MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal)

## VII SEMESTER B. TECH END SEMESTER EXAMINATIONS

## NOVEMBER 2019

## SUBJECT: BIOPROCESS CONTROL [BIO 4102]

Date of Exam: 21/11/2019 Time of Exam: 2.00 PM – 5.00 PM Max. Marks: 50

## Instructions to Candidates:

Answer ALL the questions & missing data may be suitable assumed

1A.	Name different types of forcing function and their graphical representation.	2
1B.	Define transfer function. Why is it useful? Give the significance of zeros and poles of a transfer function.	3
1C	Find the response for following linear differential equation $\frac{d^2y}{dt^2} + y = 2e^{2t}$ y(0) = 1; y'(0) = 2.	5
2A.	A thermometer showing steady state temperature of 30°C is suddenly immersed into a hot water bath at 100°C which follows first order dynamics ( $\tau_P = 0.5 \text{ min \& K}_p = 1$ ). Determine the time required to read 80°C on Thermometer.	2
2B.	What is a first order system? What is the principal characteristic of the first order processes?	2
2C.	Consider a second order system with the following transfer function $G_p(s) = \frac{1}{(S^2+S+1)}$ . Introduce a step change of magnitude 5 into the system and find a) overshoot percentage b) rise time c) period of oscillation d) maximum value of response	6
3A.	What is control valve flow characteristic? Explain selection of flow characteristics based on application with reason.	2
3B.	Discuss the effects of $K_c$ , $\tau_{I,}$ and $\tau_D$ on the closed response of a process controlled with PID Controller.	2
3C.	$X(s)_{+} \xrightarrow{+} \xrightarrow{+} \xrightarrow{G_{1}} \xrightarrow{+} \xrightarrow{+} \xrightarrow{G_{2}} \xrightarrow{-} \xrightarrow{G_{3}} \xrightarrow{+} \xrightarrow{+} \xrightarrow{+} \xrightarrow{Y(s)} \xrightarrow{H_{2}} \xrightarrow{-} \xrightarrow{-} \xrightarrow{H_{1}} \xrightarrow{-} \xrightarrow{H_{2}} \xrightarrow{-} \xrightarrow{-} \xrightarrow{H_{1}} \xrightarrow{-} \xrightarrow{-} \xrightarrow{-} \xrightarrow{-} \xrightarrow{-} \xrightarrow{-} \xrightarrow{-} $	6
4A.	Determine the closed loop transfer function for block diagram shown above. By means of Routh test, determine the stability of system shown in below figure when $K_c = 2$ .	5

