} = 0$

- (selected) A
- B
- C
- D

11. *

If $\vec{F} = (axy + z^3)\vec{i} + (3x^2 - z)\vec{j} + (3xz^2 - y)\vec{k}$ is irrotational, then the value of a is

(A) 3 (B) 1

(C) 2 (D) 6

- A
- B
- C
- (selected) D

12. *

If $\vec{F} = x\,z^3\,\vec{i} - 2\,x\,y\,z\,\vec{j} + x\,z\,\vec{k}$, then $div\,\vec{F}$ at $(1,2,0) =$	
(A) 20	(B) 1
(C) 2	(D) 3

- ( ) A
- (•) B
- ( ) C
- ( ) D

13. *

If $\vec{r}$ is the position vector of the point (x, y, z) with respect to the origin, then $\nabla \times \vec{r} =$	
(A) 0	(B) 1
(C) 2	(D) 3

- (•) A
- ( ) B
- ( ) C
- ( ) D

14. *

If the divergence of the vector is zero, then the vector is said to be

(A) irrotational vector (B) constant vector
(C) zero vector (D) solenoidal vector

- ○ A
- ○ B
- ○ C
- ◉ D

15. *

According to Green's theorem, $\oint_C (P\,dx + Q\,dy) =$

(A) $\iint_R \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y}\right) dx\,dy$ (B) $\iint_R \left(\frac{\partial Q}{\partial y} - \frac{\partial P}{\partial x}\right) dx\,dy$

(C) $\iint_R \left(\frac{\partial P}{\partial x} - \frac{\partial Q}{\partial y}\right) dx\,dy$ (D) $\iint_R \left(\frac{\partial P}{\partial y} - \frac{\partial Q}{\partial x}\right) dx\,dy$

- ◉ A
- ○ B
- ○ C
- ○ D

16. *

If $\vec{F} = 3x^2\,\vec{\imath} + 5\,x\,y^2\,\vec{\jmath} + x\,y\,z^3\,\vec{k}$, then $\nabla \bullet \vec{F}$ at $(2,\ 0,\ 0) =$

(A) 12	(B) 6
(C) – 6	(D) 24

- [x] A
- [ ] B
- [ ] C
- [ ] D

17. *

If the integral $\int_A^B \vec{F} \bullet d\vec{r}$ depends only on the end points but not on the path C, then $\vec{F}$ is

(A) neither solenoidal nor irrotational	(B) solenoidal
(C) irrotational	(D) conservative

- [ ] A
- [ ] B
- [ ] C
- [x] D

18. *

If $\vec{r}$ is the position vector of the point (x, y, z) with respect to the origin, then $div\ \vec{r} =$

(A) 0	(B) 1
(C) 2	(D) 3

- [ ] A
- [ ] B
- [ ] C
- [x] D

19. *

By Stoke's theorem, $\int_C \vec{F} \bullet d\vec{r} =$

(A) $\iint_S \nabla \times \vec{F}\, dS$	(B) $\iint_S \nabla \bullet \vec{F}\, dS$
(C) $\iint_S (\nabla \bullet \vec{F}) \hat{n}\, dS$	(D) $\iint_S (\nabla \times \vec{F}) \bullet \hat{n}\, dS$

- [ ] A
- [ ] B
- [ ] C
- [x] D

20. *

According to Green's theorem, the area bounded by a simple closed curve is

(A) $\frac{1}{2}\oint_C (x\,dy - y\,dx)$ (B) $\frac{1}{2}\oint_C (x\,dy + y\,dx)$

(C) $2\oint_C (x\,dy - y\,dx)$ (D) $\oint_C (x\,dy - y\,dx)$

- (●) A
- ( ) B
- ( ) C
- ( ) D

21. *

If φ is a scalar function, then $\nabla \times \nabla\varphi =$

(A) $\vec{0}$ (B) 1

(C) 2 (D) constant

- (●) A
- ( ) B
- ( ) C
- ( ) D

22. *

If the vector $\vec{F} = (x+3y)\,\vec{i} + (y-2z)\,\vec{j} + (x+a\,z)\,\vec{k}$ is solenoidal, then $a =$

(A) 2	(B) 0
(C) -2	(D) -1

- ( ) A
- ( ) B
- (•) C
- ( ) D

23. *

The relation between the surface integral and the volume integral is given by

(A) Green's theorem	(B) Stoke's theorem
(C) Gauss Divergence theorem	(D) Cauchy's theorem

