



STAMFORD COLLEGE SCHOOL OF ENGINEERING

FOUNDATION STUDIES IN ENGINEERING

KE 015: INTEGRAL CALCULUS

Date: JULY 2007

Time: 10:00 a.m. – 12:10 p.m.

Duration: 2 hours + 10 minutes reading time

Instructions to Candidates:

- Instructions:
1. 6 questions set.
 2. Answer 4 questions.
 3. Maximum marks attainable: 100

Please ensure that this examination paper contains SIX questions on THREE printed pages before you start the examination.

Books, papers or any other written materials are not allowed to be brought into the examination hall. A candidate who violates the examination rules of Stamford College or commits a malpractice will be disqualified from the examination.

Write your Examination Index Number on each page of your answer booklet.

Answer any FOUR questions

Question 1

(a) Perform the integration process for the following parts:

(i) $\int 5x^3 dx$ (3 marks)

(ii) $\int \sqrt{x} dx$ (3 marks)

(iii) $\int 0.25x^2 dx$ (3 marks)

(iv) $\int \frac{1}{x^3} dx$ (3 marks)

(b) Compute $\int \left(\sqrt{x} + \frac{1}{\sqrt{x}} \right)^2 dx$ (8 marks)

(c) Find the integrals $\int \ln x dx$. (5 marks)

(Total = 25 marks)

Question 2

(a) Perform the integration process for the following parts:

(i) $\int 5e^{3x} dx$ (3 marks)

(ii) $\int \frac{1}{2x+3} dx$ (3 marks)

(iii) $\int \cos(2x+5) dx$ (3 marks)

(iv) $\int (3x-3)^3 dx$ (3 marks)

(v) $\int \sqrt{5x-4} dx$ (3 marks)

- (b) Solve $\int \frac{x+1}{x^2-3x+2} dx$ using 'Integration by Partial Fractions' method. (10 marks)

(Total = 25 marks)

Question 3

Using 'Integration by Parts' method to solve the following integration:

(i) $\int x^2 \cdot \ln x \cdot dx$ (10 marks)

(ii) $\int x^2 e^{3x} \cdot dx$ (15 marks)

(Total = 25 marks)

Question 4

- (a) Find the area under the curve $y = 3x^2 + 4x - 5$ between $x = 1$ and $x = 3$. (5 marks)

- (b) (i) Sketch the function $y = 1 - x^2$. (5 marks)

- (ii) Find the area in the first quadrant bounded by the x and y axes and the curve $y = 1 - x^2$. (5 marks)

- (c) Integrate the following trigonometric functions with respect to x .

(i) $\int_1^2 4x^3 dx$ (3 marks)

(ii) $\int_1^2 (x^3 - 3x^2 + 2x) dx$ (7 marks)

(Total = 25 marks)

Question 5

(a) Integrate $\int \left(\frac{x^3}{3} + \frac{3}{x^3} + \frac{3}{x} \right) dx$ (9 marks)

(b) Solve the following functions with respect to x .

(i) $\int_0^2 e^{3x} dx$ (3 marks)

(ii) $\int \sin 3x dx$ (3 marks)

(iii) $\int \frac{1}{x^2 + 4x + 2} dx$ (5 marks)

(iv) $\int \pi^2 dx$ (2 marks)

(v) $\int 2x(x^2 + 1)^3 dx$ (3 marks)

(Total = 25 marks)

Question 6

(a) Find the mean value of $y = 3 \sin 5t + 2 \cos 3t$ between $t = 0$ and $t = \pi$. (12 marks)

(b) Find the area of the region bounded by the x -axis, the graph of $y = -x^2 + 4x - 8$, and the lines $x = -1$ and $x = 4$. (8 marks)

(c) A rocket is fired vertically into the air. Its velocity at t seconds after lift-off is $v(t) = 6t + 0.5$ meter per second. Before launch, the top of the rocket is 8 meters above the launch pad. Find the formula to calculate the height of the rocket (measured from the top of the rocket to the launch pad) at time t . (5 marks)

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