GUIDELINE FOR LAB WORK AND
PRACTICAL EVALUATION OF MATHEMATICS 2020-21

I. INTRODUCTION:

Numerical skills and other Maths related skills are inherent in a child. These skills can be nourished by activity based learning and learning by doing. This system is practiced in schools of Kerala with regard to learning of Mathematics. Learners are also getting the opportunity to learn Maths using free software like GeoGebra upto standard X. At the Higher Secondary level, where the abstract thinking is boosted, can be enhanced by extending the scope of IT enabled Mathematics learning. Considering this, SCERT has prepared guidelines for introducing the concept of 'IT Maths Lab' at Higher Secondary level. This guideline was approved by the 50th State Curriculum Steering Committee. Accordingly as per G. O (Rt) No. 522/2019/Gen. Edn. Dept, Trivandrum, dt. 08/02/2019 Govt of Kerala has decided to implement IT Maths Lab from the academic year 2019-20 onwards.The existing IT labs in Schools are to be utilised for the functioning of IT Maths Lab. Separate IT Maths Lab is not essential.

Details of IT Maths Lab:

- For the proper functioning of the IT Maths Lab detailed Maths Lab Manuals have been prepared.

- The Lab activities are prepared based on Textual content areas of Higher Secondary Maths – Class 11 & Class 12.

- For the first year, there are 16 Lab tasks based on Class 11 Syllabus.

- For the second year, there are 25 Lab tasks based on Class 12 Syllabus.

- Each Lab consists of 2 or 3 activities and some additional activities.

Evaluation of Performance of students in IT Maths Lab:

The performance of the learner in IT Maths Lab can be evaluated as a part of Practical Evaluation of the learner.

The details are discussed below:

II. SYLLABUS FOR PRACTICAL:

Learning outcomes associated with many topics in Higher Secondary Maths syllabus are better transacted if it is discussed in Lab. So IT Maths Lab is conceived as a transaction method. There are 16 Lab in class 11 and 25 Lab in class 12. Lab - 0 is a mandatory lab which deals with basics ideas of GeoGebra software platform. But there will be no questions based on this Lab in Practical exam. The additional activities in each Lab are meant for exceptional students and are not compulsory in regular Lab classes.

Under the special circumstances of COVID-19, 7 labs (including Lab-0) from class 11 and 6 labs from class 12 are suggested. Lab-0 is mandatory. From the remaining 12 labs each school can select 5 labs (3 labs from class 11 and 2 from class 12 or vice versa)

List of Suggested Labs

Class – 11	**Class – 12**
1. Lab 0: Basic concept	1. Lab 18 : Functions
2. Lab 1: Value of functions	2. Lab 19 : Invertible functions
3. Lab 2: Shifting of Graphs	3. Lab 20 : Inverse trigonometric functions
4. Lab 4: Trigonometric Functions	4. Lab 31 : Application of Integrals
5. Lab 8: Straight lines	5. Lab 34 : Vectors
6. Lab 9: Conic Sections	6. Lab 37 : The Plane
7. Lab 13: Limits	

III. LAB WORK – EXECUTION:

Keep COVID Protocol while conducting Maths IT lab activities in School Computer Lab. GeoGebra software and the applets specified in each lab as per manual should be installed in the systems. Each Lab work require atmost two periods. So the time table should be arranged by clubbing two periods. The execution of Lab consists of threefold process – Preparatory work, Performing of activities, Reporting.

Preparatory work: Students can watch the lab classes in KITE VICTERS / YouTube channel and make a preparatory work before doing the lab activities. They should be aware of the aim and procedure of the lab. They can use either a printed copy or a soft copy of the concerned Lab manual. The previous knowledge for the particular Lab should be discussed in the classes prior to the Lab. All students should have their Practical Observation Book (POB) while doing the Lab.

Performing the activities: Students should perform the activities in each Lab as per the manual. Teacher should give necessary help while students perform each activity.

