# Assignment-1

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## SECTION-A

## JEE ADVANCED

*E - Subjective Problems*

1) If $f(x-y) = f(x).g(y) - f(y).g(x)$ and $g(x-y) = g(x).g(y) - f(x).f(y)$ for all $x, y \in R$ . If right hand derivative at $x = 0$ exists for $f(x)$. Find Derivative of $g(x)$ at $x = 0$ (2005 - 4 Marks)

*F - Match the Following*

1) In this question there are entries in columns I and II. Each entry in **Column I** is related to exactly one entry in **Column II**. Write the correct letter from **Column II** against the entry number in **Column I**in your answer book. (2009 - 4 Marks)

| **Column I** | **Column II** |
|---|---|
| a) $\sin(\pi[x])$ | a) differentiable everywhere |
| b) $\sin(\pi(x - [x]))$ | b) nowhere differentiable |
| | c) not differentiable at 1 and $-1$ |

2) In the following $[x]$ denotes the greatest integer less than or equal to $x$. Match the functions in Column I with the properties in column II and indicate your answer by darkening the appropriate bubbles in the $4 \times 4$ matrix given in ORS. (2007 - 6 Marks)

| **Column I** | **Column II** |
|---|---|
| a) $x\|x\|$ | a) continuous in $(-1, 1)$ |
| b) $\sqrt{\|x\|}$ | b) differentiable in $(-1, 1)$ |
| c) $x + [x]$ | c) strictly increasing in $(-1, 1)$ |
| d) $\|x-1\| + \|x+1\|$ | d) not differentiable atleast at one point in $(-1, 1)$ |

3) Let $f_1 : R \to R$ $f_2 : [0, \infty) \to R$ $f_3 : R \to R$ $f_4 : [0, \infty) \to R$ be defined by $f_1(x) = \begin{cases} \|x\| & \text{if } x < 0 \\ e^x & \text{if } x \geq 0 \end{cases}$ ; $f_2(x) = x^2$ ; $g(x) = \begin{cases} \sin x & \text{if } x < 0 \\ x & \text{if } x \geq 0 \end{cases}$; $f_4(x) = \begin{cases} f_2(f_1(x)) & \text{if } x < 0 \\ f_2(f_1(x)) - 1 & \text{if } x \geq 0 \end{cases}$ (JEE Adv. 2014)

| **List-I** | **List-II** |
|---|---|
| P. $f_4$ is | 1. Onto but not one-one |
| Q. $f_3$ is | 2. Neither continuous nor one-one |
| R. $f_2 \circ f_1$ is | 3. Differentiable but not one-one |
| S. $f_2$ is | 4. Continuous and one-one |

**P Q R S**

(a) 3142
(b) 3124
(c) 1342
(d) 1324

4) Let $f_1 : \mathbf{R} \to \mathbf{R}$, $f_2 : (-\frac{\pi}{2}, \frac{\pi}{2}) \to \mathbf{R}$, $f_3 : (-1, e^{\frac{\pi}{2}} - 2) \to \mathbf{R}$ and $f_4 : \mathbf{R} \to \mathbf{R}$ be defined by

1. $f_1(x) = \sin(\sqrt{1 - e^{-x^2}})$,
2. $f_2(x) = \begin{cases} \frac{|\sin x|}{\tan^{-1} x} & \text{if } x \neq 0 \\ e^x & \text{if } x = 0 \end{cases}$,where the inverse trigonometric function $tan^{-1}x$ assumes value in $(-\frac{\pi}{2}, \frac{\pi}{2})$,

3. $f_3(x) = [\sin(log_e(x+2))]$,where, for $t \in \mathbf{R}$, $[t]$ denotes the greatest integer less than or equal to t,

4.$f_4(x) = \begin{cases} x^2 \sin\frac{1}{x} & \text{if } x \neq 0 \\ 0 & \text{if } x = 0 \end{cases}$.

**List-I**

P. The function $f_1$ is
Q. The function $f_2$ is
R. The function $f_3$ is
S. The function $f_4$ is

**List-II**

1. NOT continuous at $x = 0$
2. continuous at $x = 0$ and NOT differentiable at $x = 0$
3. differentiable at $x = 0$ and its derivative is NOT continuous at $x = 0$
4. differentiable at $x = 0$ and its derivative is continuous at $x = 0$

(JEE Adv. 2018)

a) $P \to 2; Q \to 3; R \to 1; S \to 4$
b) $P \to 4; Q \to 2; R \to 1; S \to 3$
c) $P \to 4; Q \to 1; R \to 2; S \to 3$
d) $P \to 2; Q \to 1; R \to 4; S \to 3$

*I - Integer Value Correct Type*

1) Let $f : [1, \infty) \to [2, \infty)$ be a differentiable function such that $f(1) = 2$. If $6\int_1^x f(t)dt = 3xf(x) - x^3$ for all $x \geq 1$. Then the value of $f(2)$ is (2011)
2) The largest value of non-negative integer a for which $\lim_{x\to1}\{\frac{-ax+\sin(x-1)+a}{x+\sin(x-1)-1}\}^{\frac{1-x}{1-\sqrt{x}}} = \frac{1}{4}$ (JEE Adv. 2014)
3) Let $f : R \to R$ and $g : R \to R$ be respectively given by $f(x) = |x| + 1$ and $g(x) = x^2 + 1$. Define $h : R \to R$ by

$h(x) = \begin{cases} \max\{f(x),g(x)\} & \text{if } x \leq 0 \\ \min\{f(x),g(x)\} & \text{if } x > 0 \end{cases}$.

The number of points at which $h(x)$ is not differentiable is (JEE Adv. 2014)
4) Let $m$ and $n$ be two positive integers greater than 1. If $\lim_{\alpha\to0}(\frac{e^{\cos(\alpha^n)}-e}{\alpha^m}) = -(\frac{e}{2})$ then the value of $\frac{m}{n}$ is (JEE Adv. 2015)
5) Let $\alpha, \beta \in \mathbf{R}$ be such that $\lim_{x\to0}\frac{x^2\sin(\beta x)}{\alpha x - sinx} = 1$. Then $6(\alpha + \beta)$ equals. (JEE Adv. 2016)

## SECTION-B

## JEE MAIN/AIEEE

1) $\lim_{x\to0}\frac{\sqrt{1-\cos 2x}}{\sqrt{2}x}$ is [2002]
   (a) 1
   (b) $-1$
   (c) 0
   (d) does not exist
2) $\lim_{x\to\infty}(\frac{x^2+5x+3}{x^2+x+3})^x$ [2002]
   (a) $e^4$
   (b) $e^2$
   (c) $e^3$
   (d) 1
3) Let $f(x) = 4$ and $f'(x) = 4$. Then $\lim_{x\to2}\frac{xf(2)-2f(x)}{x-2}$ is given by [2002]
   (a) 2

(b) $-2$
(c) $-4$
(d) 3

4) $\lim_{n\to\infty} \frac{1^p+2^p+3^p+\cdots+n^p}{n^{p+1}}$ is [2002]
(a) $\frac{1}{p+1}$
(b) $\frac{1}{1-p}$
(c) $\frac{1}{p} - \frac{1}{p-1}$
(d) $\frac{1}{p+2}$

5) $\lim_{x\to 0} \frac{\log x^n - [x]}{[x]}, n \in N$,( $[x]$ denotes greatest integer less than or equal to x) [2002]
(a) has value $-1$
(b) has value 0
(c) has value 1
(d) does not exist