

Part II only

UNIVERSITY OF RUHUNA
FACULTY OF FISHERIES AND MARINE SCIENCES &
TECHNOLOGY

Academic Year 2023/2024

Bachelor of Science Honours in Fisheries and Marine Sciences Degree

Level I Semester I Examination – November 2024

FDN 1142: Bio Mathematics

Time: 2 (Two) hours

Answer all questions in part I and any two (02) questions from part II.

Part I

Answer all questions.

01 Hour/ 50 marks

Part II

Answer **any two** (02) questions.

1 Hour/ 50 Marks

Q1

(a) Write the formulas for $\sin(\alpha + \beta)$ and $\cos(\alpha + \beta)$. [10 marks]

(b) Use the formulas in (a) to show that

(i) $\sin 3\alpha = 3\sin\alpha - 4\sin^3\alpha$ [20 marks]

(ii) $\cos 3\alpha = 4\cos^3\alpha - 3\cos\alpha$ [15 marks]

(c) Using part (b), show that [15 marks]

$$\tan 3\alpha = \frac{3\tan\alpha - \tan^3\alpha}{1 - 3\tan^2\alpha}$$

(d) Prove the following identities.

(i) $\frac{\sin 3x + \sin x}{\cos 3x + \cos x} = \tan 2x$. [20 marks]

(ii) $\frac{\tan A - \cot B}{\tan B - \cot A} = \tan A \cot B$ [20 marks]

Q2

(a) Let $A = \begin{bmatrix} 1 & 2 \\ 3 & -1 \end{bmatrix}$ be a 2×2 matrix.

(i) Find $A^2 - A - 2I$, where I is the 2×2 identity matrix. [30 marks]

(ii) Find the determinant of the matrix B where $B = A^2 - 4A + I$. [15 marks]

(iii) Using the part (i) or any other method, find the inverse of the matrix A , if exists. [20 marks]

(b) Use the Cramer's rule to solve

[35 marks]

$$2x + 3y = 8,$$

$$4x - y = -2.$$

(a) Find the following limits

[30 marks]

(i) $\lim_{x \rightarrow \infty} \frac{2x^2+1}{x^2-3x+1}$

(ii) $\lim_{x \rightarrow 1} \frac{\sin(x^2-1)}{(x-1)}$

(b) Let $y = \theta - \cos \theta$ and $x = 2\theta + \sin \theta$, then find $\frac{dy}{dx}$.

[20 marks]

(c) If $y = e^{ax} \cos bx$, where a and b are constants, then show that

[50 marks]

$$\frac{d^2y}{dx^2} - 2a \frac{dy}{dx} + (a^2 + b^2)y = 0.$$

(a) During an experiment, the height of a growing plant increased at a rate of $\frac{1}{\sqrt{t+4}}$ cm per day, where t represents the number of days since the start of the experiment. If the plant was 20 cm high at the beginning, what would its height be after 12 days?

[25 marks]

(b) Using the method of substitution, evaluate $\int \frac{e^x(1+x)}{\cos^2(xe^x)} dx$.

[30 marks]

(c) Find the constants A and B such that $\frac{3}{(x-1)(x+2)} = \frac{A}{x-1} + \frac{B}{x+2}$.

Hence, evaluate $\int \frac{3}{(x-1)(x+2)} dx$.

[45 marks]

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