BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: BE **SEMESTER: VII**
BRANCH: EEE **SESSION : MO/2018**

SUBJECT : EE8225 APPLIED CONTROL THEROY

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) Define the following in term of state space model [2]
i. State
ii. State vector
iii. State space
iv. State trajectory

(b) Construct the state model for a system characteristic by the differential equation [3]
$D^3y/dt^3 + 4\ d^2y/dt^2 + 3\ dy/dt + 2y = u$.

Q2 (a) What is the characteristic equation of a system in state-space model? [2]

(b) For the given transfer function $G(s) = \frac{(s+2)}{s^3+9s^2+24s+20}$. Obtain the Jorden canonical state model. [3]

Q3 (a) What is the Eigen value and Eigen vector? [2]

(b) How we determine the Eigen Vector when all Eigen values are Distinct? [3]

Q4 (a) "State space model is not an unique solution". Explain the statement. [2]

(b) The state variable description is $[\dot{x}] = \begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$ [3]
Determine state transition matrix of the system assuming all initial condition is zero

Q5 (a) Investigate the following system for controllability and observability [2]

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$
$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$$

(b) Consider a second order system described as [3]

$$\dot{x} = \begin{bmatrix} -1 & 3 \\ 0 & -2 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u$$
$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$$

Required to place a close loop pole at (-3,-3). Find the required state feedback gain matrix.

Q6 (a) What is the concepts of state model observer designed? what are the advantages over pole placement designed? [2]

(b) For the system given below, an observer is to be designed to estimate the state variables. Select the observer gain and write the equations describing the observer dynamics. [3]

$$\dot{x} = \begin{bmatrix} -4 & -4 \\ 1 & -2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 2 \end{bmatrix} u$$
$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} x$$