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KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2019/2020 ACADEMIC YEAR

FIRST YEAR FIRST SEMESTER EXAMINATIONS

SPECIAL/SUP EXAMINATION

FOR THE DEGREE
OF
BACHELOR OF SCIENCE

COURSE CODE: MAT 100

COURSE TITLE: MATHEMATICS FOR TECHNOLOGISTS

DATE: 01/02/2021

TIME: 2 PM - 4PM

Instructions to candidates:

- Answer question ONE and any other TWO questions.

Time: 2 hours

QUESTION 1 (30 MARKS)

- (a) Find the gradient of the tangent to the graph $\cos xy = x^2 \sin y$ at the point $(1, \frac{\pi}{2})$ 3mk
- (b) Find $\lim_{x \rightarrow \infty} \frac{2x^2 - 3x - 4}{\sqrt{x^4 + 1}}$ 3mks
- (c) The ratio of the fourth term to the first term of a geometric sequence is $\frac{1}{8}$. If the first term exceeds the second term by 5. Find the first and the eighth terms of the sequence. 4mks
- (d) In a group of 100 customers at a big red's pizza 80 of the customers ordered mushroom on their pizza and 72 of them ordered pepperoni. 60 Customers ordered both mushroom and pepperoni. How many customers ordered:
- Mushroom and no pepperoni
 - Pepperoni but no mushroom
 - Neither of these two toppings
- (e) Find the derivative of the implicit function $2y^3 + 6x^2y = x^2$ 6mks
- (f) Evaluate the following $\int x^2 \cos(4x) dx$ 4mks
- (g) Determine the angle between vectors $\mathbf{a} = 5i - 13j + 2k$ and $\mathbf{b} = 7j + 3k$ 3mks
- (h) Show that $A = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ has a complex eigenvalues 3mks
- (i) Find the second derivative with respect to x . $x^2 + y^2 = 6$ 3mks

QUESTION 2 (20 MARKS)

- (a) Find the scalar projection of $\mathbf{a} = 4i + 5j - 6k$ on $\mathbf{b} = i + 6j + 4k$ 2mks
- (b) Given that $\vec{r} = i - 2k$, $\vec{p} = 2i + j - 3k$ and $\vec{q} = 3i + 2j + k$ compute $(3\vec{r} + 2\vec{q}) \times \vec{p}$ 3mks
- (c) Prove that $\lim_{\theta \rightarrow 0} \frac{\cos \theta - 1}{\theta} = 0$ 5mks
- (d) Prove that $\vec{a} \cdot \vec{b} = \|\vec{a}\| \|\vec{b}\| \cos \theta$ 5mks
- (e) Let the functions f and g be defined by $f(x) = 4x + 3$ and $g(x) = x^2 + 2$ Compute $f \circ g$ 2mks
- (f) Prove that $\lim_{x \rightarrow 2} (x^2 - 4x + 7) = 3$ 3mks

QUESTION 3 (20 MARKS)

- (a) State and prove the De Morgan's law of union and intersection 10mks
- (b) If $U = \{j, k, l, m, n\}$, $X = \{j, k, m\}$ and $Y = \{k, m, n\}$, show that $(X \cup Y)^c = X^c \cap Y^c$ 5mks
- (c) In a group of 100 students enrolled for a BEd programme, 60 students like math and 70 like chemistry, 10 do not like any of the two subjects. Find the number of the students who like;
- i. Both math and chemistry.
 - ii. Chemistry alone
 - iii. Math alone 5mks

QUESTION 4 (20 MARKS)

- (a) Find the eigenvalues and vectors of the following matrix. $A = \begin{pmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{pmatrix}$ 15mks

- (b) Find the determinant of the following matrix 3mks

$$A = \begin{pmatrix} 4 & 2 & -2 \\ -5 & 3 & 2 \\ -2 & 4 & 1 \end{pmatrix}$$

- (c) Show that the matrix $\begin{pmatrix} 1 & 2 & 1 & 1 \\ 2 & 3 & 0 & 5 \\ 3 & 5 & 1 & 4 \end{pmatrix}$ has rank 3. 2mks

QUESTION 5 (20 MARKS)

- (a) Determine the following indefinite integrals
- i) $\int (3x + 5)(2x^2 - 2x) dx$ 3mks
 - ii) $\int (\sqrt{x} + \sqrt[3]{x}) dx$ 3mks
- (b) Find from the first principles the derivative of $y = 2x^3 - x^2 + 4x - 1$ 5mks
- (c) Show that the slope of the line tangent to the graph of the equation $\sin xy = x^2 \cos y$ at $(2, \frac{\pi}{4})$ is $\frac{\pi}{4}$ 5mks
- (d) Find y^{iv} given that $y = 4t^2 + 8t^{\frac{1}{2}} + 3e^{3t}$ 4mks