**Duration: 3hrs** **[Max Marks:80]**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

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| 1 | | Attempt any FOUR | [20] |
| | a | With suitable block diagram, explain the sample and hold circuit | |
| | b | State and explain sampling theorem | |
| | c | Write any five advantages of digital control over analog control system. | |
| | d | Explain Mason's gain formula for Signal Flow Graph. | |
| | e | Discuss in detail about the stability of a system in the z plane. | |
| 2 | a | Discuss ZOH as low-pass filter using clear diagrams of its frequency response characteristics. | [10] |
| | b | Determine the stability of the system having characteristics equation P (z) = z4 – 1.2 z3 + 0.07 z2 + 0.3 z – 0.08 = 0 using Jury's Stability Criterion. | [10] |
| 3 | a | Draw a typical block diagram of a digital control system and explain each block in detail. | [10] |
| | b | A feedback system has a closed loop transfer function Y(s)/R(s) = 10(s+4) / s(s+1)(s+3) Construct three different state models for this system: i) one where the system matrix A is diagonal matrix ii) one where A is in first companion form iii) one where A is in second companion form | [10] |
| 4 | a | With neat block diagram explain the full order observer. | [10] |
| | b | Design a deadbeat controller for a discrete-time system which is described by following open-loop pulse transfer function. Assume loop to be closed by negative unity feedback. $G(z) = \frac{2(z+0.5)}{(z-1)(z-0.61)}$ | [10] |
| 5 | a | What are the state space representation forms and explain them. | [10] |
| | b | Describe bilinear transformation approach for discretization of continuous time systems in detail. Also, comment on the mapping between s-plane and z-plane under such discretization. | [10] |
| 6 | a | Prove Ackermann's formula for the determination of the state feedback gain | [10] |
| | b | Define Controllability and Observability of a system. Discuss any one method to determine Controllability and Observability of a system. | [10] |

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