



MACHAKOS UNIVERSITY

University Examinations 2019/2020 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF MATHEMATICS AND STATISTICS

.....YEAR SEMESTER SPECIAL /SUPPLEMENTARY EXAMINATION FOR
BACHELOR OF

ECU 200: ENGINEERING MATHEMATICS V

DATE:

TIME:

INSTRUCTIONS TO CANDIDATES

Attempt question *one (compulsory)* and any other *two questions*.

QUESTION ONE (30 MARKS)

- a) Calculate the length of the equiangular spiral $r = ae^{k\theta}$ from $\theta = 0$ to $\theta = 2\pi$ (3 marks)
- b) Calculate the surface area of a sphere obtained by rotating $x^2 + y^2 = a^2$ between $x = -a$ and $x = a$ about the x -axis (4 marks)
- c) Determine the equation of a curve passing through the point (3,2) whose gradient is $5x^2 - x + 1$ at every point (x, y) (4 marks)
- d) Determine the centroid of the region bounded by $x = x^2$ and $y = x$ between $x = 0$ and $x = 1$ (4 marks)
- e) Determine
- i. $\int \frac{dx}{\sqrt{x^2 + 16}}$ (5 marks)
- ii. $\int e^{4x} \cos 2x \cos 4x dx$ (5 marks)
- iii. $\int_0^3 (2x + 3)^7 dx$ (5 marks)

QUESTION TWO (20 MARKS)

- a) Consider the integral $\int \sin^n x \, dx$
- i. Obtain its reduction formula (5 marks)
- ii. Use the formula obtained in (i) above to evaluate $\int_0^{\frac{\pi}{2}} \sin^6 x \, dx$ (9 marks)
- b) Calculate the area of the region bounded by the curves $y = 4x$ and $y = x^2$ (6 marks)

QUESTION THREE (20 MARKS)

- a) Work out the volume of the solid obtained by revolving the cardioid $r = a(1 + \cos \theta)$ about the initial line. (9 marks)
- b) Determine the surface area generated by the revolution of an arc of the catenary $y = c \cosh \frac{\pi}{c}$ about the x -axis. (11 marks)

QUESTION FOUR (20 MARKS)

Evaluate;

- a) $\int x^2 \ln x \, dx$ (4 marks)
- b) $\int \sin^3 x \, dx$ (4 marks)
- c) $\int \frac{5x+4}{(x-1)(x+2)^2} \, dx$ (5 marks)
- d) $\int x^4 e^{4x} \, dx$ (7 marks)

QUESTION FIVE (20 MARKS)

- a) Evaluate;
- i. $\int_0^{\pi} x \sin^6 x \cos^4 x \, dx$ (3 marks)
- ii. $\int_0^{\frac{\pi}{4}} \log(1 + \tan \theta) \, d\theta$ (6 marks)

- b) Compute $\int_0^1 \frac{\tan^{-1} x}{x^{\frac{3}{2}}} dx$ using Trapezoidal rule with 10 *equal* intervals. (11 marks)