ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY & SCIENCES
(AUTONOMOUS)

M.Tech II-Semester Regular Examinations, May 2016

Sliding Mode Control (Elective-II)

(Control Systems Engineering)

Date: **Time: 3 hours** **Max Marks: 60**

Answer ONE Question from each unit
All questions carry equal marks
All parts of the question must be answered at one place only

UNIT-I

1 a) Explain about variable structure control system with an example. (6M)

b) What is chattering? How chattering occurs? How chattering effect can be reduced? (6M)

(OR)

2 a) How the sliding mode control is robust and insensitive to parameter variations? (6M)

b) How the sliding mode control reduces the system order? (6M)

UNIT-II

3 a) What is reachability problem? Describe different methods for a state trajectory to reach the sliding surface. (5M)

b) Derive the equivalent control signal U_{eq} for a sliding mode controller with and without disturbances. (7M)

(OR)

4 a) Explain the unit vector approach. (6M)

b) Prove that the ideal sliding motion is totally insensitive to uncertain function $\xi(t,x)$ in state equation $x'(t) = Ax(t) + Bu(t) + D\xi(t,x)$ if $R(D) \subset R(B)$ (6M)

UNIT-III

5 a) Explain about Eigen structure assignment approach. (7M)

b) Compare the advantages of sliding mode control with any other control. (5M)

(OR)

6 a) Explain about the modal reference approach. (6M)

b) Explain the design of various reaching law methods. (6M)

UNIT-IV

7 a) Explain dynamic compensation (6M)

b) Design α state feedback law that satisfies the origin, for the given system below

$x'_1 = x_2$

$x'_2 = h(x) + g(x)\, u;$

$h(x)$, $g(x)$ all unknown, $g(x) > g_0 > 0$; $\forall \quad x \in R$ (6M)

(OR)

8 a) Explain about the square plants with an example (2M)

b) Design a sliding surface, sliding mode control equations for the second order system $x''(t) = f(x,t) + u(t)$, where $f(x,t)$ is generally nonlinear time varying and is estimated as $f(x,t)$, $u(t)$ is the control input and $x(t)$ is the state to be controlled, so that it follows a desired trajectory $x_d(t)$. The estimation error on $f(x,t)$ is boundary by some known function $F = F(x,t)$, with the help of assumptions, design the above equations. (10M)

UNIT-V

9 a) Explain about the discontinuous observer. (4M)

b) Design a general sliding mode observer for the given system $x'(t) = Ax(t) + Bu(t)$, $y(t) = Cx(t)$, where $x \in R^n$, $u \in R^p$, $y \in R^n$ (8M)

(OR)

10 a) How sliding mode observers are useful in fault detection. (7M)

b) Explain about Walcott-Zak observer. (5M)

*****