Strathmore
UNIVERSITY

SCHOOL OF COMPUTING AND ENGINEERING SCIENCES
BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING
END OF SEMESTER EXAMINATION

MAT 1202: Applied Mathematics II

Instructions **Date**: 17th March, 2026

1. This examination consists of **FIVE** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

QUESTION ONE (30 MARKS)

(a) Find the value of [4 Marks]

$$\int_0^5 \int_{-z}^{z} \int_0^{\sqrt{z^2-y^2}} \frac{3}{2}xz \; dxdydz$$

(b) An object is thrown vertically upwards with an initial velocity u of 20 m/s. The motion of the object follows the differential equation $\frac{ds}{dt} = u - gt$, where s is the height of the object in metres at time t seconds and $g = 9.8m/s^2$. Determine the height of the object after **three seconds** if $s = 0$ when $t = 0$. [3 Marks]

(c) Twenty per cent of items produced on a machine are outside stated tolerances. Determine the probability distribution of the number of defectives in a pack of five items. [3 Marks]

(d) The discrete random variable X has mean 7 and variance 11.

  (a) Calculate $E(X^2)$. [1 Marks]

  (b) Given that $Y = 2X - 4$, determine the mean and variance of Y. [2 Marks]

(e) $X \sim Geo(p)$ and it is known that $P(X = 2) = 0.21$ and $p < 0.5$. Find $P(X = 1)$. [4 Marks]

(f) Form a differential equation from the equation [4 Marks]

$$y = e^x(A\cos x + B\sin x)$$

(g) A Christmass draw aims to sell 5000 tickets, 50 of which will win a prize. A syndicate buys 200 tickets. Let X represent the number of these tickets that win a prize.
Calculate $P(X \leq 3)$. [4 Marks]

(h) An open rectangular container is to have a volume of $62.5m^3$. Determine the least surface area of material required. [5 Marks]

QUESTION TWO (15 MARKS)

(a) Emma plays a game in which she throws two dice. If she gets two sixes, she wins 20p, if she gets one six, she wins 10p, otherwise she wins nothing. She has to pay 5p to enter. Write out the probability distribution of X, the amount Emma gains in one turn. [4 Marks]

(b) The probability that a telephone box is occupied is 0.2. Find, to two significant figures, the probability that a person wishing to make a telephone call will find a telephone box which is not occupied only at the sixth box tried. [5 Marks]

(c) In the mass production of bolts, it is found that 5% are defective. Bolts are selected at random and put into packets of ten. A packet is selected at random. Find the probability that it contains (i) three defective bolts, (ii) less than three defective bolts. [4 Marks]

Two packets are selected at random.

(iii) Find the probability that there are no defective bolts in either packet. [2 Marks]

QUESTION THREE (15 MARKS)

(a) Determine the **domain** of the given multi-variable functions. [4 Marks]

(i) $f(x,y) = \dfrac{y}{1+x^2+y^2}$.

(ii) $f(x,y) = \sqrt{1-\frac{x^2}{9}-\frac{y^2}{4}}$.

(b) Safe Shades produces two kinds of sunglasses; one kind sells for \$17, and the other for \$21. The total revenue in thousands of dollars from the sale of x thousand sunglasses at \$17 each and y thousand at \$21 each is given by

$$R(x,y) = 17x + 21y.$$

The company determines that the total cost, in thousands of dollars, of producing x thousand of the \$17 sunglasses and y thousand of the \$21 sun- glasses is given by

$$C(x,y) = 4x^2 - 4xy + 2y^2 - 11x + 25y - 3$$

Find the number of each type of sunglasses that must be produced and sold in order to maximize profit. [8 Marks]

(c) Modulus of rigidity $G = (R^4\theta)/L$, where R is the radius, θ the angle of twist and L the length. Determine the approximate percentage error in G when R is increased by 2%, θ is reduced by 5% and L is increased by 4%.

[3 Marks]

QUESTION FOUR (15 MARKS)

(a) The probability distribution of a discrete random variable X is given by

x	0	1	2	3
P(X=x)	0.5	0.35	a	b

where a and b are positive constants.

(i) Given that $E(X) = 0.67$, find the value of a and the value of b. [2 Marks]

(ii) Determine the variance of X. [2 Marks]

(iii) Calculate $\text{Var}(5 + 10X)$. [2 Marks]

(b) Identical independent trials of an experiment are carried out. The probability of a successful outcome is p. On average, five trials are required until a successful outcome occurs.

(i) Find the value of p. [3 Marks]

(ii) Find the probability that the first successful outcome occurs on the fifth trial.

(c) A game consists of throwing tennis balls into a bucket from a given distance. The probability that William will get the tennis ball in the bucket is 0.4. A turn consists of three attempts.

(i) Construct the probability distribution for X, the number of tennis balls that land in the bucket in a turn. **Hint**: use a tree diagram to display all the probabilities. [4 Marks]

(ii) William wins a prize if, at the end of his turn, there are two or more tennis balls in the bucket. What is the probability that William does not win a prize? [2 Marks]

QUESTION FIVE (15 MARKS)

(a) Solve the differential equation [5 Marks]

$$(x-2)\frac{dy}{dx} - y = (x-2)^3$$

given that $y = 10$ when $x = 4$.

(b) The potential difference (p.d), V, between the plates of a capacitor C charged by a steady voltage E through a resistor R is given by the equation

$$CR\frac{dV}{dt} + V = E$$

(i) Solve the equation for V given that at $t = 0$, $V = 0$ [4 Marks]

(ii) Calculate V, correct to 3 significant figures, when $E = 25V$, $C = 20 \times 10^{-6}F$, $R = 200 \times 10^3\Omega$ and $t = 3.0s$ [2 Marks]

(c) The finite region V in the first octant, is bounded by the surfaces with equations

$$y = 4 - x^2 \qquad \text{and} \qquad y = 4 - z^2$$

Find the volume of the solid defined as the interior of V. [4 Marks]

END OF PAPER