Sanjay Ghodawat University, Kolhapur 2018-19

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M.Sc. I	**School of Science**	**Department of Physics**
PHS 507	**Mathematical Methods in Physics**	**Semester – I**
Tuesday 04/06/2019	**Examination: End Semester Examination**	10.30 am to 11.00 am **Time: 30 Minutes**
		Max Marks: 20

Seat No.:	**PRN No.:**	**Student Sign:**
Invigilator Sign:	**Examiner Sign:**	**Marks Obtained:**

A

Instructions:
1) All Questions are compulsory.
2) Mark √ to the correct option. Do not circle.
3) More than one options marked will not be considered for assessment.
4) Rough calculations on paper are not allowed
5) Use non-programmable calculator is allowed.

Q.1	**Select correct alternatives**	**Marks (20)**	**Bloom's Level**	**CO**
1.	A square matrix A=(a_{ij}) will be called a skew Hermitian matrix if,	01	L1	507.1
2.	If $A = [a_{ij}]_{mxn}$ is a scalar matrix if, (where k is any scalar)	01	L1	507.1

Question 1 options:

a) $a_{ij} = \overline{a_{ji}}$ b) $a_{ij} = -\overline{a_{ji}}$

c) $a_{ij} = a_{ji}$ d) $a_{ij} = -a_{ji}$

Question 2 options:

a) $a_{ij} = 0, when\ i \neq j$ b) $a_{ij} = 0, when\ i = j$

c) $a_{ij} = k, when\ i \neq j$ d) $a_{ij} = -k, when\ i = j$

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3.	All diagonal elements of ___________ matrix are zero.	01	L1	507.1
	a) Symmetric b) Anti-symmetric			
	c) Identity d) Triangular			
4.	The value of element a_{23} in matrix form of quadratic equation, $x_1^2 + x_2^2 - 3x_3^2 + 2x_1x_2 - 4x_1x_3 + 6x_2x_3$ is	01	L2	507.1
	a) 1 b) -2			
	c) 3 d) -3			
5.	i^{219} =	01	L3	507.2
	a) i b) -i			
	c) 1 d) -1			
6.	In complex plane, multiplication of i^2 rotates the direction of axis through angle	01	L2	507.2
	a) 90° b) 180°			
	c) 270° d) 360°			
7.	The point at which the function is not differentiable is called a ___________ of the function.	01	L1	507.2
	a) Regular point b) Singular point			
	c) None of the above			
8.	The function $\frac{1}{z-2}$ has a singular point at,	01	L2	507.2
	a) +2 b) -2			
	c) 0 d) None of the above			

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9.	Fourier series is given as,	01	L1	507.3

a) $$f(x) = a_0 + \sum_{n=1}^{\infty} a_n \sin nx + \sum_{n=1}^{\infty} b_n \sin nx$$

b) $$f(x) = a_0 + \sum_{n=1}^{\infty} a_n \cos nx + \sum_{n=1}^{\infty} b_n \cos nx$$

c) $$f(x) = a_0 + \sum_{n=1}^{\infty} a_n \sin nx + \sum_{n=1}^{\infty} b_n \cos nx$$

d) $$f(x) = a_0 + \sum_{n=1}^{\infty} a_n \cos nx + \sum_{n=1}^{\infty} b_n \sin nx$$

10.	Cosine series in the interval $(0,\pi)$ is given as,	01	L1	507.3

a) $$f(x) = \frac{1}{\pi}\int_0^{\pi} f(v)dv - \frac{2}{\pi}\sum_{n=1}^{\infty}\left\{\int_0^{\pi} f(v)\cos nv\, dv\right\}\cos nx$$

b) $$f(x) = \frac{1}{\pi}\int_0^{\pi} f(v)dv + \frac{2}{\pi}\sum_{n=1}^{\infty}\left\{\int_0^{\pi} f(v)\cos nv\, dv\right\}\cos nx$$

c) $$f(x) = \frac{1}{\pi}\int_0^{\pi} f(v)dv - \frac{1}{\pi}\sum_{n=1}^{\infty}\left\{\int_0^{\pi} f(v)\cos nv\, dv\right\}\cos nx$$

d) $$f(x) = \frac{1}{\pi}\int_0^{\pi} f(v)dv + \frac{1}{\pi}\sum_{n=1}^{\infty}\left\{\int_0^{\pi} f(v)\cos nv\, dv\right\}\cos nx$$

