

**AerE 5740: Optimal Control: Spring 2025**

Iowa State University

**Quiz 14: Additional constraints in continuous-time OCP**

Name:-----

For each of the following multiple choice problems, ONLY ONE option is correct. Clearly mark the correct option. Calculators or other electronic devices are NOT allowed.

**Problem 1**

When we have additional interior point (i.e., at some intermediate time  $t_1 \in (0, T)$ ) state equality constraint, then the optimal Hamiltonian and costate trajectories

(A) can have jump discontinuities in  $[0, T]$ . Reason: Lec. 15 p. 4-6.

(B) must be continuous in  $[0, T]$ .

(C) must be differentiable in  $[0, T]$ .

**Problem 2**

Which of the following best describes when optimal control is singular?

(A) The optimal control cannot be determined from PMP alone. Reason: Lec. 15 p. 11.

(B) The control cost weight matrix inside Lagrangian is singular.

(C) The state cost weight matrix inside Lagrangian is singular.

**Problem 3**

A linear function must change its sign

(A) at most once. Reason: Lec. 15 p. 13.

(B) at least once.

(C) exactly once.

#### Problem 4

Which of the following respects the constraint:  $-2 \leq u(t) \leq 7$  for all times  $t$ ?

(A)  $u(t) = 3 + \sin t$ . Reason:  $-1 \leq \sin t \leq 1$ , so  $2 \leq 3 + \sin t \leq 4$ .

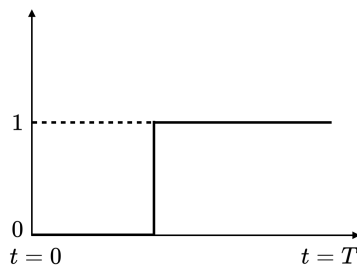
(B)  $u(t) = 3 + 5 \sin t$ .

(C)  $u(t) = 3 - 5 \sin t$ .

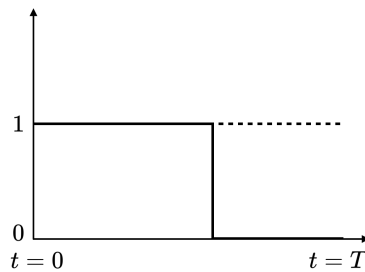
#### Problem 5

If  $0 \leq u(t) \leq 1 \ \forall t \in [0, T]$ , then which of the following  $u(t)$  is bang-bang?

(A)



(B)



(C) both of the above. Reason: both (A)-(B) have  $u(t) \in \{0, 1\} \ \forall t \in [0, T]$ .