Instructions for preparing the solution script:

- Write your name, ID#, and Section number clearly in the very front page.
- Write all answers sequentially.
- Start answering a question (not the part of the question) from the top of a new page.
- Write legibly and in orderly fashion maintaining all mathematical norms and rules. Prepare a single solution file.
- Start working right away. There is no late submission form. If you miss the deadline, you need to use the make-up assignment to cover up the marks.

In our classes, we discussed the three forms of floating number representation as shown below:

$$\text{Standard Form: } F = \pm(0.d_1d_2d_3.....d_m)_\beta \times \beta^e; d_1 \neq 0$$
$$\text{Normalized Form: } F = \pm(0.1d_1d_2d_3.....d_m)_\beta \times \beta^e$$
$$\text{Denormalized Form: } F = \pm(1.d_1d_2d_3.....d_m)_\beta \times \beta^e$$

where $d_i, \beta, e \in \mathbb{Z}, 0 \leqslant d_i \leqslant \beta - 1$ and $e_{min} \leqslant e \leqslant e_{max}$.

A. Let's take, $\beta = 2, m = 4$ and $-2 \leqslant e \leqslant 2$. Based on these, answer the following questions:

1. (5 marks) For last two forms (normalized and denormalized form), find the smallest positive and negative numbers with the largest number representable by the system. Express these numbers in both binary and decimal formats for all two forms.
2. (2 marks) How many numbers can this system represent or store in all these three forms?
3. (3 marks) Using standard form, find all the decimal numbers for e = -2 and e = 2 without negative support, plot them on a real line, and show if the number line is equally spaced or not.

B. Let's take, $\beta = 2, m = 4$ and $-2 \leqslant e \leqslant 3$. Based on these, answer the following questions:

1. (4 marks) Compute the minimum of $|x|$ for normalized and denormalized form.
2. (4 marks) Compute the machine epsilon or unit roundoff value for the normalized and denormalized form.
3. (2 marks) Compute the maximum delta value for the standard form.

C. Consider the real number $x = (3.165)_{10}$

1. (3 marks) Convert the decimal number x in binary format at least up to 9 decimal/binary places.
2. (4 marks) What will be the binary value of x [Find $fl(x)$] if you store it in a system with $m = 4$ and $m = 6$ using the standard form.
3. (3 marks) Now convert back to the decimal form the stored values you obtained in the previous part, and calculate the rounding error of both numbers.