fit@hcmus

Software Testing

CSC13003

State Transition Testing

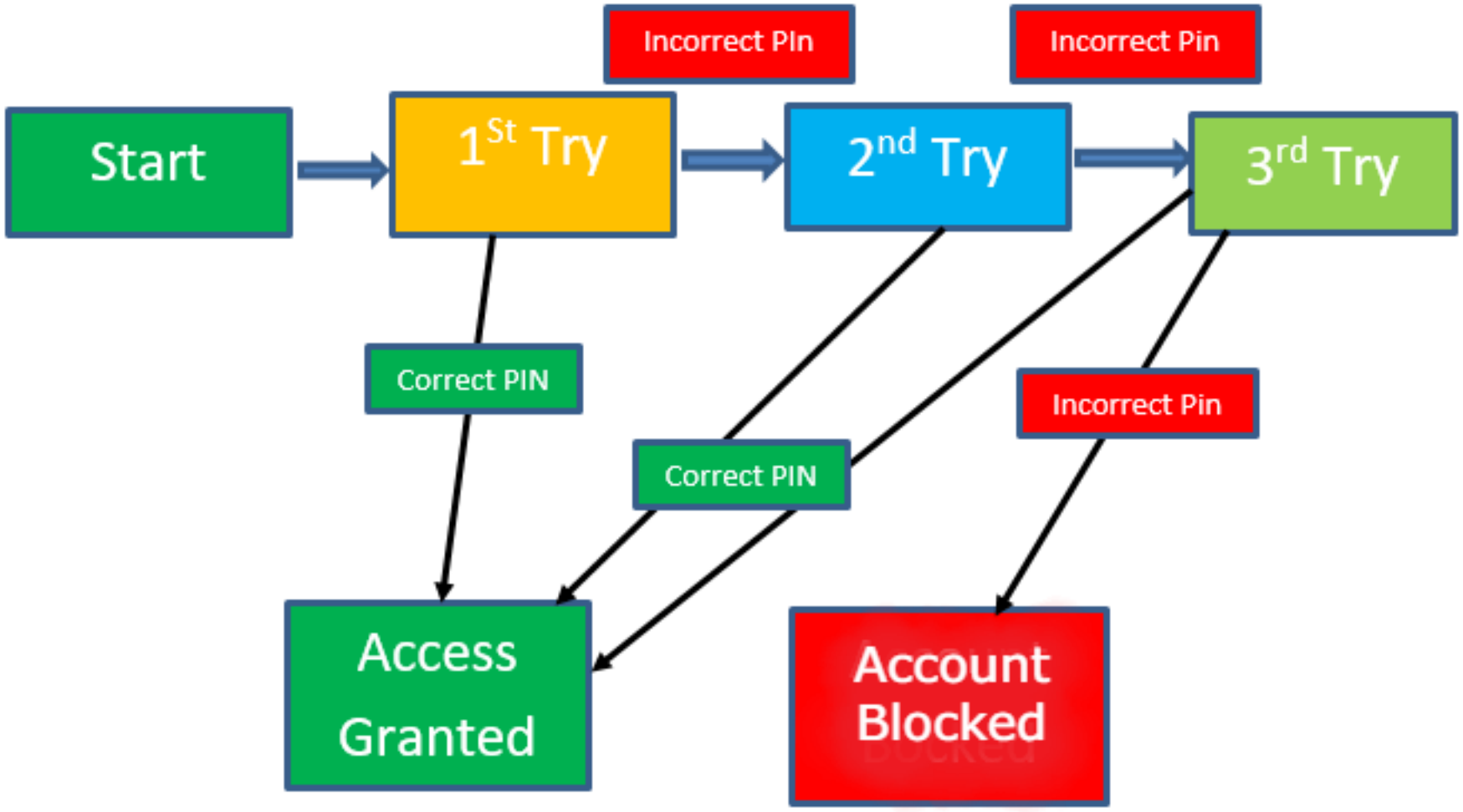
State Transition Testing

- Helpful to **test different system transitions**
- General approach
  - Describe the System Under Test as a “finite state machine” or “state transition diagram”
  - Derive test cases based on **State Transition Coverage**
  - Create State Table based on the diagram to evaluate **Invalid Transitions**

