1104-04 Total Pages : 8

Degree (Part-II) Examination, 2022

(Honours)

MATHEMATICS

[Paper : Fourth]

[PPU-D-II-(H)-MATH-4]

Time : Three Hours] **[Maximum Marks : 100**

Note : Candidates are required to give their answers in their own words as far as practicable. The questions are of equal value. Answer **five** questions in all. Question No. 1 question is **compulsory**. Besides this, attempt one question from each group.

Note : Choose the correct option of the following :

1. (i) If $\vec{a},\vec{b},\vec{c}$ are three vectors then $(\vec{a}\times\vec{b})\times\vec{c}$ is,

(a) $(\vec{a}\cdot\vec{c})\vec{b}-(\vec{b}\cdot\vec{c})\vec{a}$

(b) $(\vec{a}\cdot\vec{c})\vec{b}-(\vec{a}\cdot\vec{b})\vec{c}$

(c) $(\vec{a}\cdot\vec{b})\vec{c}-(\vec{a}\cdot\vec{c})\vec{b}$

(d) None of these

i) The value of $\vec{a}\times(\vec{b}\times\vec{c})$ is :

(a) $3\vec{a}\times(\vec{b}\times\vec{c})$

(b) $3\vec{b}\times(\vec{c}\times\vec{a})$

(c) 0

(d) None of these

) $\left[\vec{a}\times\vec{b},\vec{b}\times\vec{c},\vec{c}\times\vec{a}\right]$ is equal to :

(a) $\left[\vec{a}\,\vec{b}\,\vec{c}\right]$

(b) $\left[\vec{a}\,\vec{b}\,\vec{c}\right]^2$

(c) $\left[\vec{a}\,\vec{b}\,\vec{c}\right]^3$

(d) None of these

(iv) Solution of $ydx - xdy = xy\,dx$ is :

(a) $x = y.e^{c-x}$

(b) $x + y = c$

(c) $y = x.e^{c-x}$

(d) None of these

(v) Solution of $(x + y)dy - (x - y)dx = 0$ is :

(a) $xy - \frac{x^2}{2} + \frac{y^2}{2} = c$

(b) $x^2 - y^2 = c$

(c) $y^2 - xy = c$

(d) None of these

(vi) Solution of $\frac{dy}{dx} = \frac{y}{x} + \tan\frac{y}{x}$ is :

(a) $Kx = \sin\frac{y}{x}$

(b) $Kx = \tan\frac{y}{x}$

(c) $K\tan x = \cos\frac{y}{x}$

(d) None of these

(vii) The singular solution of $y = px + \frac{a}{p}$ where $p = \frac{dy}{dx}$ is :

(a) $x - 4ay = 0$

(b) $y^2 - 4ax = 0$

(c) $x^2 - 4ay = 0$

(d) None of these

(viii) The equation of line of action of the resultant of the coplanar forces acting upon a rigid body is :

(a) $yX - xY + G = 0$

(b) $Y.x - Xy + G = 0$

(c) $Y.y - Xx + G = 0$

(d) None of these

(ix) Hook's law is :

(a) *Stress ∝ Area*

(b) *Stress ∝ Volume*

(c) *Stress ∝ Strain*

(d) None of these

(x) The radial velocity of a particle (r, θ) at time describing a smooth curve is :

(a) $\frac{dr}{dt}$

(b) $\frac{d^2r}{dt^2}$

(c) $\frac{dt}{dr}$

(d) None of these

Group-A

2. (a) Prove that $\vec{a}\times(\vec{b}\times\vec{c})+\vec{b}\times(\vec{c}\times\vec{a})+(\vec{a}\times\vec{b})=0$

(b) $\left[\vec{a}+\vec{b},\vec{b}+\vec{c},\vec{c}\times\vec{a}\right]=2\left[\vec{a}\,\vec{b}\,\vec{c}\right]$ Prove it.

3. (a) What do you mean by vector operator. Define gradient of ϕ.

(b) Define curl of a Vector field.

Group-B

4. (a) Solve, $\frac{dy}{dx}+y\sec x=\tan x$

(b) Solve $\frac{dy}{dx}+1=e^{x-y}$

5. (a) Solve, $p(p+x)=y(x+y)$ where $p=\frac{dy}{dx}$

(b) Find the orthogonal trajectories of the cardiode $r=a(1-\cos\theta)$ where a is the parameter.

Group-C

6. (a) Obtain the equation of the line of action of the resultant of a coplanar system of forces acting upon a rigid body.

(b) Obtain the necessary and sufficient conditions of equilibrium of system of coplanar system of forces acting upon a rigid body.

7. (a) State and prove principle of virtual work for any system of forces acting in a plane.

(b) Forces P,Q,R, acting along the altitudes from A, B and C of triangle ABC are equivalent to forces X,Y,Z acting along BC, CA, AB then prove that $X \sec A = Q \operatorname{cosec} B - R \operatorname{cosec} C$.

Group-D

8. (a) State and prove Hooke's Law.

(b) Prove that the work done in stretching a elastic string is equal to the extension produced multiplied by the mean of the initial and final tensions.

9. (a) Find the radial and transverse velocities of particle (r, θ) describing a smooth curve.

(b) If the radial and transverse velocities of particle are always proportional to each other. Then show that the equation to the path is equiangular spiral.

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