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| **EE/EC 311** | **LINEAR CONTROL SYSTEMS** | | **4** | **1** | **0** | **100** | **4** |

**UNIT – I**

**Introduction:** Basic concept of simple control system – open loop – closed loopcontrol systems. Effect of feedback on overall gain – stability sensitivity and external noise.

Types of feedback control systems – Liner time invariant, time variant systems and nonlinear control systems

**Mathematical models and Transfer functions of Physical systems:** Differentialequations – impulse response and transfer functions – translational and rotational mechanical systems. Transfer functions and open loop and closed loop systems. Block diagram representation of control systems – block diagram algebra – signal flow graph – Mason’s gain formula

**Components of control systems:** DC servo motor – AC servo motor – synchrotransmitter & receiver

**UNIT – II**

**Time domain analysis:** Standard test signals – step, ramp, parabolic and impulseresponse function – characteristic polynomial and characteristic equations of feedback systems – transient response of first order and second order systems to standard test signals. Time domain specifications - steady state response – steady state error and error constants. Effect of adding poles and zeros on over shoot, rise time, band width – dominant poles of transfer functions.

**Stability analysis in the complex plane:** Absolute, relative, conditional, boundedinput –bounded output, zero input stability, conditions for stability, Routh –Hurwitz criterion.

**UNIT - III**

**Frequency domain analysis:** Introduction – correlation between time and frequencyresponses – polar plots – Bode plots – Nyquist stability criterion – Nyquist plots. Assessment of relative stability using Nyquist criterion – closed loop frequency response.

**UNIT – IV**

**Root locus Technique:** Introduction – construction of root loci Introduction to Compensation Techniques

**State space analysis:** Concepts of state, state variables and state models –diagonalisation – solution of state equations – state models for LTI systems. Concepts of controllability and Observability.

**TEXT BOOKS:**

1. B.C. Kuo, Automatic control systems, 7th edition, PHI.
2. I.J.Nagrath & M Gopal, Control Systems Engineering, 3rd edition, New Age International.
3. K. Ogata, Modern Control Engineering, 3rd edition, PHI.

**REFERENCE BOOKS**:

1. Schaum Series, Feedback and Control Systems, TMH
2. M.Gopal, Control Systems Principles and Design, TMH
3. John Van de Vegta, Feedback Control Systems, 3rd edition, Prentice Hall,1993.