E-1

King Fahd University of Petroleum & Minerals
Department of Mathematics & Statistics
Math 302 Major Exam I
The Third Semester of 2013-2014 (133)
Time Allowed: 120 Minutes

Name: _____ ID#: _____

Section/Instructor: _____ Serial #: _____

- Mobiles and calculators are not allowed in this exam.
- Write all steps clear.

Question #	Marks	Maximum Marks
1		8
2		6
3		14
4		16
5		12
6		14
7		16
8		14
Total		100

Q:1 (8 points) Let C be a curve traced by the vector function $\mathbf{r}(t) =< 3t, \sqrt{3}\ t^2, \frac{2}{3}t^3 >$, $0 \leq t \leq 1$. Evaluate the length of the curve C.

Q:2 (6 points) Find the maximum rate of change of $f(x, y) = \frac{y^2}{x}$ at the point $(2, 4)$.

Q:3 (14 points) Find the points on the hyperboloid $x^2 - y^2 + 2z^2 = 1$ where the normal line is parallel to the line that joins the points $(3, -1, 0)$ and $(5, 3, 6)$.

Q:4 (16 points) Determine if the vector field

$$\mathbf{F}(x,y) =< 2x - y\,\sin(xy) - 5y^4, -20\,xy^3 - x\,\sin(xy) >$$

is conservative field. If so, find a potential function $\phi(x,y)$ for $\mathbf{F}$ and evaluate the integral $\int_C \mathbf{F}.d\mathbf{r}$, where C is any path from $(-2,0)$ to $(1,0)$.

Q:5(a) (8 points) Use Green Theorem to evaluate

$$\oint_C (3y - e^{\sin x})dx + (7x + \sqrt{y^2 - 1})dy$$

where C is the circle $x^2 + y^2 = 9$ oriented positively.

Q:5(b) (4 points) If $\phi = 2x^3y^2z^4$, find $div(grad\ \phi)$.

Q:6 (14 points) Evaluate the surface integral $\int\int_S \; yz \; dS$, where S that portion of the cone $z = \sqrt{x^2 + y^2}$ lies between the plane $z = \frac{1}{2}$ and $z = 1$.

Q:7 (16 points) Verify Green Theorem when the vector field is $\mathbf{F} =< x, y >$, and the curve C consists of the line segment from $(0, 1)$ to $(0, 0)$ and from $(0, 0)$ to $(1, 0)$ and the parabola $y = 1 - x^2$ from $(1, 0)$ to $(0, 1)$.

Q:8 (14 points) Use Stokes' Theorem to compute $\int\int_S \ curl\mathbf{F}.\mathbf{n}\ dS$, where $\mathbf{F}(x,y,z) =< xz, yz, xy >$ and S is the part of the sphere $x^2+y^2+z^2=4$ that lies inside the cylinder $x^2+y^2=1$ and above the $xy-$ plane.