11.	Sine series in the interval $(0,\pi)$ is given as,	01	L1	507.3

a) $$f(x) = \frac{1}{\pi}\sum_{n=1}^{\infty}\cos nx\left\{\int_0^{\pi} f(v)\cos nv\, dv\right\}$$

b) $$f(x) = \frac{2}{\pi}\sum_{n=1}^{\infty}\cos nx\left\{\int_0^{\pi} f(v)\cos nv\, dv\right\}$$

c) $$f(x) = \frac{1}{\pi}\sum_{n=1}^{\infty}\sin nx\left\{\int_0^{\pi} f(v)\sin nv\, dv\right\}$$

d) $$f(x) = \frac{2}{\pi}\sum_{n=1}^{\infty}\sin nx\left\{\int_0^{\pi} f(v)\sin nv\, dv\right\}$$

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12.	The function of the square wave in the interval $-\pi \le x \le 0$ can be written as,	01	L3	507.3

a) $f(x) = \frac{\pi}{2} + 2\left[\sin 2x + \frac{\sin 4x}{4} + \frac{\sin 6x}{6} + \frac{\sin 8x}{8} + \cdots\right]$

b) $f(x) = \frac{\pi}{2} + \left[\sin 2x + \frac{\sin 4x}{4} + \frac{\sin 6x}{6} + \frac{\sin 8x}{8} + \cdots\right]$

c) $f(x) = \frac{\pi}{2} + 2\left[\sin x + \frac{\sin 3x}{3} + \frac{\sin 5x}{5} + \frac{\sin 7x}{7} + \cdots\right]$

d) $f(x) = \frac{\pi}{2} + \left[\sin x + \frac{\sin 3x}{3} + \frac{\sin 5x}{5} + \frac{\sin 7x}{7} + \cdots\right]$

13.	The coefficient a_0 of Fourier series in interval$(-\pi, \pi)$ can be written as,	01	L1	507.3

a) $\frac{1}{2\pi}\int_{-\pi}^{\pi} f(x)\, dx$ b) $\frac{1}{\pi}\int_{-\pi}^{\pi} f(x) \cos nx\, dx$

c) $\frac{1}{\pi}\int_{-\pi}^{\pi} f(x) \sin nx\, dx$ d) 0

14.	The coefficient a_n of Fourier series in interval $(-\pi, \pi)$can be written as,	01	L1	507.3

a) $\frac{1}{2\pi}\int_{-\pi}^{\pi} f(x)\, dx$ b) $\frac{1}{\pi}\int_{-\pi}^{\pi} f(x) \cos nx\, dx$

c) $\frac{1}{\pi}\int_{-\pi}^{\pi} f(x) \sin nx\, dx$ d) 0

15.	The Laplacian operator is given by,	01	L1	507.4

a) $\nabla^2 = \nabla \mathrm{r}^2 + \frac{1}{r^2}\nabla^2_{\theta,\phi}$ b) $\nabla^2 = \nabla^2 + \frac{1}{r^2}\nabla^2_{\theta,\phi}$

c) $\nabla^2 = \nabla \mathrm{r} + \frac{1}{r^2}\nabla^2_{\theta,\phi}$ d) $\nabla^2 = \nabla \mathrm{r}^2 + \frac{1}{r^2}\nabla_{\theta,\phi}$

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16. In spherical polar coordinates, Helmholtz's equation is given by, 01 L1 507.4

a) $\left[\nabla^2 = \nabla \mathrm{r} + \frac{1}{r^2}\nabla^2_{\theta,\phi}\right]\psi(r,\theta,\phi) + k^2(r)\psi(r,\theta,\phi) = 0$

b) $\left[\nabla^2 = \nabla \mathrm{r}^2 + \frac{1}{r^2}\nabla_{\theta,\phi}\right]\psi(r,\theta,\phi) + k^2(r)\psi(r,\theta,\phi) = 0$

c) $\left[\nabla^2 = \nabla \mathrm{r}^2 + \frac{1}{r^2}\nabla^2_{\theta,\phi}\right]\psi(r,\theta,\phi) + k^2(r)\psi(r,\theta,\phi) = 0$

d) $\left[\nabla^2 = \nabla \mathrm{r}^2 + \frac{1}{r}\nabla^2_{\theta,\phi}\right]\psi(r,\theta,\phi) + k(r)\psi(r,\theta,\phi) = 0$

17. The spherical harmonics is given by, 01 L1 507.4

a) $\nabla^2_{\theta,\phi}Y(\theta,\phi) - \lambda Y(\theta,\phi) = 0$

b) $\nabla^2_{\theta,\phi}Y(\theta,\phi) - \lambda Y^2(\theta,\phi) = 0$

c) $\nabla^2_{\theta,\phi}Y(\theta,\phi) + \lambda Y(\theta,\phi) = 0$

d) $\nabla^2_{\theta,\phi}Y(\theta,\phi) + \lambda Y^2(\theta,\phi) = 0$

18. The radial equation can be written as, 01 L1 507.4

a) $\frac{1}{r^2}\frac{d}{dr}\left(r^2\frac{dR}{dr}\right) + \left[k^2(r) + \frac{\lambda}{r^2}\right]R = 0$

b) $\frac{1}{r^2}\frac{d}{dr}\left(r^2\frac{dR}{dr}\right) + \left[k^2(r) - \frac{\lambda}{r^2}\right]R = 0$

c) $\frac{1}{r^2}\frac{d}{dr}\left(r^2\frac{dR}{dr}\right) + \left[k^2(r) + \frac{\lambda}{r}\right]R = 0$

d) $\frac{1}{r^2}\frac{d}{dr}\left(r^2\frac{dR}{dr}\right) + \left[k^2(r) - \frac{\lambda}{r}\right]R = 0$

