



MACHAKOS UNIVERSITY

University Examinations for 2016/2017

SCHOOL OF AGRICULTURE AND NATURAL RESOURCES MANAGEMENT

DEPARTMENT OF DEPARTMENT OF ENVIRONMENTAL STUDIES

FIRST SEMESTER SECOND SEMESTER EXAMINATION FOR
BACHELOR OF ENVIRONMENTAL RESOURCE CONSERVATION
BACHELOR OF SCIENCE IN COMMUNITY DEVELOPMENT

ENS 137: MATHEMATICS FOR ENVIRONMENTAL SCIENCES

DATE: 30/11/2016

TIME: 8.30-10.30 AM

INSTRUCTIONS:

Answer Question One and Any Other Two Questions

QUESTION ONE (COMPULSORY) (30 MARKS)

- (a) Given $A = \begin{bmatrix} 3 & 6 \\ 2 & 4 \end{bmatrix}$, $B = \begin{bmatrix} -1 & 7 \\ 8 & 4 \end{bmatrix}$, and $C = \begin{bmatrix} 3 & 4 \\ 1 & 9 \end{bmatrix}$, verify the distributive law of matrices. (5 marks)
- (b) Given $y = (3u-2v)/(u^2 + 3v)$, find the partial derivative using the quotient rule. (5 marks)
- (c) The events A, B, and C satisfy: $P(A|B \cap C) = 1/4$, $P(B|C) = 1/3$, and $P(C) = 1/2$. Calculate $P(A^C \cap B \cap C)$. (10 marks)
- (d) Using the Laplace expansion, find the determinant of:
$$M = \begin{bmatrix} 15 & 7 & 9 \\ 2 & 5 & 6 \\ 9 & 0 & 12 \end{bmatrix}$$
 (10 marks)

QUESTION TWO (20 MARKS)

- (a) Using venn diagrams, explain the key operations of sets. (10 marks)
- (b) Let $A = \{4, 5, 6\}$, $B = \{3, 4, 6, 7\}$ and $C = \{2, 3, 6\}$. Verify the distributive law of sets. (10 marks)

QUESTION THREE (20 MARKS)

- (a) Solve the following simultaneous equations using the matrix inversion method:
 $4x_1 + x_2 - 5x_3 = 8$
 $-2x_1 + 3x_2 - x_3 = 12$
 $3x_1 - x_2 + 4x_3 = 5$ (10 marks)
- (b) Using the Cramer's rule, solve the following equation system:
 $7x_1 - x_2 - x_3 = 0$
 $10x_1 - 2x_2 + x_3 = 8$
 $6x_1 + 3x_2 - 2x_3 = 7$ (10 marks)

QUESTION FOUR (20 MARKS)

- (a) State the DeMorgan's laws. (10 marks)
- (b) Let Y and Z be two events for which one knows that the probability that at least one of them occurs is $3/4$. What is the probability that neither Y nor Z occurs? (10 marks)
- (c) Suppose the events X_1 and X_2 represent environmental disasters which are rare: $P(X_1) \leq 10^{-6}$ and $P(X_2) \leq 10^{-6}$. What can you say about the probability that at least one of the disasters occurs? (10 marks)

QUESTION FIVE (20 MARKS)

- (a) Prove that: $\frac{d}{dx}[f(x)g(x)] = f(x)g'(x) + f'(x)g(x)$ (10 marks)
- (b) Find the derivative of: $(3x + 10)(6x^2 - 7x)$ (10 marks)