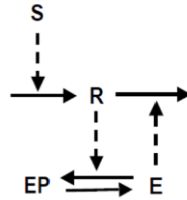


End Semester 2020

Time: 30 min

Scan/take a picture (use mobile) of your answer sheet and submit it in the MOODLE before the end of exam.

1. Draw the rate plot with respect to R and show that the system can exhibit bistable characteristics. Also, draw the signal-response (S v R_{ss}) curve. S -signal, R_{ss} - R steady state. [5 marks]



2. Individual (elementary) reactions of a model are given below: [1+2+2 marks]

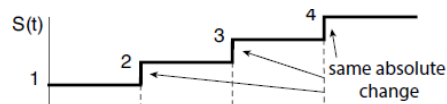
r	reaction
1	$A \xrightarrow{k_1} X$
2	$B + X \xrightarrow{k_2} Y + C$
3	$2X + Y \xrightarrow{k_3} 3X$
4	$X \xrightarrow{k_4} D$

Assuming that A, B, C and D are constant (because present in excess for example).

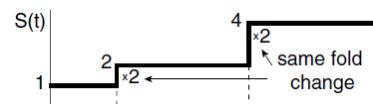
- (a) Write ODEs to describe the dynamics of X and Y based on mass action kinetics.
- (b) Write the transition probability/propensity function of individual reactions.
- (c) Write the master equation to describe how probability, $P(X, Y)$ changes with time.

3. Two inputs (A, B) to incoherent feedforward loop is given below. Draw the response (output) for each input. What is the difference in the response for each input? What characteristic of the response is common? What you can infer from the difference and common features? [5 marks]

A



B



4. Consider an excitable system of two variables (X and Y). Draw the mechanism (interactions involving X and Y) and phase plane (X vs Y). [5 marks]