RBT23MK096

PRN No.	Total No. of Questions: 09

QP Code:

JSPM's

Rajarshi Shahu College of Engineering, Tathawade, Pune- 411033

(An autonomous institute affiliated to Savitribai Phule Pune University)

END SEMESTER EXAMINATION (ESE), DEC./JAN. -2023

Academic Year: 2023-24(SEM-I)

Class: F.Y. B. Tech.(Civil, Mechanical, E&TC, Electrical, A&R)

Subject Name and pattern: ENGINEERING MATHEMATICS-I
[ES1201]

Duration: Hours **Max. Marks: 50 Marks**

Instructions to the Candidates

1. **Q.1, Q. 2 and Q.3** is compulsory.
2. Attempt **Q.4 or Q.5 , Q.6 or Q.7 , Q.8 or Q.9.**
3. Figures to the right indicates full marks.
4. Use of nonprogrammable electron pocket calculator is allowed.
5. Assume suitable and necessary data wherever required.

Q. No.			Marks	BL	CO
1		**Attempt (Any One)**			
	a	Find the value of k so that the equations $2x-y+3z=2\ ;\ x+y+2z=2\ ;\ 5x-y+8z=k$ have infinite number of solutions. Hence find the solution.	4	BL3	CO1
	b	Determine the values of l, m, n when $\begin{bmatrix} 0 & 2m & n \\ l & m & -n \\ l & -m & n \end{bmatrix}$ is orthogonal	4	BL3	CO1
2		**Attempt (Any One)**			
	a	Find the Eigen values and **Eigen vector corresponding to smallest** eigen value of the matrix $A=\begin{bmatrix} 0 & 0 & -2 \\ 1 & 2 & 1 \\ 1 & 0 & 3 \end{bmatrix}$	4	BL3	CO1
	b	Find the modal matrix P which diagonalize the matrix $A=\begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$	4	BL3	CO1
3		**Attempt (Any One)**			
	a	Using Taylors theorem, expand $3x^3-2x^2+x-6$ in power of $(x-2)$	4	BL3	CO2
	b	Evaluate : $\lim_{x\to 0}\left(\frac{1}{x}\right)^{2\sin x}$	4	BL3	CO2

4 a Obtain the Fourier series expansion for $f(x)=\begin{cases}-\pi, & -\pi<x<0\\ x, & 0<x<\pi\end{cases}$ in $(-\pi,\pi)$ where $f(x+2\pi)=f(x)$ — 4 BL3 CO3

b Find the Fourier series to represent the function $f(x)=|x|$ in $-\pi<x<\pi$ and $f(x+2\pi)=f(x)$ — 4 BL3 CO3

c The turning moment T units of the crank shaft of a steam engine is given for a series of values of the crank angle θ in degrees. — 4 BL3 CO3

θ	0	30	60	90	120	150
T	0	5224	8097	7850	5499	2626

Find the coefficients of first two terms b_1 and b_2 in a series of sines to represent T.(Take $L=\pi$)

OR

5 A Express y as a Fourier series upto first harmonic where y is given as — 4 BL3 CO3

x	0	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	π	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$
y	1.0	1.4	1.9	1.7	1.5	1.2

b Find the constant term a_0 and coefficient of first two terms a_1 and a_2 of series of cosines to represent y where y is given in the following table — 4 BL3 CO3

x	0	1	2	3	4	5
y	9	18	24	28	26	20

(Take $L=6$)

c Obtain the half range sine series expansion of $f(x)=e^x$ in $0<x<1$ — 4 BL3 CO3

6 a Verify $\frac{\partial^2 u}{\partial x\partial y}=\frac{\partial^2 u}{\partial y\partial x}$ for $u=\log\left(x^2+y^2\right)$ — 4 BL3 CO4

b If $u=\sin^{-1}\left(x^3+y^3\right)^{\frac{2}{5}}$, then find the value of $x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}$ — 5 BL3 CO4

c If $u=x^2-y^2$; $v=2xy$ and $z=f(u,v)$, — 4 BL3 CO4

then show that $\left(\frac{\partial z}{\partial x}\right)^2+\left(\frac{\partial z}{\partial y}\right)^2=4\left(u^2+v^2\right)^{\frac{1}{2}}\left[\left(\frac{\partial z}{\partial u}\right)^2+\left(\frac{\partial z}{\partial v}\right)^2\right]$

OR

7	a	If $x = r\cos\theta; y = r\sin\theta$; show that $\left(\frac{\partial y}{\partial r}\right)_x \cdot \left(\frac{\partial y}{\partial r}\right)_\theta = 1$	4	BL3	CO4
	b	If $u = \tan^{-1}\left(\frac{x^3+y^3}{x-y}\right)$, then prove that $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2} = \sin 2u(2\cos 2u - 1)$	5	BL3	CO4
	c	If $z = f(x, y)$ where, $x = e^u + e^{-v}$; $y = e^{-u} - e^v$, then prove that $\frac{\partial z}{\partial u} - \frac{\partial z}{\partial v} = x\frac{\partial z}{\partial x} - y\frac{\partial z}{\partial v}$	4	BL3	CO4
8	a	If $x+y+z = u, y+z = uv, z = uvw$ then find $\frac{\partial(x,y,z)}{\partial(u,v,w)}$	4	BL3	CO5
	b	Examine whether the functions $u = \sin^{-1}x + \sin^{-1}y, v = x\sqrt{1-y^2} + y\sqrt{1-x^2}$ are functionally dependent. If dependent then find the relation between them.	5	BL3	CO5
	c	Find the minimum value of $xy + a^3\left(\frac{1}{x}+\frac{1}{y}\right)$.	4	BL3	CO5
		OR			
9	a	If $x = uv$, $y = \frac{u+v}{u-v}$ then find $\frac{\partial(u,v)}{\partial(x,y)}$	4	BL3	CO5
	b	Examine whether the functions $u = \frac{x-y}{x+y}$, $v = \frac{x+y}{x}$ are functionally dependent. If dependent then find the relation between them.	5	BL3	CO5
	c	The volume V of right circular cone is given by $V = \frac{1}{3}\pi r^2 h$ where r is radius of base and h is height. In calculating the volume, an errors of 2% and 1% are made in measuring the height and radius of base respectively. Find the percentage error in calculating volume.	4	BL3	CO5

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