

**The Open University of Sri Lanka**  
**Faculty of Natural Sciences**  
**B.Sc/ B. Ed Degree Programme**



<b>Department</b>	<b>: Physics</b>
<b>Level</b>	<b>: 04</b>
<b>Name of the Examination</b>	<b>: Final Examination</b>
<b>Course Title and - Code</b>	<b>: PHU4303 – Mathematical Methods for Physics</b>
<b>Academic Year</b>	<b>: 2020/2021</b>
<b>Date</b>	<b>: 07<sup>th</sup> December 2021</b>
<b>Time</b>	<b>: 1.30 p.m. to 3.30 p.m.</b>
<b>Duration</b>	<b>: 2 hours</b>

**General Instructions**

1. Read all instructions carefully before answering the questions.
  2. This question paper consists of **(06)** questions in **(03)** pages.
  3. Answer any **(04)** questions only. All questions carry equal marks.
  4. Answer for each question should commence from a new page.
  5. Draw fully labelled diagrams where necessary
  6. Involvement in any activity that is considered as an exam offense will lead to punishment
  7. Use blue or black ink to answer the questions.
  8. Clearly state your index number in your answer script
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1.

a.

What are the main steps in the *bisection algorithm*? ( 5 marks)

b.

Name and briefly describe the different types of errors that can occur in numerical methods due to limited number of bits used in a computer to represent a number. ( 5 marks)

c.

Calculate the root of the following equation using bisection method.  
Clearly show all the steps in a table.

$$x^5 - 3x^2 = -270$$

Use the initial interval of [-6, 10], Accuracy: 0.001 or better ( 15 marks)

2.

a.

Calculate the determinant of the following matrix.

$$3.A = \begin{bmatrix} 2 & -5 & 3 \\ 0 & 7 & -2 \\ -1 & 4 & 1 \end{bmatrix}$$

( 5 marks)

b.

Consider matrix P

$$P = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$$

i. Calculate the Eigen values of matrix P ( 10 marks)

ii. Calculate the Eigen vectors of matrix P ( 10 marks)

3.

a.

Calculate the area between  $y = x^2$  and  $y = \sqrt{x}$  from  $x = 0$  to  $x = 1$  (10 marks)

b.

A box with square base and no top side is to hold a volume  $100 \text{ cm}^3$ . Find the dimensions of the box, that requires the least material for the five sides. (15 marks)

4.

a.

Calculate the divergence of the following vector field

$$\vec{V} = (x^2y)i + (xyz)j - (x^2y^2)k$$

(10 marks)

b.

Calculate the curl of the following vector field

$$\vec{V} = (yz^2)i + (xy)j - (yz)k$$

(15 marks)

5.

a.

How do you check if an ordinary differential equation (ODE) is an exact differential equation?

(5 marks)

b.

Show the following ODE is an exact differential equation.

$$(3x^2 + 3y + \sin(x) e^y). dx + (3x - \cos(x) e^y). dy = 0$$

(5 marks)

c.

Solve the following exact differential equation.

$$(3x^2 + 3y + \sin(x) e^y). dx + (3x - \cos(x) e^y). dy = 0$$

(15 marks)

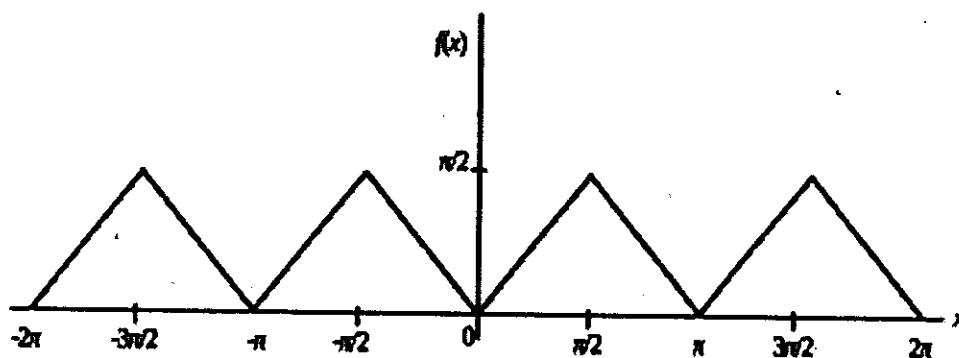
6.

a.

Write the function for following signal for the period from 0 to  $\pi$ . You may use piecewise function. ( 5 marks)

b.

Calculate the first four coefficients of the Fourier series (both  $a_n$  and  $b_n$ ) of the following signal



( 20 marks)

-End-