Please write your first name, last name and student number on your answer sheet.

Please create groups with up to three students and use Microsoft Office to take this HW.

In each of the following questions, please provide both the image of script written in MATLAB and the output results.

One of the group members should submit answer sheet in the PDF format in CW.

Due Date: 1403/12/26

1) The standard normal probability density function is a bell-shaped curve that can be represented as:

$$f(z) = \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}}$$

Use MATLAB to generate a plot of this function from $z = -5$ to 5. Label the ordinate as frequency and the abscissa as *z*.

2) Develop a code in MATLAB that takes a number in decimal system from the user and converts it to the binary form. The number can have decimals. Provide an example in your answer sheet.

3) If a force *F* (N) is applied to compress a spring, its displacement *x* (m) can often be modeled by Hooke's law:

$$F = kx$$

where *k* = the spring constant (N/m). The potential energy stored in the spring *U* (J) can then be computed as:

$$U = \frac{1}{2} k x^2$$

Five springs are tested and the following data compiled:

F (N)	14	18	8	9	13
x (m)	0.013	0.020	0.009	0.010	0.012

Use MATLAB to store *F* and *x* as vectors and then compute vectors of the spring constants and the potential energies. Use the *max* function to determine the maximum potential energy.

4) The Maclaurin series expansion for the cosine is:

$$cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \frac{x^8}{8!} - \cdots$$

Use MATLAB to create a plot of the cosine (solid line) along with a plot of the series expansion (black dashed line) up to and including the term $\frac{x^8}{8!}$. Use the built-in function factorial in computing the series expansion. Make the range of the abscissa from $x = 0$ to $\frac{3\pi}{2}$.

5) The "divide and average" method, an old-time method for approximating the square root of any positive number ***a***, can be formulated as:

$$x = \frac{x + \frac{a}{x}}{2}$$

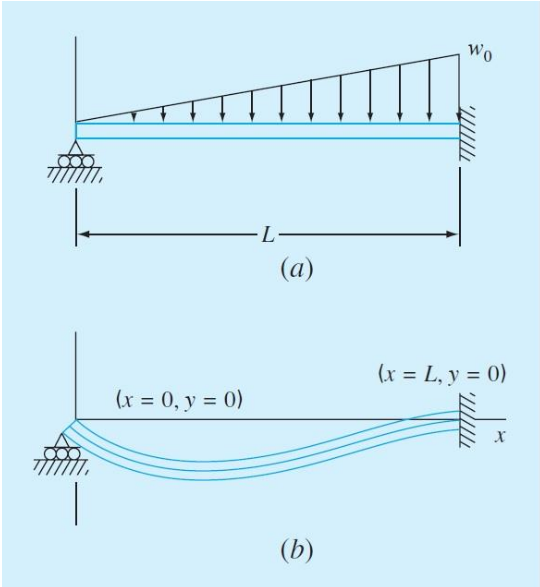
Write a well-structured M-file function based on the **while...break** loop structure to implement this algorithm. Use proper indentation so that the structure is clear. At each step estimate the error in your approximation as:

$$\varepsilon = \left| \frac{x_{new} - x_{old}}{x_{new}} \right|$$

Repeat the loop until ε is less than or equal to a specified value. Design your program so that it returns both the result and the error. Make sure that it can evaluate the square root of numbers that are equal to and less than zero. For the latter case, display the result as an imaginary number. For example, the square root of −4 would return 2i. Test your program by evaluating a = 0, 2, 10 and −4 for $\varepsilon = 1 \times 10^{-4}$.

6) Figure *a* shows a uniform beam subject to a linearly increasing distributed load. As depicted in Fig. *b*, deflection y (m) can be computed with:

$$y = \frac{w_0}{120EIL}(-x^5 + 2L^2x^3 - L^4x)$$



where E = the modulus of elasticity and I = the moment of inertia (m^4). Employ this equation and calculus to generate MATLAB plots of the following quantities versus distance along the beam:

(a) displacement (y),

(b) slope $[\theta(x) = \frac{dy}{dx}]$,

(c) moment $[M(x) = EI\frac{d^2y}{dx^2}]$,

(d) shear $[V(x) = EI\frac{d^3y}{dx^3}]$, and

(e) loading $[w(x) = -EI\frac{d^4y}{dx^4}]$.

Use the following parameters for your computation: L = 600 cm, E = 50,000 kN/cm^2, I = 30,000 cm^4, w_0 = 2.5 kN/cm and Δx = 10 cm. Employ the subplot function to display all the plots vertically on the same page in the order (a) to (e). Include labels and use consistent MKS units when developing the plots.

7) Write a user-defined MATLAB function that calculates the determinant of a square ($n \times n$) matrix, where n can be 2, 3 or 4. For function name and arguments, use D = Determinant (A).

The input argument A is the matrix whose determinant is calculated. The function Determinant should first check if the matrix is square. If it is not, the output D should be the message "The matrix must be square".

Use Determinant to calculate the determinant of the following two matrices:

(a) $\begin{bmatrix} 1 & 5 & 4 \\ 2 & 3 & 6 \\ 1 & 1 & 1 \end{bmatrix}$

(b) $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \\ 13 & 14 & 15 & 16 \end{bmatrix}$