Reg. No.: | | | | | | | | | |

G.T.N. ARTS COLLEGE SELF FINANCE (AUTONOMOUS)

(Affiliated to Madurai Kamaraj University || Accredited with 'B' Grade by NAAC)

END SEMESTER EXAMINATION - NOVEMBER - 2021

(UNDER OUTCOME BASED EDUCATION (OBE) PATTERN)

Programme : M.Sc. Physics — **Date : 14.02.2022**

Course Code : 20PPHC11 — **Time : 10:00 AM - 1:00 PM**

Course Title : Mathematical Physics - I — **Max. Marks : 60**

Q. No.	SECTION - A (10 * 1 = 10 Marks) Answer ALL Questions		CO(s)	K - Level
1.	If vectors A and B are mutually perpendicular, then _____.		CO1	K1
	1.A · B = 0	2.A · B > 0		
	3.A · B < 0	4.A × B = 0		
2.	Grad $\left(\frac{1}{r}\right)$ is equal to _____.		CO1	K2
	1.$\frac{r}{r^2}$	2.$-\frac{r}{r^2}$		
	3.$-\frac{r}{r^3}$	4.$\frac{xyz}{r^2}$		
3.	A Fourier series of a function f(x) contains only cosine terms if functions f(x) is _____.		CO2	K1
	1.an odd function of x	2.an even function of x		
	3.an exponential function containing real terms only	4.it is not possible		
4.	If complex form of Fourier series is f(t) = $\sum_{-\infty}^{+\infty} C_n e^{in\omega t}$, then Parseval's formula is _____.		CO2	K2
	1.$\frac{2}{T}\int_0^T \|f(t)\|^2 dt = \sum_{-\infty}^{+\infty} \|C_n\|^2$	2.$\frac{1}{T}\int_{-T/2}^{T/2} \|f(t)\|^2 dt = \sum_{-\infty}^{+\infty} \|C_n\|^2$		
	3.$\frac{2}{T}\int_{-T/2}^{T/2} \|f(t)\|^2 dt = \sum_{-\infty}^{+\infty} \|C_n\|^2$	4.$\frac{1}{2T}\int_0^T \|f(t)\|^2 dt = \sum_{-\infty}^{+\infty} \|C_n\|^2$		
5.	The value of β(2, z) is _____.		CO3	K1
	1.$\frac{1}{z}$	2.$\frac{1}{z+1}$		
	3.$\frac{1}{z(z+1)}$	4.$\frac{z-1}{z+1}$		
6.	What is the ratio $\frac{\Gamma(-\frac{3}{2})}{\Gamma(\frac{3}{2})}$ is _____.		CO3	K2
	1.1	2.3/8		
	3.8/3	4.2/3		
7.	The modified Bessel's functions J_n (x) and K_n (x) are _____.		CO4	K1
	1.oscillatory in nature	2.exponential in nature		
	3.linear in nature	4.Poisson's equation		
8.	Which function represents F (1, 1, 2, x)?		CO4	K2
	1.$\ln(1-x)$	2.$\frac{1}{x}\ln(1-x)$		
	3.$-\frac{1}{x}\ln(1+x)$	4.$-\frac{1}{x}\ln(1-x)$		

9.	The basic equation of vibration of a membrane in two dimensions is _____. 1. $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ 2. $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{\rho}{\varepsilon_0}$ 3. $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{1}{c^2}\frac{\partial^2 u}{\partial t^2}$ 4. $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = \frac{1}{c}\frac{\partial u}{\partial t}$	CO5	K1
10.	The differential equation $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 0$ by the method of separation of variables is _____. 1. $e^x e^{-y}$ 2. $\left(\frac{x}{y}\right)^c$ 3. $(xy)^c$ 4. $e^{(x+y)/2}$	CO5	K2

Q. No.	SECTION - B (5 * 4 = 20 Marks) Answer ALL Questions	CO(s)	K - Level
11. (a)	What are the values of A·B×A and A×B×A?	CO1	K2
	[OR]		
(b)	Check whether the vector $12\hat{i} + 4\hat{j} - 6\hat{k}$ is parallel or perpendicular to vector $6\hat{i} + 2\hat{j} - 3\hat{k}$.	CO1	K2
12. (a)	Find the Fourier transform of $e^{-\lvert t \rvert}$	CO2	K3
	[OR]		
(b)	State and prove the linear property of FT.	CO2	K3
13. (a)	Using gamma function, show that $\int_0^1 \frac{35x^2}{32\sqrt{1-x}}dx = 1$	CO3	K4
	[OR]		
(b)	Prove that $\Gamma\frac{1}{2} = \sqrt{\pi}$	CO3	K4
14. (a)	Show that $H_{2n}\left(0\right) = (-1)^n\frac{(2n)!}{n!}$	CO4	K2
	[OR]		
(b)	Show that $x^2 = \frac{1}{2}H_0\left(x\right) + \frac{1}{4}H_2\left(x\right)$	CO4	K2
15. (a)	If Sn and Sm are zonal spherical harmonics, then prove that, $\iint S_n S_m ds = 0,\ n \neq m$	CO5	K3
	[OR]		
(b)	Derive Helmholtz equation.	CO5	K3

Q. No.	SECTION - C (3 * 10 = 30 Marks) Answer any of 3	CO(s)	K - Level
16.	Using Gauss divergence theorem evaluate the following integral, $\int\int_S$ $(x^3\, dy\, dz + y^3\, dz\, dx + z^3\, dx\, dy)$ where S is the surface of the sphere $x^2 + y^2 + z^2 = a^2$.	CO1	K2
17.	Find the Fourier integral of the following function $f\left(x\right) = \begin{cases} 1 & when\ \lvert x\rvert < 1 \\ 0 & when\ \lvert x\rvert > 1 \end{cases}$ Hence prove that $\int_0^\infty \frac{\cos\lambda x \sin\lambda}{\lambda}d\lambda = \begin{cases} \frac{\pi}{2} & for\ 0 < x < 1 \\ \frac{\pi}{4} & for\ x = 1 \\ 0 & for\ x > 1 \end{cases}$	CO2	K3
18.	Verify the following β-function identities, (i) β (m, n) = β (m+1, n) + β (m, n+1) (ii) β (m, n) = $\frac{m+n}{n}\beta\left(m,\ n+1\right)$	CO3	K4
19.	If n is a positive integer, prove that $\int_{-1}^{+1} P_n\left(x\right)\left(1 - 2xz + z^2\right)^{-1/2}dx = \frac{2z^n}{2n+1}$ and hence, making use of Rodrigue's formula, deduce that	CO4	K2

$$\int_{-1}^{1} \left(1 - x^2\right)^n \left(1 - 2xz + z^2\right)^{-n-(1/2)} dx \ = \frac{2^{2n+1}\,(n!)^2}{2n+1}$$

where Pn (x) are Legendre's polynomials.

20. Write Laplace's equation in Cartesian, cylindrical and spherical polar coordinates. Solve it in Cartesian coordinates. CO5 K3

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