QP Code: RM20MSC091 Reg. No | | | | | | | | | | | AR 20

GIET UNIVERSITY, GUNUPUR – 765022

M. Sc (First Semester) Examinations, May – 2021

20PHPC101 – MATHEMATICAL METHODS IN PHYSICS

(PHYSICS)

Time: 2 hrs Maximum: 50 Marks

(Figures in the right-hand side indicates marks)

PART– A **$(2 \times 10 = 20$ marks)**

Q.1. Answer ***ALL*** questions

a. Show that the function $e^x(\cos y + i\sin y)$ is an analytic function, Find its derivative.

b. Expand the following function in a Laurent series about the point $(z=0)$

$$\boldsymbol{f(z) = \frac{1 - \cos z}{z^3}}$$

c.. Find out the zeroes in the function, $\boldsymbol{f(z) = \frac{z-2}{z^2} \sin\left(\frac{1}{z-1}\right)}$

d. What is the value of $\varepsilon_{ijk}\varepsilon_{ijk}$?

e. Prove that:$\boldsymbol{\varepsilon_{ilm}\varepsilon_{jlm} = 2\delta_{ij}}$.

f. What is the Rodrigues formula for Legendre polynomial? Using that find $P_2(x)$ and $P_0(x)$.

g. Show with usual notation that $\boldsymbol{\frac{\partial g_{ij}}{\partial x_k} = [j, ik] + [i, jk]}$

h. Find the Laplace transform of t^n.

i. Prove that if every element of a group 'G' be its own inverse, then 'G' is abelian.

j. What is Cayley's theorem in Group Theory?

PART–B **(6 x 5 = 30)**

Answer ***ANY FIVE*** of the questions Marks

2. Find the values of C_1 and C_2 such that the function: $f(z)=x^2+C_1y^2-2xy+i(C_2x^2-y^2+2xy)$ is analytic. Also find $f'(z)$. (6)

3. State and prove Laurent's theorem. (6)

4. Derive transformation laws for the Christoffel's symbols of the first and Second kind. (6)

5. Find the Fourier transform of $f(x) = \begin{cases} 1 - |x|, if\ |x| \le 1 \\ 0, \qquad if\ |x| > 1 \end{cases}$ (6)

6. Express $f(x)=4x^3+6x^2+7x+2$ in terms of Legendre polynomials. (6)

7. Show that the following matrix represents a tensor. (6)

$$\begin{pmatrix} -\mathrm{xy} & y^2 \\ x^2 & xy \end{pmatrix}$$

8. Let G be an abelian group. Prove that the subset $H=\{g\epsilon G: g^2 = e\ (identity\ element)\}$ forms a subgroup of G. (6)

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