Hard | Deputy Executive Engineer (Electric | 2026 | orts Authority of Gujarat / Assistant Engineer (El

A second-order system has damping ratio 0.5 and natural frequency 4 rad/s, then 1. The system is underdamped and exhibits oscillatory response. 2. The damped natural

A. 2 and 3 only

B. 1 and 3 only

C. **1, 2 and 4 only** — Correct

D. All of the above

Correct Answer: C

Full Detailed Explanation

Correct Answer: C - 1, 2 and 4 only Quick Concept Explanation Second-order dynamics are governed by two independent energy-storage states and are described by natural frequency and damping ratio. With =0.5 and n=4 rad/s, d= n (1) 3.46 rad/s, so the response is underdamped and has nonzero overshoot. Key relation: Characteristic form: s +2 _n s+ _n =0.Exam focus: <1 underdamped, =1 critical, >1 overdamped. Common trap: Overdamped responses do not sustain oscillations. Statement-wise Verification Statement 1 - Correct.The system is underdamped and exhibits oscillatory response.An underdamped response oscillates with exponentially decaying amplitude, critical damping gives the fastest non-oscillatory response, and overdamping gives a slower non-oscillatory response. Statement 2 - Correct.The damped natural frequency is less than the natural frequency.Second-order dynamics are governed by two independent energy-storage states and are described by natural frequency and damping ratio. Statement 3 - Incorrect.The peak overshoot is zero for this system.For =0.5 the system is underdamped and has nonzero overshoot Statement 4 - Correct.The settling time decreases as damping ratio increases (within underdamped region).Second-order dynamics are governed by two independent energy-storage states and are described by natural frequency and