- ( ) A
- ( ) B
- (•) C
- ( ) D

24. *

The condition for $\vec{F}$ to be conservative is

(A) $\nabla \bullet \vec{F} = 0$ (B) 0

(C) $\nabla \times \vec{F} = \vec{0}$ (D) 1

- [ ] A
- [ ] B
- [x] C
- [ ] D

25. *

By Gauss divergence theorem, $\iiint_V \nabla \bullet \vec{F}\, dV =$

(A) $\iint_S \vec{F} \bullet \hat{n}\, dS$ (B) $\iint_S \vec{F} \times \hat{n}\, dS$

(C) $\int_S \vec{F} \bullet \hat{n}\, dS$ (D) $\int_S \vec{F} \times \hat{n}\, dS$

- [x] A
- [ ] B
- [ ] C
- [ ] D

26. *

$L[t^3] =$

(A) $\frac{3}{s^3}$	(B) $\frac{6}{s^4}$
(C) $\frac{3}{s^4}$	(D) $\frac{6}{s^3}$

- ○ A
- ◉ B
- ○ C
- ○ D

27. *

$L[e^{-t}t] =$

(A) $\frac{1}{s+1}$	(B) $\frac{1}{(s-1)^2}$
(C) $\frac{1}{(s+1)^2}$	(D) $\frac{1}{s-1}$

- ○ A
- ○ B
- ◉ C
- ○ D

28. *

If $L[f(t)] = F(s)$, then $L\left[\int_0^t f(t)\,dt\right] =$

(A) $\frac{F(s)}{s}$ (B) $F\left(\frac{s}{a}\right)$

(C) $\frac{f(t))}{t}$ (D) $F\,(u)$

- (●) A
- ( ) B
- ( ) C
- ( ) D

29. *

$L[e^{3t}] =$

(A) $\frac{1}{s-3}$ (B) $\frac{s}{s^2+9}$

(C) $\frac{1}{s-\log 9}$ (D) $\frac{9}{s}$

- (●) A
- ( ) B
- ( ) C
- ( ) D

30. *

$L[\sin 3\,t] =$

(A) $\frac{1}{s^2-9}$ (B) $\frac{1}{s^2+9}$

(C) $\frac{s}{s^2-9}$ (D) $\frac{3}{s^2+9}$

- ○ A
- ○ B
- ○ C
- ◉ D

31. *

$L[f(t) * g(t)] =$

(A) $F(s) - G(s)$ (B) $F(s) + G(s)$

(C) $F(s)\,G(s)$ (D) $F(s) \div G(s)$

- ○ A
- ○ B
- ◉ C
- ○ D

32. *

$L[1] =$

(A) $\frac{1}{s}$ (B) $\frac{1}{s^2}$

(C) $\frac{2}{s^3}$ (D) $\frac{1}{s^3}$

- (●) A
- ( ) B
- ( ) C
- ( ) D

33. *

$L[\sinh 2t] =$

(A) $\frac{2}{s^2 - 4}$ (B) $\frac{2}{s^2 + 4}$

(C) $\frac{1}{s^2 - 4}$ (D) $\frac{s}{s^2 + 4}$

- (●) A
- ( ) B
- ( ) C
- ( ) D

34. *

$L\left[\frac{\sin 4t}{4}\right] =$

(A) $\frac{s}{s^2+16}$ (B) $\frac{1}{s^2+16}$

(C) $\frac{1}{s^2-16}$ (D) $\frac{s}{s^2-16}$

- ○ A
- ◉ B
- ○ C
- ○ D

35. *

If $L[f(t)] = F(s)$, then $L[e^{at} f(t)] =$

(A) $F(s+a)$ (B) $F(s-a)$

(C) $\frac{1}{a} F\left(\frac{s}{a}\right)$ (D) $\frac{1}{s} F\left(\frac{s}{a}\right)$

- ○ A
- ◉ B
- ○ C
- ○ D

36, *

$L[t \sin 2t] =$	
(A) $\frac{4s}{(s^2+4)^2}$	(B) $\frac{4s}{(s^2-4)^2}$
(C) $\frac{s}{(s^2+4)^2}$	(D) $\frac{4s}{(s^2-4)^2}$

- (•) A
- ( ) B
- ( ) C
- ( ) D

37. *

If $L[f(t)] = F(s)$, then $L[f'(t)] =$	
(A) $s\,F(s) - f(0)$	(B) $s^2\,F(s) - f(0)$
(C) $s\,F(s) - s\,f(0)$	(D) $s\,F(s)$