State Transition Diagram

	A state is a distinguishable situation of a system. A system can only be in one state at any point in time. A system can transition from one state to another.
	A transition is a change from one state to another. A transition may also be to the same state (a “transition-to-self”).
	An event is an occurrence inside or outside a system that can result in a transition.
	An action is behavior executed at a particular point in the system. It can also be a string of actions.

State Diagram for Login



Ref: https://www.guru99.com/state-transition-testing.html

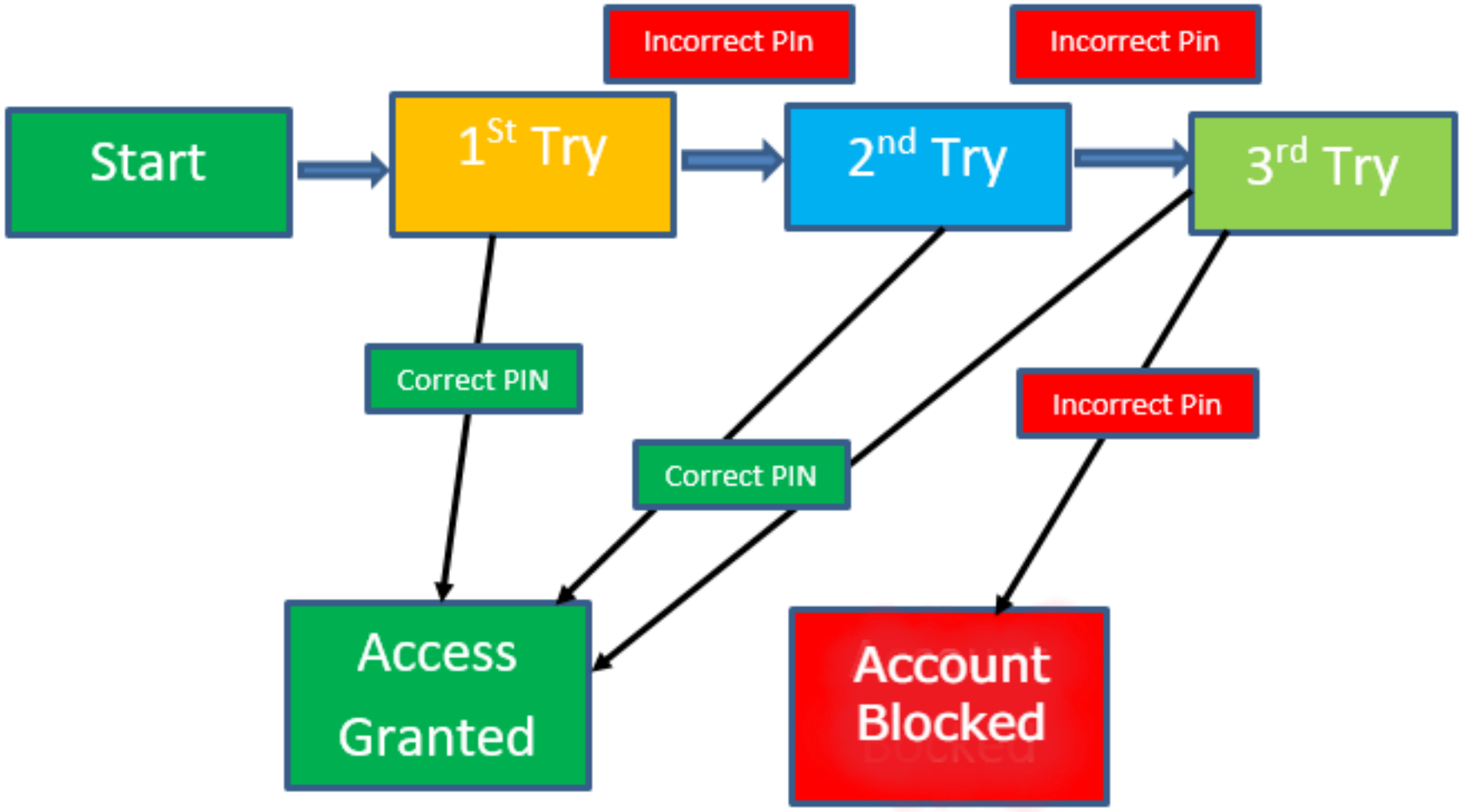
State Transition Table

	Correct PIN	Incorrect PIN
S1. Start	_	_
S2. 1st Try	S5	S2
S3. 2nd Try	S5	S4
S4. 3rd Try	S5	S6
S5. Access Granted	_	_
S6. Account Blocked	_	_

State Transition Coverage

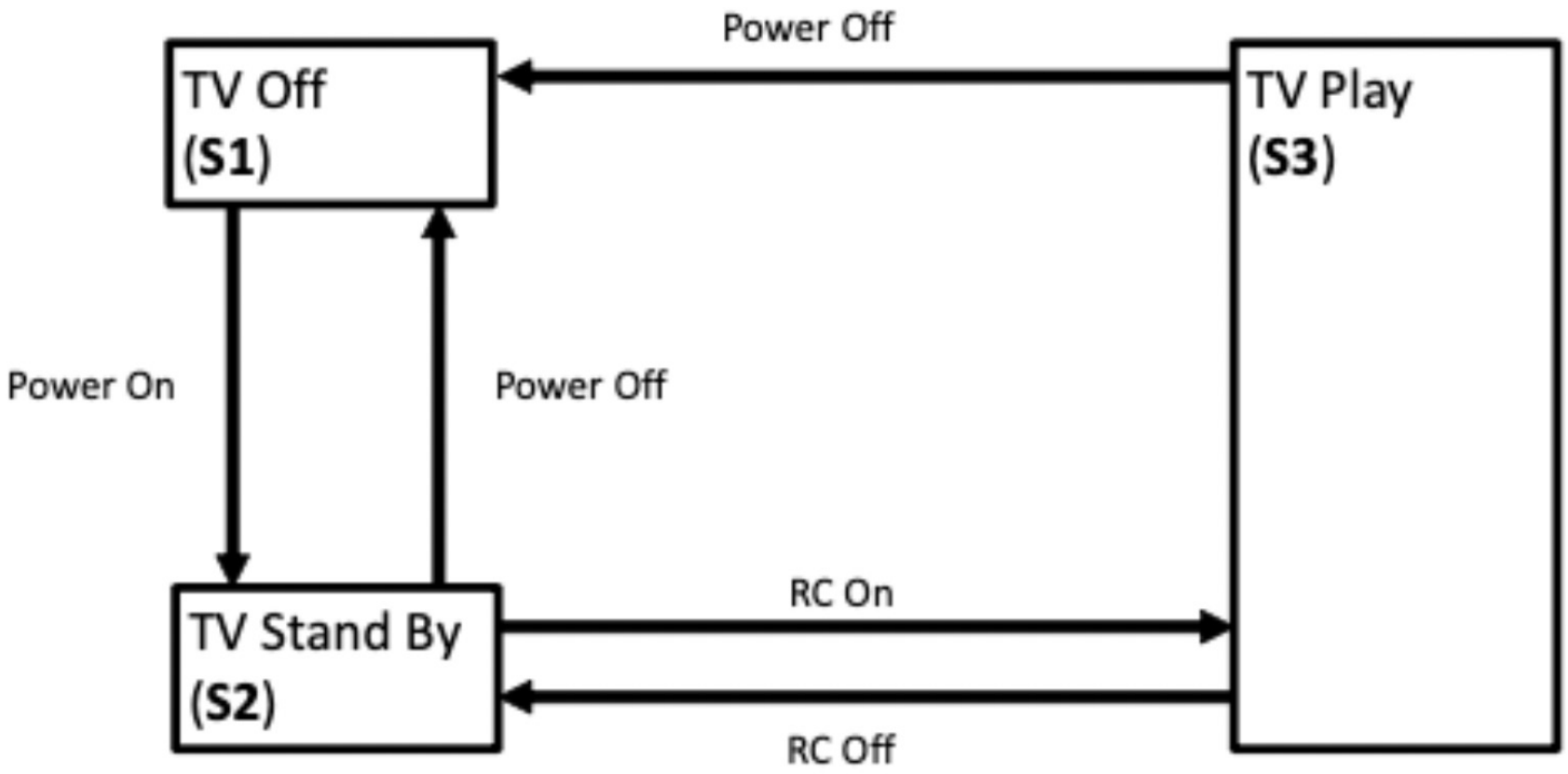
- State Transition Coverage % = Number of identified states or transitions tested / The total number of states or transitions in the test object.
- ➔ All States Coverage
- ➔ All Transitions Coverage

