HSE March 2021

IT Maths Lab Practical Examination

Model Question Paper

Time : 3 Hours **Maximum Score : 32**

General instructions to the candidates

- Five questions, each carrying 14 scores are given. You can answer any question or sub question to get a maximum of 32 scores.
- Read the instructions given with each question carefully
- GeoGebra applets are required to answer some questions. Your examiner will provide it.
- If the question demands, you can use fresh GeoGebra windows for constructions.
- You are not permited to use any software other than GeoGebra, or any other electronic devices like calculators in the examination hall.
- You can write the answers either in English or in Malayalam

Q1: Lab 1. Value of functions

Use the applet Q1A to answer the given questions

About the applet

- Graph of a function $f(x) = x^2$ is given. You can change the function using the input box for f.
- A slider **a** is given.
- The point A is defined as $(a, 0)$.
- AP is perpendicular to the x axis and PB is perpendicular to the y axis.

Answer the following questions

1. The function is f and the coordinates of the point A is $(a, 0)$. Write the coordinates of the points P and B (2)

2. Consider only **two** questions having $\surd$ mark from the following

   i) $\sqrt{5}$ ii) $3^{\frac{2}{3}}$ iii) $\sin(1.2)$

   iv) $\tan(-1)$ v) $e^{2.3}$ vi) $\log(6)$

   Answer the following questions.

   (a) Write the method of finding each of above values using this applet. (4)

   (b) Find their values (4)

3. Answer only **one** question having $\surd$ mark from the following (4)

   (a) Using the input box, set the function as $f(x) = x^3$. Write the method of finding an approximate value of $\sqrt[3]{2.197}$ and find its value.

   (b) Using the input box, set the function as $f(x) = \sin(x)$. Write the method of finding an approximate value of $\sin^{-1}(0.891)$ and find its value.

   (c) Using the input box, set the function as $f(x) = e^x$. Write the method of finding an approximate value of $\log(6.05)$ and find its value.

Q2: Lab 2. Shifting of Graphs

1. Follow the directions given below and construct a GeoGebra applet. (4)

   - Draw the graph of the function $f(x) = x^2$
   - Create two sliders **a** and **b** with Min = -5, Max = 5 and increment 0.01
   - Draw the graph of the function $g(x)$ using the input command
     `g(x)=f(x+b)+a`

2. Answer the following questions

   (a) Fix the values of **a** and **b** at '0' so that the graph of $g(x)$ coincides with the graph of $f(x)$. Increase the value of **a** from 0 to 2. What happens to the graph of $g(x)$? (2)

   (b) Fix the values of **a** and **b** at '0'. Increase the value of **b** from 0 to 2. What happens to the graph of $g(x)$? (2)

3. Answer only **two** questions having $\surd$ mark from the following. In each question you have to find and write the values of **a** and **b** so that the function $g(x)$ satisfies the given conditions. (6)

   (a) Range of the function g is $[-3, \infty)$. Write the function $g(x)$.

   (b) Graph of $g(x)$ coincides with the graph of the function $x^2 + 4x + 1$

   (c) $x = 2$ and $x = -2$ are the solutions of the equation $g(x) = 0$ .Write the function $g(x)$.

   (d) g is decreasing in $(-\infty, 4]$ and increasing in $[4, \infty)$.Write the function $g(x)$.

Q3: Lab 9. Conic Sections

Use the applet Q3.1 to answer the given questions

About the applet

- A slider **c** is given
- The points A and B are defined as $(-c, 0)$ and $(c, 0)$ respectively.
- **a** is a slider and radius of the circle centered at A is defined as **a**.
- You can animate the slider **a** using the **ANIMATION** button and stop animation using the **STOP** button.
- Using the input bar given, you can change the radius of the circle centered at B (at present it is given as **2a**).
- P and Q are points of intersection of the circles.
- *Animate the slider **a** and observe the path traced by the points P and Q.*

Answer the following questions

1. Edit the radius of the circle, centered at B, to $10 - a$. Set the value of c as 3. Animate the slider **a**. Observe the path traced by the points P and Q.

   (a) Write the name of the conic obtained. (1)

   (b) Write the reason for which the path traced by the points P and Q is this particular conic. (2)

   (c) Write the coordinates of the foci and vertices of the conic obtained. (2)

   (d) Write the equation of the conic (2)

   (e) Edit the value of the slider **c** to get the curve $\frac{x^2}{25} + \frac{y^2}{9} = 1$ and trace the curve. (3)

   At this position save the applet as **ANS3.1e**

2. Use the applet Q3.2 , which is same as the applet Q3.1 used above with a slight change. In this applet, by animating the slider **a** we get a hyperbola.

