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UNIVERSITY OF RUHUNA - FACULTY OF ALLIED HEALTH SCIENCES

DEPARTMENT OF PHARMACY

FIRST BPHARM PART I EXAMINATION - JULY/AUGUST 2026

PH1152 : MATHEMATICS - SEQ

TIME: TWO HOURS

INSTRUCTIONS

- There are **four** questions in this paper.
- Answer **all** questions.
- Calculators will be allowed.
- No paper should be removed from the examination hall.
- Do not use any correction fluid.
- Use illustrations where necessary.

1. 1.1 Find the following limits:

1.1.1 $\lim_{x \rightarrow -2} \frac{x^2 + 5x + 6}{x^2 + 3x + 2}$ (15 marks)

1.1.2 $\lim_{x \rightarrow 5} \frac{\sqrt{x+11} - 4}{x-5}$ (15 marks)

1.2 Find $\lim_{\delta x \rightarrow 0} \frac{f(x+\delta x) - f(x)}{\delta x}$, if $f(x) = x^3$ (15 marks)

1.3 Consider the function $f(x) = (x+2)^2(2x-3)$.

1.3.1 Find the coordinates of the stationary points and determine the nature of each using the **second derivative** $f''(x)$. (35 marks)

1.3.2 Find the equation of the tangent to the curve at the point where $x = -1$. Give your answer in the form $ax + by + c = 0$. (20 marks)

2. 2.1 Consider the function $z = (x^2 + y^2) \ln(xy)$.

2.1.1 Find the first partial derivatives $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ at the point $(1, e)$. Give your answers in terms of e . (30 marks)

2.1.2 Write down the total differential dz of z at the point $(1, e)$. (10 marks)

2.1.3 Find the second partial derivatives $\frac{\partial^2 z}{\partial x \partial y}$ and $\frac{\partial^2 z}{\partial y \partial x}$. What can you say about the two derivatives. (25 marks)

2.2 A two variable function is given as $h(x, y) = x^3 - 2x^2y + 3xy^2 + y^3$.

2.2.1 Is $h(x, y)$ homogeneous? What is the degree of homogeneity? (15 marks)

2.2.2 Prove that $h(x, y)$ satisfies the Euler's theorem. (20 marks)

3. 3.1 Using the substitution $u = 1 + \sqrt{x}$, evaluate the integral $\int \frac{\sqrt{1+\sqrt{x}}}{\sqrt{x}} dx$. (20 marks)

3.2 Use the **method of integration by parts** to evaluate $\int_0^{\pi/3} x \cos 3x dx$. (30 marks)

3.3 Evaluate the integral $\int \frac{7x-6}{x^2+x-6} dx$ using the **method of partial fractions**. (25 marks)

3.4 Given that $\frac{ds(t)}{dt} = 4 \cos\left(2t - \frac{\pi}{6}\right)$, and $s(0) = 1$, find $s(t)$. (25 marks)

4. 4.1 A fish population in a lake grows at a rate proportional to its current size which can be represented by the differential equation

$$\frac{dP(t)}{dt} = rP(t),$$

where $P(t)$ is the fish population at time t and r is the proportionality constant. Using the **method of separation of variables**, show that

$$P(t) = P_0 \exp\{rt\},$$

stating clearly how P_0 is chosen appropriately. (15 marks)

4.2 Let the initial population in the lake be 100 fish. If, **without any outside factors**, the fish population doubles in 5 days, find r , the proportionality constant. (15 marks)

4.3 However, each day, 5 fish migrate into the area, 18 are caught by fishermen, and 7 die of natural causes. This situation can be modelled by the differential equation

$$\frac{dP(t)}{dt} = rP(t) - 20.$$

Rewrite the above differential equation in the form of a **standard linear differential equation** and use the **integrating factor** to obtain $P(t)$ as

$$P(t) = \frac{100}{\ln(2)} + K \exp\left\{\frac{\ln(2)}{5}t\right\}.$$

(40 marks)

4.4 Find the value of K using the initial conditions and hence write down the particular solution. (15 marks)

4.5 Determine if the population will survive over time and, if not, when the population will become extinct. (15 marks)

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