- (•) A
- ( ) B
- ( ) C
- ( ) D

38. *

If $L[f(t)] = F(s)$, then by Initial Value Theorem $\lim_{t \to 0} f(t) =$

(A) $\lim_{s \to \infty} s\,F(s)$ (B) $\lim_{s \to 0} s\,F(s)$

(C) $\lim_{s \to \infty} F(s)$ (D) $\lim_{s \to 0} F(s)$

- (●) A
- ( ) B
- ( ) C
- ( ) D

39. *

The Laplace transform of a periodic function $f(t)$ with period p is given by

(A) $L[f(t)] = \frac{1}{1-e^{-sp}} \int_0^p e^{-st} f(t)dt$

(B) $L[f(t)] = \frac{1}{1+e^{-sp}} \int_0^p e^{-st} f(t)dt$

(C) $L[f(t)] = \frac{1}{1+e^{-sp}} \int_0^\infty e^{-st} f(t)dt$

(D) $L[f(t)] = \frac{1}{1-e^{-sp}} \int_0^\infty e^{-st} f(t)dt$

- (●) A
- ( ) B
- ( ) C

C

D

40. *

$$L^{-1}\left[\frac{1}{s+3}\right] =$$

(A) e^{3t} (B) e^{-3t}
(C) $\cos 3t$ (D) $\sin 3t$

A

B

C

D

41. *

$$L^{-1}\left[\frac{s}{s^2-9}\right] =$$

(A) $\cos 3t$ (B) $\sin 3t$

(C) $\cosh 3t$ (D) $\sinh 3t$

A

B

C

D

42. *

$$L^{-1}\left[\frac{1}{(s-1)^2}\right] =$$

(A) $t\,e^{t}$	(B) e^{t}
(C) e^{-t}	(D) $t\,e^{-t}$

- (●) A
- ( ) B
- ( ) C
- ( ) D

43. *

If $L[f(t)] = F(s)$, then $L^{-1}[s\,F(s)] =$

(A) $\int_0^t f(t)\,dt$	(B) $\int_0^\infty f(t)\,dt$
(C) $f'(t)$	(D) $f''(t)$

- ( ) A
- ( ) B
- (●) C
- ( ) D

44. *

$$L^{-1}\left[\frac{1}{s^2+2s+5}\right] =$$

(A) $e^{-t}\cosh 2t$	(B) $e^{t}\cos 2t$
(C) $\frac{e^{-t}\sin 2t}{2}$	(D) $\frac{e^{-2t}\sinh 5t}{5}$

- ○ A
- ○ B
- ◉ C
- ○ D

45. *

$$L^{-1}\left[\frac{1}{s^2+4}\right] =$$

(A) $\frac{\cos 2t}{2}$	(B) $\frac{\sin 2t}{2}$
(C) $\sin 2t$	(D) $\cos 2t$

- ○ A
- ◉ B
- ○ C
- ○ D

46. *

If $L[f(t)] = F(s)$, then $L^{-1}[F(s+a)] =$

(A) $e^{at} f(t)$ (B) $e^{-at} f(t)$

(C) $\frac{1}{a} f(t)$ (D) $\frac{1}{s} f(t)$

- A
- B (selected)
- C
- D

47. *

By Linear Property of Inverse Laplace Transforms, $L^{-1}[a\,F(s) + b\,G(s)] =$

(A) $L^{-1}[a\,F(s)]$ (B) $a\,L^{-1}[F(s)] + b\,L^{-1}[G(s)]$

(C) $L^{-1}[b\,G(s)]$ (D) $L^{-1}[F(s)] + L^{-1}[G(s)]$

- A
- B (selected)
- C
- D

48. *

$$L^{-1}\left[\frac{1}{(s-a)^2+b^2}\right] =$$

(A) $e^{at}\cosh bt$ (B) $e^{at}\cos bt$

(C) $\frac{e^{at}\sin bt}{b}$ (D) $\frac{e^{at}\sinh bt}{b}$

- ○ A
- ○ B
- ◉ C
- ○ D

49. *

$$L^{-1}\left[\frac{1}{s}\right] =$$

(A) 1 (B) $\sin t$

(C) 2 (D) $\cos t$

- ◉ A
- ○ B
- ○ C
- ○ D

50. *

$$L^{-1}\left[\frac{s}{s^2-16}\right] =$$

(A) $\cosh 4t$	(B) $\cos 4t$
(C) $\frac{\sinh 4t}{4}$	(D) $\sin 4\,t$

- (•) A
- ( ) B
- ( ) C
- ( ) D

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