04.04.2014

BIL108E MIDTERM EXAM I

Duration: 4 hours from 8.30 to 12.30.
Do not copy/cheat or submit "similar" papers.
You are not allowed to ask questions to the proctors and instructors during exam.
Do not write any explanations in Turkish.
Please create your .m files as indicated and submit your solutions via ninova.
Upload each solution separately.

1) **(20 Points)**
Open a new script in the Matlab Editor and save it as `solvingequations.m`
Create a 3x3 matrix from your 9 digit student ID (140110011 as in *abcdefghl*) as

$$\begin{bmatrix} a & b & c \\ d & e & f \\ g & h & l \end{bmatrix}$$

Assign these variables in the following equations in order to find three unknowns, x_1, x_2, x_3

$$ax_1 + bx_2 + cx_3 = 25$$

$$dx_1 + ex_2 + fx_3 = 13$$

$$gx_1 + hx_2 + lx_3 = 6$$

Discuss your results using % comment operator in mathematical sense (complex numbers etc.)

2) **(20 Points)** Open a new script in the Matlab Editor and save it as `butterflycurves.m`
Plot function r which is $r = e^{\cos\theta} - 2\cos 4\theta + \sin 5(\frac{\theta}{12})$ in polar coordinates (r, θ)
Generate 5000 elements using `linspace` function, and define θ from 0 to 20π.

Use pink color for the curve, add gridlines, x,y labels and title of the graph.

3) **(25 Points)** Open a new script in the Matlab Editor and save it as `seriesconvergenceA.m`

a) Plotting geometric series $G = \sum_{k=0}^{\infty} p^k$

i. For defined values of p and k;
p=0.99
k is vector containing the integers from 0 to 1000, inclusive.
Define function such as `geomSeries = p^k`
Calculate each term in the series, elementwise.

ii. Calculate the value of the infinite series which is derived as;

$$G = \sum_{k=0}^{\infty} p^k = \frac{1}{1-p}$$

Plot the value of the infinite series that you calculated above, using horizontal red line. (Hint: y is constant for all values of k)

iii. On the same plot, plot the value of the finite series for all values of k
Plot the cumulative sum of `geomSeries` versus `k` . The cumulative sum of a vector is a vector of the same size, where the value of each element is equal to the sum of all the elements to the left of it in the original vector. (use `cumsum`, and try `cumsum`([1 1 1 1 1]) to understand what it's doing.) Use a blue line when plotting.

iv. Label x,y axes and give figure a title as your name&surname.

v. Create a legend, label each plot. In particular, label the first line 'Infinite sum', and the second line 'Finite Sum'. (Hint: `legend`)

vi. Run the script and identify how many elements comes very close to the value of infinite sum. (Use comment operator% for your explanations and comments)

b) Save this script as `seriesconvergenceB.m`

Follow the same steps described above to plot series $F = \sum_{s=1}^{\infty} \frac{1}{s^m}$

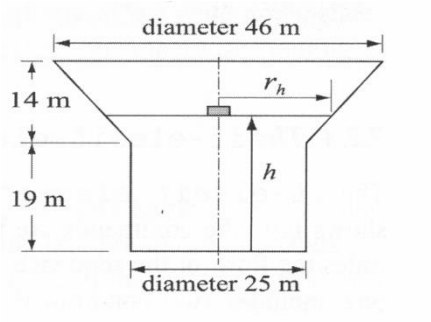
i. For defined values of *m* and *s*;
m=2
s is vector containing the integers from 1 to 500, inclusive.
Define function such as `FSeries = 1/(s^m)`
Calculate each term in the series, elementwise.

ii. Calculate the value of the infinite series. The infinite F-series with m = 2 has been proven to converge to

$$F = \sum_{s=1}^{\infty} \frac{1}{s^m} = \frac{\pi^2}{6}$$

iii. Make a new figure and plot the infinite sum as well as the finite sum, as you did for the geometric series. Repeat steps ii,iii,iv,v,vi for F Series this time.

4) **(25 Points)** Open a new script in the Matlab Editor and save it as `Tank.m`



The tank in a water tower has the geometry shown in the figure (the lower part is a cylinder and the upper part is an inverted frustum cone). Inside the tank there is a float that indicates the level of the water. Write a user-defined function file that determines the volume of the water in the tank from the position height *(h)* of the float. The input to the function is the value of *h* in m, and the output is the volume of the water m^3.

Hint1: Consider the conditions for h>19 and h ≤ 19;

Hint2: The volume of a cylinder with height h is equal to $V = \pi r^2 h$ and the volume of a inverted frustum cone with height h, bottom radius r1, and top radius r2, is equal to $V = \frac{1}{3}\pi h(r_1^2 + r_1 r_2 + r_2^2)$.

5) **(10 Points)** Please correct the codes given below and save it to new .m files.

a) Open a new script in the Matlab Editor, make the correction in necessary lines and save it as `corrected5A.m`

```
numerator=0;
for n=1:10^(-6)
a=(1).^(n+1)./(2.*n-1);
sum(a);
numerator;
if
sun(a)-(pi/4)<10^(-6);
break
end
end
```

b) Open a new script in the Matlab Editor, make the correction in necessary lines and save it as `corrected5B.m`

```
>> Z= [1:2]
Z = 1     2
>> sum((-1).^(n+1)/(2.*n-1))
ans = -0.0476
```

But the answer should be .6667. Can you see what's wrong? Please correct it.

6) **Bonus (10 Points)**

Open a new script in the Matlab Editor and save it as `testingnumbers.m`

With user input n, test any number such that if the number is smaller than 15, then print "too small", if $15 \leq n \leq 25$ then print "just right", and if the number is greater than 25, print "too large" to the screen.

Best Luck