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University Examinations 2013/2014

FIRST YEAR, SECOND SEMESTER EXAMINATIONS FOR DEGREE OF BACHELOR OF SCIENCE IN STATISTICS/ BACHELOR OF SCIENCE/ BACHELOR OF SCIENCE IN COMPUTER SCIENCE/ BACHELOR OS SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE/ BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE

SMA 2102/ STA 2105: CALCULUS II/ CALCULUS FOR STATISTICS II

DATE: APRIL 2014   **TIME: 2 HOURS**

INSTRUCTIONS: *Answer question one and any other two questions.*

QUESTION ONE – (30 MARKS)

(a) (i) Find $\frac{dy}{dx}$ of the following function $y^3 = 3axy + x^4 = 0$ (3 Marks)

(ii) Given that the function y of x is given by the parametric equations

$\left.\begin{matrix} x = a\cos t \\ y = a\sin t \end{matrix}\right\} 0 \le t \le \pi$. Find $\frac{dy}{dx}$ when $t = \frac{\pi}{4}$ (3 Marks)

(iii) Given that $2x^3 - 3y^2 = 7$, find $\frac{d^2 y}{dx^2}$ in terms of x and y only.   (4 Marks)

(b) Perform the following integrations:

(i) $\int \frac{x+1}{\sqrt{x}} dx$ (3 Marks)

(ii) $\int e^{\cos x} \sin x \, dx$ (3 Marks)

(iii) $\int \frac{2x+3}{x^2 - 2x + 1} dx$ (3 Marks)

(c) Use integration by parts to find the indefinite integral $\int \ln x\,dx$. (3 Marks)

(d) Discuss the maxima and minima of $y = x + \sin 2x \ for \ 0 \le x \le \pi$. (4 Marks)

(e) Find the tangent and the normal to the curve $6x^2 + 3xy + 2y^2 + 17y - 6 = 0$ at $(-1, 0)$.
(4 Marks)

QUESTION TWO – (20 MARKS)

(a) Integrate the following functions.

(i) $\int \dfrac{3x + 2}{(x + 2)(x + 1)(x - 3)}\,dx$ (4 Marks)

(ii) $\int \dfrac{2x^2 - 5x + 7}{(x - 2)(x^2 - 2x + 1)}\,dx$ (4 Marks)

(iii) $\int \dfrac{2x + 3}{x^2 + 3x + 7}\,dx$ (3 Marks)

(b) Evaluate the definite integral $\int_0^{\frac{\pi}{6}} \sec^4 x \tan x \ dx$ (4 Marks)

(c) Integrate $\int x^2 e^{-2x}\,dx$ (5 Marks)

QUESTION THREE – (20 MARKS)

(a) The annual sales of a company are expected to grow at a rate proportional to the difference between the sales and an upper limit of k£ 20 million. The sale is zero initially and k£4 million during the 2nd year of operations.
   (i)   What should the company expect the sales to be during the 10th year?
(5 Marks)
   (ii)   During which year are the sales expected to be k£15 million? (4 Marks)

(b) Find the approximate value of $\sqrt[3]{25}$. (5 Marks)

(c) Evaluate $\int_{0}^{2.4} e^{-\frac{x^2}{3}} \, dx$ correct to 4 s.f using the mid-ordinate rule with 6 intervals.

(6 Marks)

QUESTION FOUR – (20 MARKS)

(a) The product of two numbers is 16. Find the numbers if their sum is to be minimum.

(4 Marks)

(b) Given that $ye^x = \sin x$, show that $\dfrac{d^2 y}{dx^2} + \dfrac{dy}{dx} + y = 0$

(4 Marks)

(c) Evaluate $\int_{0}^{\frac{\pi}{4}} \dfrac{dx}{5 + 3\cos x}$

(4 Marks)

(d) (i) Resolve $\dfrac{x^2 + 1}{x^2 - 3x + 2}$ into partial fractional.

(6 Marks)

(ii) Hence determine $\int \dfrac{x^2 + 1}{x^2 - 3x + 2} \, dx$

(2 Marks)