SGU	**Sanjay Ghodawat University, Kolhapur** Established as State Private University under Govt. of Maharashtra. Act No XL, 2017		**2018-19** **EXM/P/09/00**
Program: B. Sc-III	**School of Science** section-A	**Dept. : Physics**	
Course Code: PHS305	**Physics VII (Mathematical Physics)**	**Semester -V**	
Saturday, 23 Nov. 2019	**Examination: ESE, Max Marks: 100, Time ½ hrs**	**10:30 AM to 11 AM**	
Seat No.:	**PRN No.:**	**Student Sign:**	
Invigilator Sign:	**Examiner Sign:**	**Marks Obtained:**	

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 of non-programmable calculator is allowed.

Q.1 Select the correct alternative — **Marks** | **Bloom's Level** | **CO**

1. Which of the following is the property of Matrix Multiplication____ — 01 | L3 | CO1

   a) $AB \neq BA$ b) $A(B+C) = AB+AC$

   c) $A(BC) = (AB)C$ d) All the above options a, b and c

2. The square matrix $A= (a_{ij})$ is said to be Symmetric if, _______ — 01 | L1 | CO1

   a) $A^{\theta}= - A$ & $\bar{A} = - A$ b) $\bar{A} = - A$ & $A' = - A$

   c) $A' = A$ & $a_{ij} = a_{ji}$ d) $A^{\theta} = - A$ & $a_{ii} = 0$

3. A system of homogeneous linear equations AX= O is said to be consistent and has unique solution if, — 01 | L1 | CO1

   a) $R(A) = n$ b) $R(A) \neq R(C)$

   c) $R(A) = R(C) = n$ d) $R(A) < n$

4. The averaging or mean operator, μ, is defined by_______ — 01 | L1 | CO2

   a) $\mu = \frac{1}{2}(E^{1/2} - E^{-1/2})$ b) $\mu = \frac{1}{2}(E^{1/2} + EE^{-1/2})$

   c) $\mu = \frac{1}{2}(EE^{1/2} - E^{-1/2})$ d) $\mu = \frac{1}{2}(E^{1/2} + E^{-1/2})$

5. The first order difference of f (x) in the forward difference is defined as — 01 | L2 | CO2

   a) $\Delta f_n = f(x_{n+1}) + f(x_n)$ b) $\Delta f_n = f(x_{n+1}) - f(x_n)$

   c) $\Delta f_n = f(x_{n-1}) - f(x_n)$ d) None of the above

6. The first order difference of f (x) in the backward difference is defined as — 01 L2 CO2

a) $\Delta f_n = f(x_n) - f(x_{n-1})$ b) $\nabla f_n = f(x_n) - f(x_{n-1})$

c) $\nabla f_n = f(x_n) + f(x_{n-1})$ d) $\Delta f_n = f(x_n) - f(x_{n+1})$

7. Which of the following is not a beta function____ — 01 L1 CO3

a) $\beta(l,m) = \int_0^1 x^{l-1}(1-x)^{m-1}dx$ b) $\beta(m,l) = \int_0^1 x^{m-1}(1-x)^{l-1}dx$

c) $\beta(l,m) = \beta(m,l)$ d) $\beta(m,l) = \int_0^1 x^{m-1}(1+x)^{l-1}dx$

8. The relation between beta and gamma function is given by — 01 L4 CO3

a) $\beta(l,m) = \frac{\Gamma l \, \Gamma m}{\Gamma (l+m)}$ b) $\beta(l,m) = \frac{\Gamma l \, \Gamma m}{\Gamma (l-m)}$

c) $\beta(m,l) = \frac{\Gamma l \, \Gamma m}{\Gamma (l-m)}$ d) None of the above

9. The complementary error function of x, $erf_c\,(x)$ is — 01 L1 CO3

a) $\frac{2}{\sqrt{\pi}}\int_0^x e^{-t^2}\,dt$ b) $\frac{\sqrt{\pi}}{2}\int_\infty^x e^{-t^2}\,dt$

c) $\frac{2}{\sqrt{\pi}}\int_0^\infty e^{t^2}\,dt$ d) $\frac{2}{\sqrt{\pi}}\int_x^\infty e^{-t^2}\,dt$