Reporting: Students should write the procedure of the Lab in POB in their own way. There will not be any prescribed format for writing the procedure. The findings and output mentioned in Lab manual should be written in the POB. After the completion of each Lab the concerned teacher should sign the POB. There is only one POB for both the years and should be produced at the time of Practical Exam. The applets created by the students as a part of the lab activities should be kept in separate folders and should be produced during the practical examination.

IV. EVALUATION PATTERN

After the implementation of IT Maths Lab, the evaluation pattern is as follows:

YEAR	TE	CE	PE	TOTAL
First Year	60	20	–	80
Second Year	60	20	40	120

The Details of Practical Evaluation is explained below.

V. PRACTICAL EVALUATION (PE)

In Practical Evaluation, only the Mathematical knowledge of students based on the syllabus are evaluated. Necessary help in using the software will be provided along with the questions. The internal or external examiner can also help the students in this regard. The following are the guidelines for conducting PE.

- The questions will be strictly based on the syllabus prescribed for practical work in each year.

- The examination will be of 3 hours duration and maximum score of 40.

- Practical examination should be conducted in batches. The maximum number of students in each batch is limited to 15.

- Students should attend the PE with the Practical Observation Book. It should compulsorily include 6 Lab works (including Lab-0) as per the directions given above, duly singed by the concerned teacher. The same should be verified and counter signed by the external examiner at the time of PE.

- Each student will get a question paper consisting of 5 questions, one each from the 5 labs selected at the school (excluding Lab-0). The maximum score of each question will be 14. Students can answer any number of questions and can get a maximum score of 32.

- The following indicators should be considered while evaluating the answers.

    - Analysing the problem

    - Choosing an appropriate method

    - Content Knowledge

    - Knowledge of the procedure

    - Problem solving skill

    - Generating output

- The Practical Observation Book and the saved materials will be evaluated by the external examiner. The maximum score is 4.

Scoring indicators are given below.

Indicators	Score
Systematic recording of POB	2
Saved materials	2

- A viva - voce will be conducted for each student based on the questions answered. It should be formal in the form of an interview. It should be a casual interaction with the students during the evaluation to check whether he/she has conceptual/ process clarity in the given area. Students can get a maximum score of 4.

Scoring indicators for Viva-voce :

Indicators	Score
Content knowledge	1
Clarity of concept	1
Logical sequencing of idea	1
Communication skill	1

- The score sheet should be filled in by the external examiner. The format of score sheet is given below.

Sample Score Sheet

Sl No	Reg No	Qn No.1 Score (14)	Qn No.2 Score (14)	Qn No.3 Score (14)	Qn No.4 Score (14)	Qn No.5 Score (14)	Total Score	Score Awarded Maximum (32)	POB and Saved materials Score (4)	Viva voice Score(4)	Total Score Awarded
1											
2											
3											

- Name and Designation of External Examiner: ....

....

Signature: ....

Date of Exam:..................

- The final score sheet should be send to DHSE as per instruction given by the Directorate.

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 $\sqrt{}$ 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 $\sqrt{}$ 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 $\sqrt{}$ 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 $\dfrac{x^2}{25} + \dfrac{y^2}{9} = 1$ 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 $\dfrac{x^2}{16} - \dfrac{y^2}{9} = 1$ 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 $\sqrt{}$ 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 $\sqrt{}$ 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 $\sqrt{}$ 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 $\sqrt{}$ 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 $2\hat{i} + 3\hat{j} - 4\hat{k}$ and $4\hat{j} + 2\hat{k}$ 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 $\checkmark$ 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 $\vec{r} \cdot (3\hat{i} - 2\hat{j} + \hat{k}) = 5$

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

2. Answer only **one** question, having $\checkmark$ 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 $\vec{r} = 4\hat{i} + 3\hat{j} + \lambda(2\hat{i} + 2\hat{k}$

   (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 $\checkmark$ 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

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

   (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 $2\hat{i} + 4\hat{j} - 3\hat{k}$

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