State Transition Coverage



Ref: https://www.guru99.com/state-transition-testing.html

State Diagram for TV



N-Switch Testing

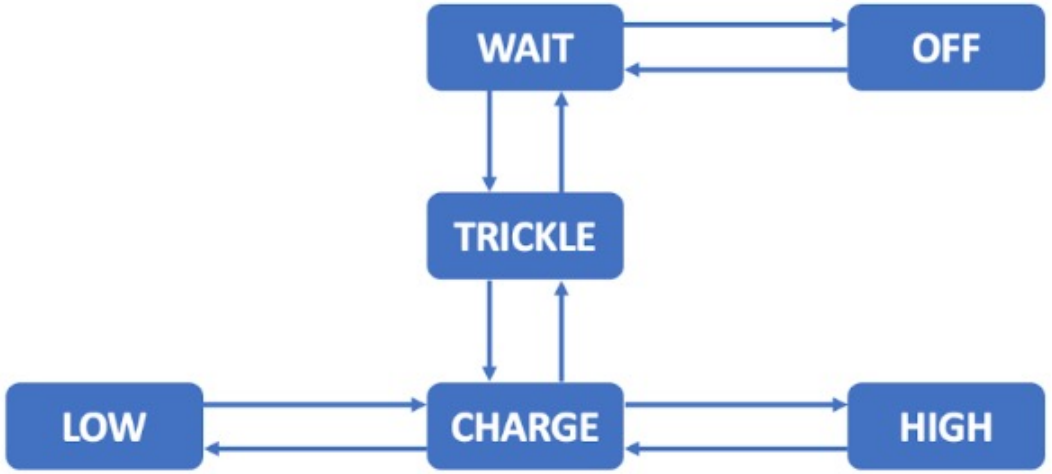
- N-switch tests are state transition tests in which the test cases are designed to execute all **valid sequences of N+1 transitions**.
- ➔ **0-switch**: every single (0+1=1) transition is tested
- ➔ **1-switch**: all combinations of two (1+1=2) consecutive transitions are tested transitions are tested

0-switch Coverage Test cases

	TC1	TC2	TC3	TC4	TC5
Start state	TV Off (S1)	TV Stand By (S2)	TV Stand By (S2)	TV Play (S3)	TV Play (S3)
Input (event)	Power On	Power Off	RC On	Power Off	RC Off
Output (action)	TV is stand by	TV is (turned) off	TV is playing something	TV is (turned) off	TV is stand by
Finish state	TV Stand By (S2)	TV Off (S1)	TV Play (S3)	TV Off (S1)	TV Stand By (S2)

Quizzes

Given the following state model of a battery charger software:



Which of the following **sequences of transitions** provides the **highest level** of **transition coverage** for the model?