10. Which of the following is not correct — 01 L3 CO3

a) $\Gamma(n+1) = n\Gamma n$ b) $\Gamma(n+1) = n!$

c) $\Gamma 1 = 1$ d) None of the above

11. The error function of ∞, $erf\,(\infty)$ is — 01 L3 CO3

a) 2 b) 1

c) $\sqrt{\pi}$ d) 0

12. The error function of $erf\,(-x)$ is — 01 L3 CO3

a) $-erf\,(x) + erf\,(-x)$ b) $\sqrt{\pi}$

c) $-erf\,(x)$ d) C

13. $\beta\left(\frac{1}{2},\frac{1}{2}\right)$ is_______ — 01 L3 CO3

a) π b) $\sqrt{\pi}$

c) 2 d) $2\sqrt{\pi}$

14. Which of the following function is even? — 01 L1 CO4

a) $f(x) = x$ b) $f(x) = x^2$

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c) $f(x) = x^3$ d) $f(x) = sinx$

15. The Fourier coefficient b_n for n = 1, 2, 3, ….. can be represented by_______ 01 L1 CO4

a) $b_n = \frac{1}{\pi}\int_{-\pi}^{\infty} f(x)\sin^2 nxdx$ b) $b_n = \frac{1}{2}\int_{-\pi}^{\infty} f(x)\cos nxdx$

c) $b_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\sin nxdx$ d) $b_n = \frac{1}{\pi}\int_{-\pi}^{\infty} f(x)\sin nxdx$

16. The Fourier for square wave for the function $f(x) = \{^{0 \quad -\pi<x<0}_{n \quad 0<x<\pi}$ can be written as__ 01 L1 CO4

a) $f(x) = \frac{h}{4} + \frac{2h}{\pi}[\sin x + \frac{\sin 3x}{3} + \frac{\sin 5x}{5} + ...]$

b) $f(x) = \frac{h}{4} + \frac{\pi}{2h}[\sin x + \frac{\sin 5x}{5} + ...]$

c) $f(x) = \frac{h}{4} + \frac{\pi}{2h}[\sin x + \frac{\sin 3x}{3} + \frac{\sin 5x}{5} + ...]$

d) $f(x) = \frac{h}{4} + \frac{\pi}{2h}[\sin x + \frac{\cos 5x}{5} + ...]$

17. The expansion of Fourier series is________ 01 L1 CO4

a) $f(x) = a_0 + \sum_{n=1}^{\infty}\left(a_n \frac{\cos n\pi x}{L} + b_n \frac{\sin n\pi x}{L}\right)$

b) $f(x) = a_0 + \sum_{n=1}^{\infty}\left(a_n \frac{\cos n\pi x}{L} + b_n \frac{\cos n\pi x}{L}\right)$

c) $f(x) = a_0 + \sum_{n=1}^{\infty}\left(a_n \frac{\sin n\pi x}{L} - b_n \frac{\sin n\pi x}{L}\right)$

d) $f(x) = a_0 + \sum_{n=1}^{\infty}\left(a_n \frac{\sin n\pi x}{L} + b_n \frac{\cos n\pi x}{L}\right)$

18. The Fourier coefficient a_n can be represented by________ 01 L1 CO4

a) $a_n = \frac{1}{2\pi}\int_{-\pi}^{\pi} f(x)\cos nxdx$

b) $a_n = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)\cos nxdx$

c) $a_n = \frac{1}{2}\int_{-\pi}^{\pi} f(x)\sin nxdx$

d) $a_n = \frac{1}{2}\int_{-\pi}^{\pi} f(x)\sin^2 nxdx$

19. The Fourier for sawtooth wave can be written as__ 01 L1 CO4

a) $(y_t) = a + \frac{a}{\pi}[\sin \omega t + \frac{1}{2}\cos 2\omega t + \frac{1}{3}\sin \omega t + ...]$

b) $(y_t) = a + \frac{a}{\pi}[\sin \omega t + \frac{1}{3}\sin \omega t + ...]$

c) $(y_t) = a + \frac{a}{\pi}[\sin \omega t + \frac{1}{2}\sin 2\omega t + \frac{1}{3}\sin 3\omega t + ...]$

d) $(y_t) = a + \frac{a}{\pi}[\sin \omega t + \frac{1}{2}\sin \omega t + ...]$

20. The Fourier for full wave rectifier for the function $f(x) = \{^{\sin \omega t \quad 0<\omega t<\pi}_{-\sin \omega t \quad -\pi<\omega t<0}$ can be written as__ 01 L1 CO4

a) $f(t) = \frac{4}{\pi} + \frac{4}{\pi}[\frac{\cos 2\omega t}{3} + \frac{\cos 4\omega t}{15} + ...]$

b) $f(t) = \frac{4}{\pi} + [\frac{\cos 2\omega t}{3} + \frac{\sin 4\omega t}{5} + ...]$

c) $f(t) = \frac{4}{\pi} - \frac{4}{\pi}\left[\frac{\cos 2\omega t}{3} + \frac{\cos 4\omega t}{15} + ...\right]$

d) $f(t) = \frac{4}{\pi} + [\frac{\cos 2\omega t}{3} + \frac{\sin \omega t}{25} + ...]$