   Edit the value of the slider **c** and the radius of the circle to get the hyperbola $\frac{x^2}{16} - \frac{y^2}{9} = 1$ and trace the curve. (4)

   At this position save the applet as **ANS3.2**

Q4: Lab 31-Applications of integrals

1. (a) Using the instructions given below construct a GeoGebra applet (2)

   - Draw the graph of the function $f(x) = x^2$ and create an Inputbox.
   - Create two number sliders **a** and **b**.
   - Use the input command `Integral[f,a,b]` to find the area bounded by the curve $y = f(x)$, x axis and the lines $x = a$ and $x = b$.

   (b) Use the above applet to answer the following questions. Answer only **two** questions having $\surd$ mark.

   Find the area of the region bounded by the given curves (2)

   i. $y = x^2 + 2$, x axis, $x = -2$,$x = 2$

   ii. $y = x^3 + 2$,x axis, $x = -1$, $x = 2$

   iii. $y = (x - 2)^2$, x axis $x = 1$, $x = 4$

   iv. $y = 2 \sin x$, x axis, $x = 0$ and $\frac{\pi}{4}$

   v. $y = \tan x$, x axis, $x = 0$ and $x = 1$

   (c) Use above applet to answer only **one** question, having $\surd$ mark, from the following.

   Find the area bounded by the given curve and the x axis (3)

   i. $y = x^2 - 2$

   ii. $y = 9 - x^2$

   iii. $y = x^2 - 4x + 2$

   (d) Use above applet to answer only **one** question, having $\surd$ mark, from the following.

   Find the area of the region bounded by the given curves. (3)

   i. $y = 3 \cos x$, x axis, $x = 0$, $x = \pi$

   ii. $y = x^3$, x axis, $x = -2$, $x = 3$

   iii. $y = x^2 - 3$, x axis $x = -1$, $x = 2$

   (e) Use above applet to answer only **one** question, having $\surd$ mark, from the following.

   Find the area of the region specified. (4)

   i. Region in the first quadrant bounded by x axis, the line $y = 2x$ and the circle $x^2 + y^2 = 4$

   ii. Region enclosed between the two circles $x^2 + y^2 = 4$ and $(x + 2)^2 - y^2 = 4$

   iii. Region enclosed between the parabolas $2y = x^2$ and $3x = y^2$

Q5: Lab 37-The Plane

Use the applet Q1A to answer the given questions

About the applet

- You can find cross product of two vectors using the input boxes given in the Graphics View.Enter the components of the vectors in the input boxes. For example, if the vectors are $2\hat{\imath}+3\hat{\jmath}-4\hat{k}$ and $4\hat{\jmath}+2\hat{k}$ enter $(2,3,-4)$ in one of the boxes and $(0,4,2)$ in the other box.
- Using the input boxes given in Graphics 2 you can create a plane passing through a given point and perpendicular to a given vector. Equation of the plane is also shown.

1. Answer only **one** question, having $\surd$ mark, from the following.

   Construct the plane passing through the given point and parallel to the given plane. Write the normal vector and the equation of the plane. (2)

   (a) Point $(3,2,1)$, plane $2x-3y+4z=10$

   (b) Poind $(0,2,3)$, plane $\vec{r}\cdot(3\hat{\imath}-2\hat{\jmath}+\hat{k}=5$

   (c) Position vector of the point is $2\hat{\imath}-3\hat{k}$. Plane $3x+2y-z=0$

2. Answer only **one** question, having $\surd$ mark, from the following.

   Construct the plane passing through the given point and perpendicular to the given line. Write the normal vector and the equation of the plane. (2)

   (a) Point $(4,-3,1)$. Line $\vec{r}=4\hat{\imath}+3\hat{\jmath}+\lambda(2\hat{\imath}+2\hat{k}$

   (b) Point $(-2,4,4)$, line $\dfrac{x-1}{2}=\dfrac{y}{-3}=\dfrac{z+1}{3}$

   (c) Passing through the origin and perpendicular to the line $\dfrac{x}{3}=\dfrac{y}{1}=\dfrac{z-1}{2}$

3. Answer only **two** question, having $\surd$ mark, from the following.

   Construct the planes satisfying the given conditions. Write the equation of the plane. Write the procedure. (10)

   (a) Passing through the point $(3,2,1)$ and parallel to the lines

   $$\frac{x+2}{2}=\frac{y-1}{3}=\frac{z+1}{-2} \text{ and } \frac{x}{-3}=\frac{y}{2}=\frac{z+1}{4}$$

   (b) Passing through the points $(2,1,3),(0,2,-3)$ and $(-2,2,4)$

   (c) Passing through the points $(5,-2,1),(2,3,-2)$ and parallel to the vector $2\hat{\imath}+4\hat{\jmath}-3\hat{k}$

   (d) Contains the lines $\vec{r}=2\hat{\imath}-3\vec{\jmath}+\lambda(4\hat{\imath}-2\hat{\jmath}+\hat{k})$ and $\vec{r}=2\hat{\imath}-3\vec{\jmath}+\lambda(5\hat{\imath}+2\hat{k})$