# Assignment-1 Instructions

1. Last date of submission 5-February-2019

2. For question number (2), you have to submit program (.m or .py file) and plot.

3. For question number (1, 3, 4), you have to submit a pdf file.

4. Upload all the documents (program, plot, pdf) as a single zip file with your name and roll number in the file name (e.g. Rahul_16126.zip)

# Assignment-1 - 10Marks

(1) For what value of 'a' in the equation below will give rise to (a) stable equilibrium point (asymptote), (b) stable oscillations, and (c) unstable oscillations.

$$N(t+1) = a\, N(t)\, (1 - N(t))$$

**Note**: For the stable asymptote the eigen value λ should be $0 < \lambda < 1$. For stable oscillations eigen value λ should be $-1 < \lambda < 0$. For unstable oscillations eigen value λ should be $-1 > \lambda$. (2M)

(2) (a) Write MATLAB/Python codes to get the cobweb plots (N(t+1) Vs N(t) space) for each of the cases mentioned in Q(1). (b) Also provide the N(t+1) vs t for the corresponding 'a' values. (c) Draw the bifurcation diagram (N(t) Vs 'a') for a values ranging from 1.4 to 4 in steps of 0.01. (4M)

(3) For the equation $N(t+1) = N(t)\, e^{(r(K-N(t)/K)}$ , find the value of 'r' for which the equation will exhibit oscillations. (2M)

(4) For the continuous logistic equation the solution is given as

$$N(t) = \frac{K}{1+\left(\frac{K-N(0)}{N(0)}\right)e^{-rt}}.$$

Express N(t+1) as a function of N(t) (2M)