LIST OF ENTRANCE EXAM QUESTIONS

FOR THE INTERNATIONAL MASTER'S DEGREE PROGRAM

ITMO

DIGITAL CONTROL SYSTEMS

1. Standard mathematical models of continuous systems: input-output models (transfer function and transfer matrix), state-space models.
   [1 – sect. 2.2, 2.4, 2.5, 3.2, 3.3]
2. First-order and second-order systems: transfer functions, step response, impulse response.
   [2 – sect. 2-2, 5-2, 5-3]
3. Block diagram transformations: cascaded, parallel, and feedback interconnections.
   [1 – sect. 2.6]; [2 – sect. 2-3]; [3 – sect. 1.2]
4. Structural properties of mathematical models: controllability and observability. Criteria for controllability and observability for continuous systems.
   [1 – sect. 11.2]; [2 – sect. 9-6, 9-7]; [3 – sect. 11.1, 11.6, 15.1, 15.2, 15.9]
5. Performance characteristics (specifications) of system: overshoot, settling time, steadystate error, relative stability, damping ratio.
   [1 – sect. 2.4, 4.6, 4.8, 4.9, 5.5, 6.3]; [2 – sect. 5-3, 7-7]
6. Stability of continuous-time systems: definition, Lyapunov stability, asymptotic stability, exponential stability.
   [3 – sect. 8.2]
7. Stability of continuous-time systems: the s-plane root location, Routh-Hurwitz stability criterion.
   [1 – sect. 6.1, 6.2]
8. Stability analysis of discrete systems. Discretization of continuous signals.
   [4 – sect. 4-3, 5-5]
9. Lyapunov's method of determining the stability of continuous-time systems.
   [3 – sect. 8.5]
10. Full-order and reduced-order state observers for continuous-time systems (Luenberger observer).
    [1 – sect. 11.4]; [2 – sect. 10-5]
11. Steady-state accuracy. Steady-state errors in unity-feedback control systems with different type number (the number of integrations).
    [1 – sect. 5.6]; [2 – sect. 5-8]
12. Frequency response. Frequency response plots: polar plot (Nyquist plot), Bode diagrams or logarithmic plots (log-magnitude–phase diagrams).
    [1 – sect. 8.2, 8.3, 8.4]; [2 – sect. 7-2, 7-3]
13. Using frequency response methods considering phase and gain margin, and system bandwidth with Bode plots and Nyquist plots.
    [1 – sect. 8.4, 9.4]; [2 – sect. 7-7]
14. The Nyquist stability criterion.
    [1 – sect. 9.3]; [2 – sect. 7-5]
15. Pole-placement (modal) control method for controllers synthesizing.
    [1 – sect. 11.3]; [2 – sect. 10-2]
16. PID controller parameters tuning using the Ziegler and Nichols method.
    [1 – sect. 7.6]; [2 – sect. 8-2]

RECOMMENDED LITERATURE

1. Dorf R.C. and R.H. Bishop, Modern Control Systems (13th Edition). – Boston: Pearson, 2017. – 1106 p. https://www.academia.edu/85802780/Richard_C_Dorf_and_Robert_H_Bishop_Modern_Control_Systems_13th_Edition
2. Ogata K., Modern Control Engineering (5th Edition). – Boston: Prentice Hall, 2010. – 905 p. https://www.academia.edu/85803099/Katsuhiko_Ogata_Modern_Control_Engineering_5th_Edition
3. Hespanha J. P., Linear Systems Theory. – New Jersey: Princeton University Press, 2009. – 263 p. https://www.academia.edu/13106698/linear_systems_theory_Joao_P_Hespanha
4. Ogata K., Discrete-Time Control Systems (2nd Edition). – New Jersey: Prentice Hall, 1995. – 905 p. https://www.academia.edu/39521084/Ogata_K_Discrete_Time_Control_Systems_2nd_ed_PH_1995_0133286428_