Duration : 2 Hours **Total Marks : 60**

Q. 1 **Attempt any four of the following** 16

a. Make a graph of the following function and find its asymptote critical point and inflection point.

$y=\frac{x^2-2x}{x^2-1}$

b. Show that , $f(x)=\begin{cases}x^2+x+1, & x<1\\ 3x, & x>1\end{cases}$ is continuous at x=1 . Determine whether f is differentiable at x=1.

c. Find $\frac{dy}{dx}$ by using chain rule.

$y=\sqrt{x}.tan^3(\sqrt{x})$

d. Use the first and second derivative to show that f(x)=$3x^2-6x+1$ have relative minimum at x=1.

e. You have $600m^2$ of fencing to create an enclosed flower garden you have 3 types of flowers and you want them to be kept separate. What are the dimension on of largest possible garden

f. Find.

a. $\frac{d}{dx}[\sin(\sqrt{1+cosx})]$ b. $\frac{d\mu}{dt}$ if μ=sec$\sqrt{wt}$ (w constant)

g. At which interval f is increasing, decreasing, concave up, concave down.

f(x)=$3x^4-4x^3$

h. The profit 'y' generating from sale of 'x' items of a certain product is given by formula y=600x+$15x^2-x^3$.Calculate the value of x which gives a maximum profit and determine the maximum profit.

Q. 2 **Attempt any four of the following** 16

a. Use the definition of x_k^* as the right end point of each subintervals to find the area between the graph of f(x)=x^2 and the interval [0,1]

b. Evaluate $\int_0^3 f(x)dx$ if $f(x)=\begin{cases}x^2, & x<2\\ 3x-2, & x\geq 2\end{cases}$

c. Find the arc length of the curve over the interval y=$(3x)^{\frac{3}{2}}$-1

d. Solve the initial value problem by method of separation of variables.

$y'=\frac{3x^2}{y+cosy}$; y(0)=π

e. Approximate the integral by using Simpsons rule with n=6

f(x)=$\int_0^1 sin\sqrt{x}$dx.

f. Find the area of the following curve

X=siny , x=0, y=$\frac{\pi}{4}$ and y=$\frac{3\pi}{4}$

g. Write down the formula for Simpson's 1/3 rd and Euler's method for n+1 approximation.

h. Find the arc length of the curve y=$x^{3/2}$ from (1,1) to (2.,2$\sqrt{2}$)

Duration : 2 Hours **Total Marks : 60**

Q. 3 **Attempt any four of the following** **16**

a. Define limits of a function of two variable and three variable using examples.

b. Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ if z=x^4.sin(x.y^2)

c. Given that z=e^{xy}, x=2u+v , y=u/v find $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$ by using the chain rule.

d. Find directional derivative of f at point p using vector u.
f(x,y,z)=4$x^5y^2z^2$. P(2,-1,1) , u=$\frac{1}{3}$i+$\frac{2}{3}$j-$\frac{2}{3}$k

e. Consider the ellipsoid x^2+4y^2+z^2=18
a. find an equation of the tangent plane to the ellipsoid at the point (1,2,1)
b. Find the parametric equation of the line that is normal to the ellipsoid at the point (1,2,1)
c. find the acute angle that the tangent plane at the point (1,2,1)

f. Suppose that w=$x^2 + y^2 - z^2$, x=$\varrho sin\phi cos\theta$, y=$\varrho sin\phi cos\theta$ and z=$\varrho sin\phi$
Use the appropriate form of the chain rule to find $\frac{\partial w}{\partial \varrho}, \frac{\partial w}{\partial \theta}, \frac{\partial w}{\partial \phi}$

g. Find the gradient of f at the indicated point.
f(x,y)= $(x^2 + xy)^3; (-2, -1)$

h. Locate all the relative extrema and saddle point of the function
f(x,y)=$3x^2 - 2xy + y^2 - 8y$.

Q. 4 **Attempt any Three of the following** **12**

a. Find the value of constant k if possible that will make the function continuous everywhere.

$$f(x) = \begin{cases} kx^2, & x \leq 2 \\ 2x + k, & x > 2 \end{cases}$$

b. Find $f''(\pi/4)$ if f(x)=secx.

c. Solve the differential equation $\frac{dy}{dx}$+2xy=x.

d. Use Euler's method with a step size of 0.1 of the solution of the initial problem y'=y-x , y(0)=2 over the interval $0 \leq x \leq 1$.

e. Find f_x(x,y) and f_y(x,y) for f(x,y)=2x^3y^2+2y+4x, and use those partial derivatives to compute $f_x(1,3)$ and $f_y(1,3)$.

f. Determine whether the following limit exists. If so find its value.

$$\lim_{(x,y)\to(0,0)} \frac{x^4 - 16y^4}{x^2 + 4y^2}$$

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