AP-2202

M.A./M.Sc. (Final) Examination, 2020

MATHEMATICS

(For Due)

Paper-Opt-XII

(Relativity and Transform Calculus)

Time allowed : Two hours
Maximum Marks : 100

SECTION – A **(Marks : 2 × 10 = 20)**

Answer all **ten** questions (Answer limit 50 words). Each question carries 2 marks.

खण्ड – अ **(अंक : 2 × 10 = 20)**

समस्त दस प्रश्नों के उत्तर दीजिए (उत्तर सीमा 50 शब्द) । प्रत्येक प्रश्न 2 अंक का है ।

SECTION – B **(Marks : 4 × 5 = 20)**

Answer all **five** questions. Each question has internal choice (Answer limit 200 words). Each question carries 4 marks.

खण्ड – ब **(अंक : 4 × 5 = 20)**

समस्त पाँच प्रश्नों के उत्तर दीजिए । प्रत्येक प्रश्न में विकल्प का चयन करें (उत्तर सीमा 200 शब्द) । प्रत्येक प्रश्न 4 अंक का है ।

SECTION – C **(Marks : 20 × 3 = 60)**

Answer any **three** questions out of **five** (Answer limit 500 words). Each question carries 20 marks.

खण्ड – स **(अंक : 20 × 3 = 60)**

पाँच में से किन्हीं तीन प्रश्नों के उत्तर दीजिए (उत्तर सीमा 500 शब्द) । प्रत्येक प्रश्न 20 अंक का है ।

SECTION – A

1. (i) Define Lorentz contraction factor.

   (ii) Define world line of a particle.

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(iii) State the equivalence of mass and energy.

(iv) Define the Energy-Momentum tensor of a continuous material system.

(v) Define Planetary orbit.

(vi) State the three crucial test.

(vii) Define Fourier cosine transform.

(viii) Find the Fourier sine transform of x.

(ix) Define linearity property of Hankel transform.

(x) Define Mellin Transform.

SECTION – B

2. Describe Michelson and Morley experiment.

OR

Prove that if two events are connected by a time-like interval there exists a frame in which they happen at the same point.

3. Discuss the relativistic motion law of a particle.

OR

Explain the principle of General Covariance.

4. Discuss the Analogues of Kepler's laws in general relativity.

OR

Obtain the formula for Energy Momentum Tensor for perfect fluid.

5. Find the Fourier sine transform of the function :

$$f(x) = \begin{cases} \sin x, & 0 < x < a \\ 0 \quad , & x > a \end{cases}$$

OR

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Show that the Fourier Transform of $f(x) = e^{-x^2/2}$ is $e^{-p^2/2}$.

6. Find the Hankel Transform of :

$$f(x) = \begin{cases} 1, & 0 < x < a, n = 0 \\ 0. & x > a, n = 0 \end{cases}$$

OR

Show that $M[e^{-ax}; p] = \frac{\Gamma p}{a^p}$, $Re(p) > 0$.

SECTION – C

7. Obtain the Lorentz transformation equations.

8. Obtain the Newton's equations of motion in a classical gravitational field.

9. Discuss the Schwarzschild Internal solution.

10. Using Fourier Transform solve,

$$\frac{\partial\theta}{\partial t} = k\frac{\partial^2\theta}{\partial x^2}, x > 0, t > 0.$$

BC : $\theta = \theta_0$ when $x = 0, t > 0$

And IC : $\theta = 0$ when $t = 0, x > 0$

11. State and prove convolution theorem for Mellin Transform.

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