A. OFF → WAIT → OFF → WAIT → TRICKLE →CHARGE → HIGH → CHARGE → LOW

B. WAIT → TRICKLE → WAIT → OFF → WAIT →TRICKLE → CHARGE → LOW → CHARGE

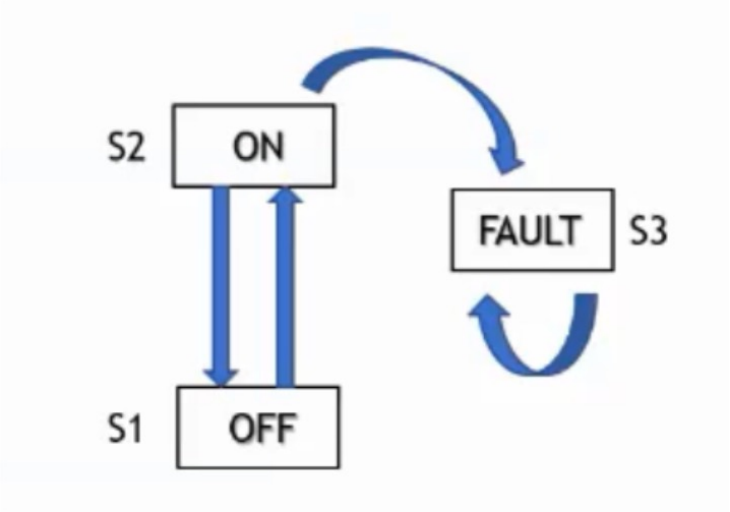
C. HIGH → CHARGE → LOW → CHARGE → TRICKLE →WAIT → TRICKLE → WAIT → TRICKLE

D. WAIT → TRICKLE → CHARGE → HIGH → CHARGE →TRICKLE → WAIT → OFF → WAIT

Ref: https://www.testing.vn/state-transition/

Quizzes

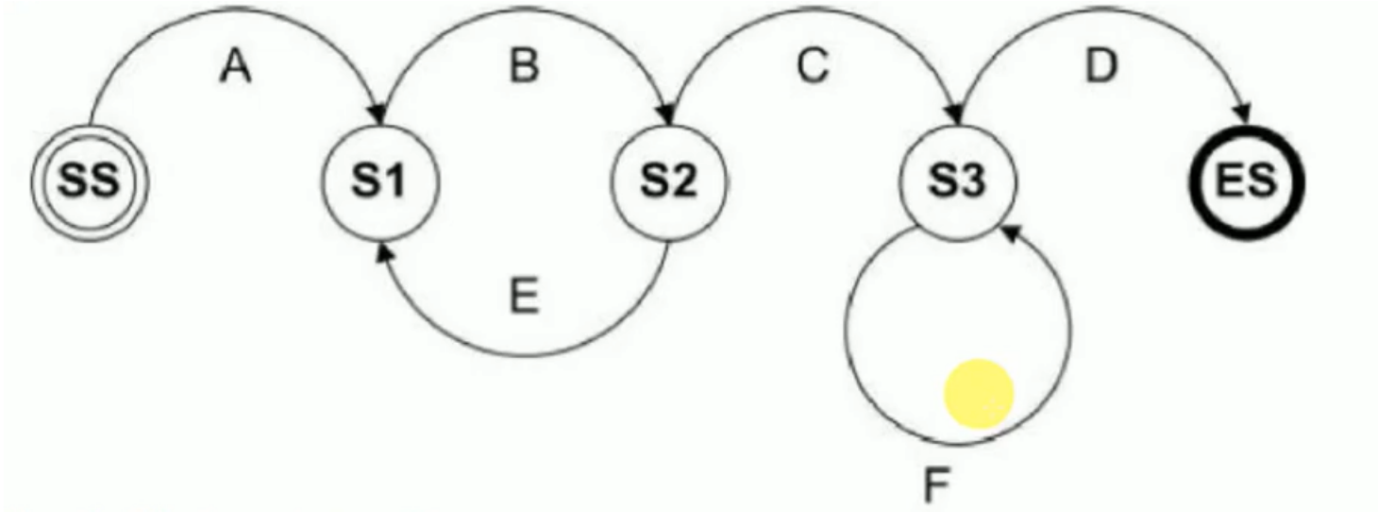
Based on the given State Transition Diagram of a switch ,which of the following test case is invalid?