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19.	The theta equation can be written as,	01	L1	507.4

a) $\frac{1}{\sin\theta}\frac{d}{d\theta}\left(\sin\theta\frac{d\Theta}{d\theta}\right)-\left[\lambda-\frac{m}{sin^2\theta}\right]\Theta=0$

b) $\frac{1}{\sin\theta}\frac{d}{d\theta}\left(\sin\theta\frac{d\Theta}{d\theta}\right)+\left[\lambda-\frac{m}{sin^2\theta}\right]\Theta=0$

c) $\frac{1}{\sin\theta}\frac{d}{d\theta}\left(\sin\theta\frac{d\Theta}{d\theta}\right)-\left[\lambda-\frac{m^2}{sin^2\theta}\right]\Theta=0$

d) $\frac{1}{\sin\theta}\frac{d}{d\theta}\left(\sin\theta\frac{d\Theta}{d\theta}\right)+\left[\lambda-\frac{m^2}{sin^2\theta}\right]\Theta=0$

20.	The Azimuthal equation can be written as,	01	L1	507.4

a) $\frac{d^2\Phi}{d\phi^2}-m^2\Phi=0$ b) $\frac{d^2\Phi}{d\phi^2}-m\Phi=0$

c) $\frac{d^2\Phi}{d\phi^2}+m^2\Phi=0$ d) $\frac{d^2\Phi}{d\phi^2}+m\Phi=0$

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EXM/P/09/00

M.Sc. I **School of Science** **Department of Physics**

Mathematical Methods in Physics

PHS 507 **Semester – I**

Tuesday 04/06/2019

Time: 2 Hours 30 Minutes

End Semester Examination

Max Marks: 80

(B)

11.00 am to 1.30 pm

Instructions: 1)All Questions are compulsory

2) Rough calculations on paper are not allowed

3) Use non-programmable calculator is allowed.

		Marks (16)	Bloom's Level	CO
Q.2.	**Attempt the following**			
1.	Find the characteristic polynomial of the following matrix and verify Caley-Hamilton theorem to find inverse of the same. $\begin{bmatrix} 1 & -2 & 3 \\ 2 & 4 & -2 \\ -1 & 1 & 2 \end{bmatrix}$	12	L3	507.1
2.	Form the cofactor matrix of following matrix, $A = \begin{bmatrix} 7 & 3 & 1 \\ 2 & 1 & 9 \\ 1 & 5 & 8 \end{bmatrix}$	4	L3	507.1
	Or			
2.	Form the cofactor matrix of following matrix, $B = \begin{bmatrix} 9 & 1 & 7 \\ 8 & 2 & 6 \\ 1 & 7 & 3 \end{bmatrix}$	4	L3	507.1

		Marks (16)		CO
Q.3.	**Attempt the following**			
1.	State and prove Taylor's theorem.	12	L3	507.2

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2.	Find the first three terms of the Taylor's series expansion of $f(z) = \frac{1}{z^2+4}$, about z=-i.	4	L3	507.2
	Or			
2.	Discuss and show the graphical representation of multiplication of complex numbers.	4	L3	507.2
Q.4.	**Attempt the following**	**Marks (24)**		**CO**
1.	Evaluate the coefficients of Fourier series for the function in the interval$(-\pi, \pi)$.	12	L5	507.3
2.	Extend the interval of Fourier series from $(-\pi, \pi)$ to$(-l, l)$.	8	L2	507.3
	Or			
2.	Derive Parseval's theorem from Fourier series.	8	L2	507.3
3.	Give graphical representation of a square wave function.	4	L2	507.3
Q.5.	**Attempt the following**	**Marks (24)**		**CO**
1.	State and prove orthogonality properties of Legendre's polynomials	12	L2	507.4
2.	Develop the three ordinary differential equations from Helmholtz's equation in spherical polar coordinates.	8	L4	507.4
	Or			
2.	Starting from solution of the Legendre's differential equation in the form of some variable w=cos θ, construct a solution which will be valid for the interval $-1<w< +1$.	8	L4	507.4
3.	Develop the recurrence relation for Legendre's differential equation.	4	L4	507.4

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