The Open University of Sri Lanka
B.Sc. Degree Programme, Level – 04
Final Examination – 2023/2024
PHU4303 – Mathematical Methods for Physics
Duration: 2 hours

Date: 19th October 2023 Time: 9.30 a.m. to 11.30 a.m.

This paper has 3 pages and 6 questions. **Answer any four (4) questions**
Non-programmable calculators are allowed.

1)

a)

i) A Certain microbe takes one hour to grow. It reproduces by splitting itself in to two microbes at the end of the growth period. Scientists put newly 'born' 100 such microbes to a Petri dish at 10.00 a.m. Assuming each of them split to two copies exactly after each hour and no microbe dies, how many microbes will be in the petri dish just after 4.00 p.m. on the same day?
Use your knowledge in sequence or series equations to get the answer. Do Not tabulate all the hours and calculate each step separately. (05 marks)

ii) How do you determine if a geometric series is convergent using the ratio test? (05 marks)

b)

i) Calculate the curl of the following vector. (10 marks)

$$\mathbf{V} = (3x^2y + 5z)\boldsymbol{i} - 6xy^2z\boldsymbol{j} + 5y\boldsymbol{k}$$

ii) What is the value of curl(**V**) at the point (5,10,2) ? (05 marks)

2)

a)

Calculate the eigen values of the following matrix (10 marks)

$$\begin{bmatrix} -6 & 3 \\ 4 & 5 \end{bmatrix}$$

b)

A company sells a product at *p* rupees each. The sales team had found out the number of items sold (*n*), is related to its selling price(p). The relationship between the number of items sold and its selling price is given by following equation.

$$n = 1500 - 10p$$

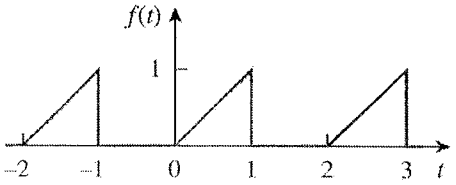
Daily income is calculated by multiplying the number of units sold with the selling price. Using your knowledge on differentiation and optimization calculate the best sales price (p) that will generate the highest income per day. (15 marks)

3)

a)

i) Write the piece wise function to describe following periodic signal. (05 marks)

ii) Calculate the Fourier series for the following periodic signal. (10 marks)



b)

A student does an experiment to synthesize a new chemical compound. Following table presents weight of the new chemical he got after ten repeated attempts.

Attempt	1	2	3	4	5	6	7	8	9	10
Weight (g)	5.1	5.1	4.8	5.0	4.6	5.2	5.2	5,1	4.9	5.1

i) What is the mode of the data set? (03 marks)

ii) Calculate the average weight. (03 marks)

iii) Based on the above data, if he repeats the experiment one more time, estimate the probability he would get a weight less than 5.0 g. (04 marks)

4)

a)

i) Solve $\frac{dy}{dt} = \frac{t}{y^2}$ (10 marks)

ii) Find the solution for y if $y(0) = 2$; (05 marks)

b) Consider following vectors. $\boldsymbol{A} = 6i + 3j - k$ *and* $\boldsymbol{B} = 3i + k$

i) Calculate the cross product of vectors **A** and **B**. (05 marks)

ii) Calculate the dot product of vectors **A** and **B**. (05 marks)

5)

a)

i) Evaluate $\int x.\cos(2x)\,.\,dx$ (05 marks)

ii) Calculate the area under the curve $f(x) = 3x^2 + x + 3$ from x = -1 to +3 (10 marks)

b)

i) Calculate $\frac{2+5i}{1-5i}$; Where $i = \sqrt{-1}$ (05 marks)

ii) Plot your answer in an Argand diagram. (05 marks)

6)

a)

i) $P(x, y, z) = x^3z + 6xy - xy^3$;

Calculate $\frac{\partial P}{\partial y}$ (10 marks)

b)

Use bi-section method to calculate a numerical solution for f(x), where

$$f(x): x^5 + 2x - 1 = 0$$

Copy the following table to your answer script to show intermediate steps. Initial values for a and b are -1 and + 1. Calculate up to 5 iterations. Use minimum of 4 decimal points for each calculation. (15 marks)

Iteration	a	b	midpoint	f(midpoint)
1	-1	+1		
2				
3				
4				
5				

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