Options:

1. OFF to ON
2. ON to OFF
3. FAULT to ON
4. ON to FAULT

Quizzes

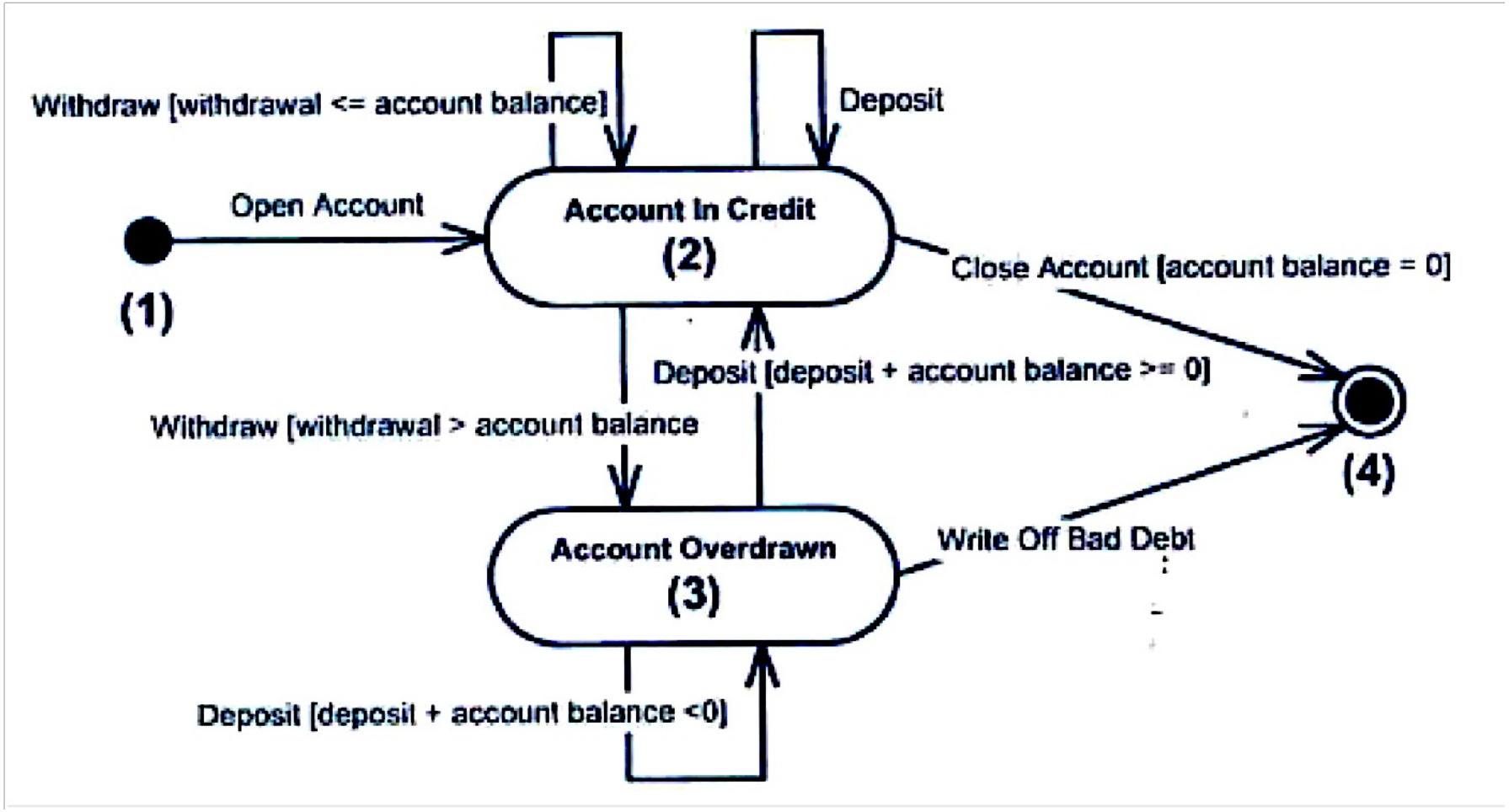


Given the following state transition, which of the following series of state transitions below will provide 100% 0-switch coverage.

Options:

1. A,B,E,B,C,F,D
2. A,B,E,B,C,F,F
3. A,B,E,B,C,D
4. A,B,C,F,F,D

State Diagram for a Bank Account



State Transition Table

- List all possible state-transition combinations, not just the valid ones
  - Advantage: Help detect defects in implementation that enable invalid paths from one state to another
  - Disadvantage: state tables become very large very quickly as the number of states and events increases

State Table for Bank Account

Prior State	New State	Valid Transition	Comment
1	1	N	
1	2	Y	New account
1	3	N	Possible negative test case
1	4	N	
2	1	N	
2	2	Y	Deposit and withdraw [withdrawal <= account balance]
2	3	Y	Withdraw [withdrawal > account balance]
2	4	Y	Closed account [account balance=0]
3	1	N	
3	2	Y	Deposit [deposit + account balance >= 0]
3	3	Y	Deposit [deposit + account balance < 0]
3	4	Y	Write Off Bad Debt [account balance < 0]
4	1	N	
4	2	N	Possible negative test case
4	3	N	Possible negative test case
4	4	N	Possible negative test case

Test Cases from State Table

#TC	Precondition (State)	Condition (Event)	Expected Result (Action)	Note
TC1	No account	Open account	Account created with balance >=0	S1 => S2
