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University Examinations 2012/2013

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

SMA 2200/STA 2204: CALCULUS III/CALCULUS FOR STATISTICS

DATE: APRIL 2013   TIME: 2 HOURS

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

QUESTION ONE (30 MARKS)

a) Convert the following polar equation to the equivalent Cartesian equation $r = \cos\theta + \sin\theta$. (3 Marks)

b) Find the polar equation equivalent to the Cartesian equation
$\frac{x^2}{25} + \frac{y^2}{4} = 1$. (3 Marks)

c) Given $g(x) = x - x^3$. Find the extreme values of g on [0,1] and determine at which number in [0,1] they occur. (4 Marks)

d) State the mean value theorem. (2 Marks)

e) Evaluate the iterated integral
$\int_{x=0}^{1} \int_{y=x}^{\sqrt{x}} xy^2 \, dy \, dx$ (4 Marks)

f) Given that $f(x,y) = \frac{x^3y - xy^3}{x^2 + y^2}$ find f_x and f_y. (6 Marks)

g) Find the $\lim_{x \to 0} \frac{e^x - x - 1}{x^2}$. (3 Marks)

h) Find the Mac Laurin's series generated by $f(x) = e^x$. (5 Marks)

QUESTION TWO (20 MARKS)

a) Show that the point $(2, \frac{\pi}{2})$ lies on the curve $r = 2\cos 2\theta$. (4 Marks)

b) Find the Cartesian equivalent of the polar equation.
$r\cos\left(\theta - \frac{\pi}{6}\right) = 3$. (4 Marks)

c) Define the Taylor's and Maclaurin's series generated by a function f. (4 Marks)

d) i) Find the Taylor series generated by $f(x) = \frac{1}{x}$ at $a = 2$. (4 Marks)

ii) Show that the series is geometric and converges to $\frac{1}{x}$. (4 Marks)

QUESTION THREE (20 MARKS)

a) Given that $F(x, y) = \sqrt{\ln(4 - x^2 - y^2)}$. Find a function f of two variables and a function g of one variable such that $F = g \circ f$. (6 Marks)

b) Let $f(x, y) = 24xy - 6x^2y$. Find f_x and f_y and evaluate them at (1,2). (6 Marks)

c) Find the domain of the function $f(x, y) = \sqrt{x^2 + y^2 - 25}$. (4 Marks)

d) Let $f(x) = \frac{1}{3}x^3 + 2x$. Find C in (0,3) such that $f'(c) = \frac{f(3) - f(0)}{3 - 0}$. (4 Marks)

QUESTION FOUR (20 MARKS)

a) i) define the improper integral of non negative f. (2 Marks)

ii) Evaluate $\int_0^\infty xe^{-2x}dx$. (5 Marks)

b) By first changing the Cartesian integral to the equivalent polar integral, evaluate

$\int_0^a \int_0^{\sqrt{a^2 - x^2}} (x^2 + y^2)dydx$ (5 Marks)

c) Find the centre of gravity of a lamina bounded by the parabola $y = x^2$ and the line $y = x + 2$. (8 Marks)