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Program: B. Sc-III	School of Science Section-B	**Dept. : Physics**
Course Code: PHS305	**Physics VII (Mathematical Physics)**	**Semester -V**
Saturday, 23 Nov. 2019	**Examination: ESE, Max Marks: 100, Time 3 hrs**	**11 AM to 1:30 PM**

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

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	Q.2 Attempt the following questions.	**Marks**	**Bloom's Level**	**CO**
a)	The matrix A is defined as $A = \begin{bmatrix} 1 & 2 & -3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$, Find the eigen values of $3A^3 + 5A^2 - 6A + 2I$.	08	L3	CO1
b)	If $A = \begin{bmatrix} 1 & -2 & 3 \\ 2 & 3 & -1 \\ 2 & 1 & -3 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 1 & 2 & 0 \end{bmatrix}$ find the product AB and BA, and show that $AB \neq BA$.	04	L2	CO1
	OR			
b)	Determine the values of $\alpha, \beta, and\ \gamma$ when $A = \begin{bmatrix} 0 & 2\beta & \gamma \\ \alpha & \beta & -\gamma \\ \alpha & -\beta & \gamma \end{bmatrix}$ is orthogonal.	04	L2	CO1

	Q.3 Attempt the following questions.	**Marks**	**Bloom's Level**	**CO**
a)	Using Simpson's 1/3 Rule, find the value of the integral $\int_0^1 \frac{dx}{1+x}$ correct	08	L2	CO2

ESE

to third decimal place. {Take h = 0.25}

		Marks	Bloom's Level	CO
b)	Write the expressions for first order and second order differentiation using ***Stirling Formula for $x = x_0 + rh$ and $x = x_0$.***	04	L3	CO2
	OR			
b)	Derive an expression for ***Central difference Interpolation Formula.***	04	L3	CO2

Q.4	**Attempt the following questions.**	**Marks**	**Bloom's Level**	**CO**
a)	Show that, 1. $\beta(l, m) = \dfrac{\overline{|l}\,\overline{|m}}{\overline{|l+m}}$ 2. $\beta(l, m) = \beta(m, l)$ using beta and gamma function.	08	L4	CO3
b)	Evaluate using beta function 1. $\int_0^1 x^4\left(1-\sqrt{x}\right)^5 dx$ 2. $\int_0^1 \left(1-x^3\right)^{-\frac{1}{2}} dx$	08	L5	CO3
c)	Evaluate $\int_0^\infty \dfrac{x^a}{a^x}dx$ using gamma function, hence show that $\int_0^\infty \dfrac{x^7}{7^x}dx = \dfrac{7!}{(\log 7)^8}$	04	L3	CO3
d)	Prove that $\int_0^1 x^m(\log x)^n dx = \dfrac{(-1)^n}{(m+1)^{n+1}}\overline{|n+1}$	04	L5	CO3
e)	Prove that $\int_0^{\frac{\pi}{2}} \sqrt{\sin\theta}\,d\theta \times \int_0^{\frac{\pi}{2}} \dfrac{1}{\sqrt{\sin\theta}}d\theta = \pi$	04	L2	CO3
	OR			
e)	Show that $\int_0^\infty e^{-x^2-2bx}dx = \dfrac{\sqrt{\pi}}{2}e^{b^2}\left[1-erf(b)\right]$	04	L2	CO3

Q.5	**Attempt the following questions.**	**Marks**	**Bloom's Level**	**CO**
a)	Find the Fourier series for $f(x) = x^2$ in the interval $[-\pi, \pi]$	08	L3	CO4
b)	Find the Fourier series for $f(x) = |x|$ in the interval $[-\pi, \pi]$.	08	L2	CO4

c)	Find the Fourier integral $f(x)=\begin{cases}1 & \lvert x\rvert<1\\ 0 & \lvert x\rvert>1\end{cases}$	04	L2	CO4
d)	Elaborate sine Fourier series.	04	L2	CO4
e)	Obtain Fourier series expansion for full wave rectifier.	04	L3	CO4
	OR			CO4
e)	Expand Fourier series for sawtooth wave.	04	L3	CO4

ESE