

PE-258
(522) M.Sc. Physics (Second Semester)
Examination June 2022
Compulsory/Optional
MATHEMATICAL METHODS-II
Paper-I

Time: Three Hours

Maximum Marks: 080
Minimum Passing Marks:

नोट: दोनों खण्डों से निर्देशानुसार उत्तर दीजिए। प्रश्नों के अंक उनके दाहिनी ओर अंकित हैं।

Note: Answer from both section as directed. The figures in the right-hand margin indicate marks.

SECTION-A

1. Answer the following questions:

[1 X 10 = 10]

- (a) The outer product of two mixed tensor A^u_v and B^m_n is:-
(a) a scalar (b) a tensor of rank-2 (c) a tensor of rank-4 (d) does not exist.
- (b) If $A^{\mu\nu} = A^{\nu\mu}$ then $A^{\mu\nu}$ is :
(a) 0 (b) a symmetric tensor (c) an antisymmetric tensor (d) a scalar
- (c) Christoffel's 3 index symbols are:-
(a) invariant (b) vectors (c) tensors (d) not the tensors
- (d) State symmetry property of Green's function.
- (e) What is Green's function?
- (f) Write the formula of heat flow equation.
- (g) Write the formula of expansion of Green's Formula.
- (h) The analytic function $f(z)$, whose real part in $(x^2 - y^2)$ is :
(a) z (b) z^2 (c) $|z|^2$ (d) z^2
- (i) The residue of the function $f(z) = \frac{z^2}{z^2+4}$ at $z = 2i$ is : Type equation here.
(a) $e^{i\pi/2}$ (b) $e^{i\pi\frac{(z^2+4)}{x}}$ (c) $e^{3i\pi/2}$ (d) $e^{-i\pi/2}$
- (j) The value of integral $\int \frac{\cos mx}{x} dx$ is
(a) 0 (b) 1 (c) $\frac{\pi}{2}$ (d) π

2. Answer the following questions (any 5)

[2 X 5 = 10]

- (a) Define contraction of tensors with an example.
- (b) Discuss outer product and inner product of two tensor.
- (c) Discuss the symmetry property of Green's function.
- (d) Write poisson and laplace equation, Give its uses.
- (e) Discuss D'Alembert's solution of vibrating string.
- (f) Define an analytic function of a complex variable.

SECTION-B

Answer the following questions:

[15 X 4 = 60]

3. (i) State and prove Quotient Law. (10)
(ii) Discuss addition and subtraction of two mixed tensor. (05)

Or,

- (i) State and prove equation of Geodesics. (10)
(ii) Discuss covariant fundamental tensor of rank-2. (05)

4. Derive Green's function for Quantum mechanical scattering problem. (15)

Or,

Determine the Green's function associated with boundary value problem $\frac{d^2 y}{dx^2} = f(x)$ with boundary condition $y(0) = 0$ and $(\frac{dy}{dx})_{x=1} = 0$ using the method of expansion of Green's function in terms of orthonormal function of operator $\frac{d^2}{dx^2}$ (15)

5. Derive and solve two – dimensional heat flow equation. (15)

Or,

A thin rectangular plate whose surface is impervious to heat flow has arbitrary distribution of temperature $f(x,y)$ at $t = 0$, its four edges $x = 0, x = a; y = 0, y = b$ are kept at zero temperature. Determine the subsequent temperature of the plate after time t . (15)

6. (a) State and prove cauchy-Riemann equation for a function of complex variable to be analytic. (10)
(b) Define line integral of a complex function. (05)