TC2	No account	Withdraw	Message: Account does not exist	S1 => S3
TC3	No account	Close account	Message: Account does not exist	S1 => S4
TC4	Account with balance >= 0	Deposit D	Balance = balance + D	S2 => S2
TC5	Account with balance >= 0	Withdraw W<=balance	Balance = balance – W >= 0	S2 => S2

Test Cases from State Table

#TC	Precondition (State)	Condition (Event)	Expected Result (Action)	Note
TC6	Balance >=0	Withdraw W>balance	Balance = (balance – W) < 0	S2 => S3
TC7	Balance >=0	Close account	Account closed Balance = 0	S2 => S4
TC8	Balance < 0	Deposit D+Balance>= 0	Balance = Balance + D >= 0	S3 => S2
TC9	Balance < 0	Deposit D+Balance<0	Balance = Balance + D < 0	S3 => S3
TC10	Balance < 0	Write bad debit	Account in bad debit	S3 => S4

Test Cases from State Table

#TC	Precondition (State)	Condition (Event)	Expected Result (Action)	Note
TC1 1	Account in bad debit	Deposit D+Balance>= 0	Balance = Balance + D >= 0	S4 => S2
TC1 2	Account in bad debit	Deposit D+Balance<0	Balance = Balance + D < 0	S4 => S3
TC1 3	Account closed	Deposit	Message: Account already closed	S4 => S2
TC1 4	Account in bad debit	Withdraw	Message: Account in bad debit	S4 => S3
TC1 5	Account closed	Withdraw	Message: Account already closed	S4 => S3
TC1 6	Account in bad debit	Close	Message: Account in bad debit	S4 => S4
TC1 7	Account closed	Close	Message: Account already closed	S4 => S4


Q
A