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| **SESSION** | **APRIL 2025** |
| **PROGRAM** | **MCA** |
| **SEMESTER** | **I** |
| **COURSE CODE & NAME** | **DCA6107 FUNDAMENTALS OF MATHEMATICS**  |
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### **SET-I**

**1. If** $f\left(x\right)=e^{x}$**, show that** $f^{'}\left(x\right)=e^{x}$

**Ans 1.**

### **Step 1: Understanding the Function**

We are given:

$$f\left(x\right)=e^{x}$$

This is an **exponential function**, where the base $e≈2.718$ is Euler’s number — a fundamental constant in mathematics.

### **Step 2: Differentiating the Function**

To find the derivative $f^{'}\left(x\right)$, we use the basic rule of differentiation:

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**2. write**

$$∫\left(\frac{3}{\sqrt{1-x^{2}}}+\frac{4}{\sqrt{1+x^{2}}}+\frac{5}{x\sqrt{x^{2}-1}}\right)dx$$

**Ans 2.**

### **Term 1:**

$$∫\frac{3}{\sqrt{1-x^{2}}}dx$$

We recall a standard integral identity:

$$∫\frac{1}{\sqrt{1-x^{2}}}dx=sin^{-1}\left(x\right)+C$$

So:

$$∫\frac{3}{\sqrt{1-x^{2}}}dx=3⋅sin^{-1}\left(x\right)$$

This integration problem demonstrates the effective use of standard techniques to evaluate seemingly complex expressions. It emphasizes the importance of understanding foundational integrals and their application in advanced mathematics. Mastery of these methods equips learners with tools to solve practical problems in physics, engineering, and economics involving continuous change.

**3. Find all the second order derivatives for** $f\left(x,y\right)=cos2x-x^{2}e^{5y}+3y^{2}$**.**

**Ans 3.**

### **Step 1: First Order Partial Derivatives**

**Partial derivative with respect to x:**

$$f\_{x}=\frac{∂}{∂x}\left[cos\left(2x\right)-x^{2}e^{5y}+3y^{2}\right]$$

* Derivative of $cos\left(2x\right)$ w.r.t x is $-2sin\left(2x\right)$
* $-x^{2}e^{5y}$ w.r.t x is $-2xe^{5y}$
* $3y^{2}$ w.r.t x is 0

### **SET-II**

**4. Given** $r\_{1}=5i-2j+3k$**,** $r\_{2}=i-j-k$**,** $r\_{3}=-2i+j-3k$**, find the magnitude of: (i)** $r\_{3}$ **(ii)** $r\_{1}+r\_{2}+r\_{3}$ **(iii)** $2r\_{1}-3r\_{2}-5r\_{3}$

**Ans 4.**

We are to find:

### **(i) Magnitude of** $\vec{r\_{3}}$

Formula for magnitude:

$$∣\vec{r}∣=\sqrt{a^{2}+b^{2}+c^{2}}$$

For $\vec{r\_{3}}=-2\hat{i}+1\hat{j}-3\hat{k}$

$$∣\vec{r\_{3}}∣=\sqrt{\left(-2\right)^{2}+1^{2}+\left(-3\right)^{2}}=\sqrt{4+1+9}=\sqrt{14}$$

### **(ii) Vector sum** $\vec{r\_{1}}+\vec{r\_{2}}+\vec{r\_{3}}$

**5. Find the value of** $\frac{tan^{2}60-2tan^{2}45+sec^{2}30}{2sin^{2}45^{∘}sin90^{∘}+cos^{2}60^{∘}cos^{2}30^{∘}}$ **(All angles are in degrees)**

**Ans 5.**

### **Step 1: Recall Trigonometric Values**

| Function | Value |
| --- | --- |
| $$tan60^{∘}$$ | $$\sqrt{3}$$ |
| $$tan45^{∘}$$ | $$1$$ |
| $$sec30^{∘}$$ | $$\frac{2}{\sqrt{3}}$$ |
| $$sin45^{∘}$$ | $$\frac{1}{\sqrt{2}}$$ |
| $$sin90^{∘}$$ | $$1$$ |
| $$cos60^{∘}$$ | $$\frac{1}{2}$$ |
| $$cos30^{∘}$$ | $$\frac{\sqrt{3}}{2}$$ |

### **Step 2: Simplify the Numerator**

$$tan^{2}60^{∘}=\left(\sqrt{3}\right)^{2}=3$$

**6. If** $x+iy=\sqrt{\frac{a+ib}{c+id}}$**, prove that** $\left(x^{2}+y^{2}\right)=\frac{a^{2}+b^{2}}{c^{2}+d^{2}}$

**Ans 6.**

In this problem, the complex number expression under the square root simplifies into another complex number. By taking the modulus on both sides, we eliminate the imaginary component and work only with real positive values. This allows us to apply the rule that the modulus of a square root of a complex fraction is the square root of the modulus of that fraction.

$$x+iy=\sqrt{\frac{a+ib}{c+id}}$$

**Prove that**

$$x^{2}+y^{2}=\frac{a^{2}+b^{2}}{c^{2}+d^{2}}$$

### **Step 1: Let z = complex expression**