Assignment # 1 MATH471(012) **Dr. AL-Homidan** **Due**: Monday February 4

1) Page 15, problem # 8.
2) Page 16, problem # 12.
3) Page 16, problem # 14.
4) Verify the Taylor series about $x_\circ = 0$

$$\ln(e+x) = 1 + \frac{x}{e} - \frac{x^2}{2e^2} + \cdots = 1 + \sum_{k=1}^{\infty} \frac{(-1)^{k-1}}{k!}\left(\frac{x}{e}\right)^k$$

prove that the infinite series converges for $-e < x < e$.

5) For $|x| < \frac{1}{2}$ use Taylor series to prove that $\left|\cos x - (1 - \frac{x^2}{2})\right| < k$ Find the best k.

6) Find the value ξ that serves in Taylor series for $x = \dfrac{\pi}{4}$ and $c = 0, n = 4$ when used to approximate $\sin x$

7) To get started with MATLAB, in the command window type *x = -1: 0.1:1* and then execute the following statements by typing them in and pressing return*: sqrt(x), sin(x), cos(x), x.^2, x.^3, plot(x,cos(x.^4)) , plot(x,sin(x.^3)).* Examine and report the effect of each.

8) Repeat what you did in question (7) to the following matrices commands

```
A=[1 2 3 4;5 6 7 8;9 1 2 3;1 5 8 9]
v=[1 2 4];
b=A(v,2);
c=A(v,:)
D=ones(3 ,3)
 I=eye(3 ,3)
 Z=zeros(3 ,3)
E=[1:3 4:2:8 10:0.5:11]
F=rand(4,4)
G=A*F;  H=A.*F
```

9) Follow Example 1 page 6-8 step by step but in Matlab environment**.**

Assignment # 2 MATH471(012) **Dr. AL-Homidan** **Due**: Saturday February 9

1) Page 27, problem # 4.

2) Page 28, problem # 17.

3) Page 28, problem # 19.

4) Page 29, problem # 24.

5) Compute the absolute and relative error when e is approximated by 2.71828 18.

6) The polynomial

$$P(x) = 3 - 4x - 5x^2 - 6x^3 + 7x^4 - 8x^5$$

can be evaluated for a particular x in three different ways; that is,

a) By considering $cx^k = c*(x*x*...*x)k-1$ times.

a) By computing each power of x by multiplying x times the proceeding power of x; that is, $x^2 = x*x$, $x^3 = x*x^2$, $x^4 = x*x^3$, and so on.

c) By nested multiplication; that is,

$$P(x) = 3 - x(4 - x(5 - x(6 + x(7 - 8x))))$$

i. How many additions and multiplications are required to evaluate $P(x)$ using the three above techniques.

ii. Which one is expected to produce a more accurate value and why.

iii. When using a machine, it is assumed that all numbers used are machine numbers, derive an expression for $fl(P(x))$.

7) The adjoin Matlab routine chops or round a floating number x to r digits. Very the procedure works for the following values

a. x=124.031 r=5

b. x=124.036 r=5

c. x=-124.031 r=5

d. x=-124.036 r=5

```
if x == 0
  w = 0;
else
  ee = fix(log10(abs(x)));
  if abs(x) > 1
    ee = ee + 1;
  end;
  if rnd == 1
    w = round(x*10^(r-ee))*10^(ee-r);
  else
    w = fix(x*10^(r-ee))*10^(ee-r);
  end;
end;
res = w ;
```

Assignment # 3 MATH471(012) **Dr. AL-Homidan** **Due**: Wednesday February 13

1) Page 38, problem # 3a.

2) Page 38, problem # 7a.

3) Page 38, problem # 9.

4) To find the derivative by definition we use the formula

$$f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

a) Write a MATLAB code to approximate $f'(0.5)$ where $f(x) = \ln x$ and $h = \frac{1}{10^n}, \quad n = 1, 2, \ldots, 10$

b) Compute the absolute and the relative errors for each h in the previous part. Arrange the results in a table where one can see the results for each h easily.

c) Comment on the results.

5) a) Write a Matlab function for evaluating any polynomial of any degree using nested multiplication. The input to the function is the array of the coefficients and a point. Do not use Matlab functions polyval or polyvalum.

b) Count manually the number of arithmetic operations. Compare with the count from the Matlab function flops. List your observations.

6) How many floating point operations (addition, subtraction, multiplication and division) occur in executing the following code

```
For j=1: n
For i=1:j
x=x + A(i,j)*B(i,j)
end
end.
```

7) Let $x = \sum_{n=1}^{1000} \ln(n)$ and $y = \sum_{n=1000}^{1} \ln(n)$ Write an m-file that calculates x and y without using the function sum. Report your observations and conclusions.

8) Write an m-file that calculates the sum $\sum_{i=1}^{n} \sum_{j=1}^{i} a_i b_j$ Find manually the number of multiplications and additions. Compare with the count obtained by flops. Report your observations and conclusions.

9) Run the following two codes and explain the results**:**

```
eps=1.;
eps1=eps+1.
While eps1 >1
eps=eps/2
epasl=eps+1
end
```

```
eps=1.;
While eps > 0
eps=eps/2
end
```

10) Write an m-file that calculates the approximation $e = \sum_{n=0}^{15} \frac{1}{n}$ and the absolute and relative errors.