Notes from January 21 – Thursday

- While the matlab command “a=15.4” generates a single memory location assigned to the variable name a. The matlab command “a=eye(3)” generates a 3 by 3 identity matrix for a and there are 9 elements. Similarly, “a=zeros(5)” generates a 5 by 5 matrix with all zeros as elements. Use matlab command “help eye” and “help zeros” to find out more about these commands.

- To enter a matrix from the command line prompt, use brackets in the following way: “a=[1 3 5; 2 4 6]” would generate a matrix with 2 rows and 3 columns, the delimiter “;” is equivalent to “enter” when a row is completed. The matrix must be rectangular in nature; each row should have the same number of elements.

- To fetch from or store to a particular element in an array, use an integer index. For example a(2,3) refers to the element on row 2 and column 3. Similarly, a(1,2) refers to the element on row 1 and column 2.

- The colon symbol can used to specify a range. For example, a(2,1:2) refers to elements on row 2 and columns from 1 to 2. The reference of a(1,:) means the first row of a with all columns included. a(:,2) refers to the column 2.

- In Project Two, Part B, it is requested that a table be created for the value of theta from 0 to 90 with an increment of 5. A row vector for theta can be created by using the command “theta=0:5:90” and the values would be assigned to theta as 0 5 10 15 20 25 30 … 85 90, etc.

- Note that td (theta dot) and tdd (theta dot dot) are scalars, they are the same for all theta values. Likewise for m, the mass.

- Matlab has implemented a class of operators preceded by a period, e.g., “.*”, “./”, etc. The expression a.*b means that each element of array “a” is multiplied by its corresponding value of array “b”.

- The instruction sind(theta) would also generate an array of 19 elements.

- Special note: if you decide to use degrees throughout, be sure to change pi to 180 in the equation for beta.

- If you want to use radians, you can convert theta into t using the formula “t=theta*pi/180” and that would also create an array for t.

- Now these are Matlab operators only, they do not exist in C, C++ or Fortran. In the equation for r there is a term cos(t) squared. Matlab recognized that you can only square a scalar or a square matrix, so
the expression “cos(t).^2” was created. That means each element of the cos(t) array is squared individually.

- In the line which determines rd (r dot), it is perfectly fine to multiply a scalar td (theta dot) with the array r using “r*td” but since sin(t) is also an array, be sure to use “r*td.*sin(t)” or “(r*td).*sin(t)” and “.*” means multiply each corresponding element of the two arrays individually.

- Also, in the expressions for rd and rdd, each has the same denominator. It is good to generate an array “bottom” so it could be reused for both expressions with a duplication of efforts. But when the division is needed, be sure to use “top./bottom” and each corresponding element would be divided individually.

- There are also array type of multiplication or division in the expressions for beta, N and Q. Be careful.

- Expressions like the “+0.03” factor is added inside the sqrt of the expression for r. That is fine, 0.03 would be added to each element of the array. Similarly in Fs, 0.1 is subtracted from each element of the array r.

- To print the title of the table, just count out the exact number of spaces needed to make the table columns line up. Use the statement:

  `fprintf('     theta        Fs         N         Q
');`

- To print the arrays theta,Fs,N and Q as a table, it is necessary to create a matrix OUT with 4 rows. Later on, when the concept of loops is covered, it would not be necessary to this step. Perform the commands

  `OUT(1,:)=theta;`  
  `OUT(2,:)=Fs;`  
  `OUT(3,:)=N;`  
  `OUT(4,:)=Q;`

- In the above statements, theta is entered into row 1 of OUT, Fs is entered into row 2 of OUT. N and Q are in rows 3 and 4 of OUT, respectively.

- In matlab, as in fortran, the matrix organized in a “row major convention.” That means the 4 rows by 19 columns matrix is organized in the order: OUT(1,1), OUT(2,1), OUT(3,1), OUT(4,1), OUT(1,2), OUT(2,2), etc. That means the row index is altered more rapidly than the column index.
- For the rest of the table, use
  
  `fprintf('%10.0f%10.2f%10.2f%10.2f\n',OUT);`

- If the above implementation of array output is too difficult to grasp, here is an installment of a counter loop which could be used for project 2:
  
  ```
  for i=1:19
    fprintf('%10.0f%10.2f%10.2f%10.2f\n',theta(i),Fs(i),N(i),Q(i));
  end
  ```

- The syntax of `%10.2f` is the format editor for a floating point number. The symbols `%` and `f` are required but the numbers in between specify the way the floating number is appear as output. `10.2` means 10 total spaces reserved for the number and 2 indicates the number of places after the decimal. The value of pi would appears as `babbabb3.14`, in which `b` represents a blank in this paragraph. If pi is written out in a `%10.4f` format, it would appears as `bbbb3.1416`. 