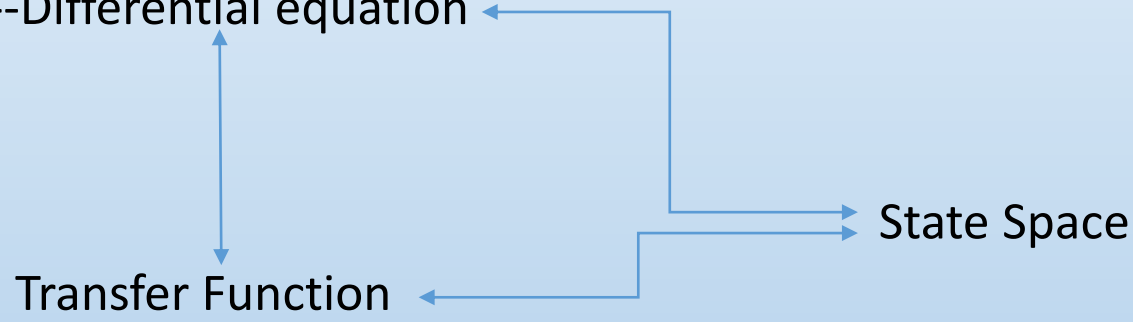
EEPC35-Control System-II

- MOTIVATION, MODELLING OF DIGITAL CONTROL SYSTEMS
  - Introduction to digital control
  - Mathematical models of discrete-time systems
- DESIGN OF DIGITAL CONTROL ALGORITHMS
  - Digital control design
- CONTROL SYSTEM ANALYSIS AND DESIGN IN STATE-SPACE
  - Introduction to state space model
  - Feedback control design
- NONLINEAR SYSTEMS ANALYSIS
  - Introduction to nonlinear systems
  - Stability analysis of nonlinear systems

DIGITAL CONTROL SYSTEMS

Brief of CS-I

- LTI Systems Continuous time
- Mathematical Model-------Differential equation



Representation---- a)Signal Flow Graph

b) Block Diagram

- Analysis of System

Main Concern Stability of the system

- Define Performance Specifications

➢ Time Domain

❖ Transient Region(Relative stability)

✓ Rise Time t_r

✓ Delay Time t_d

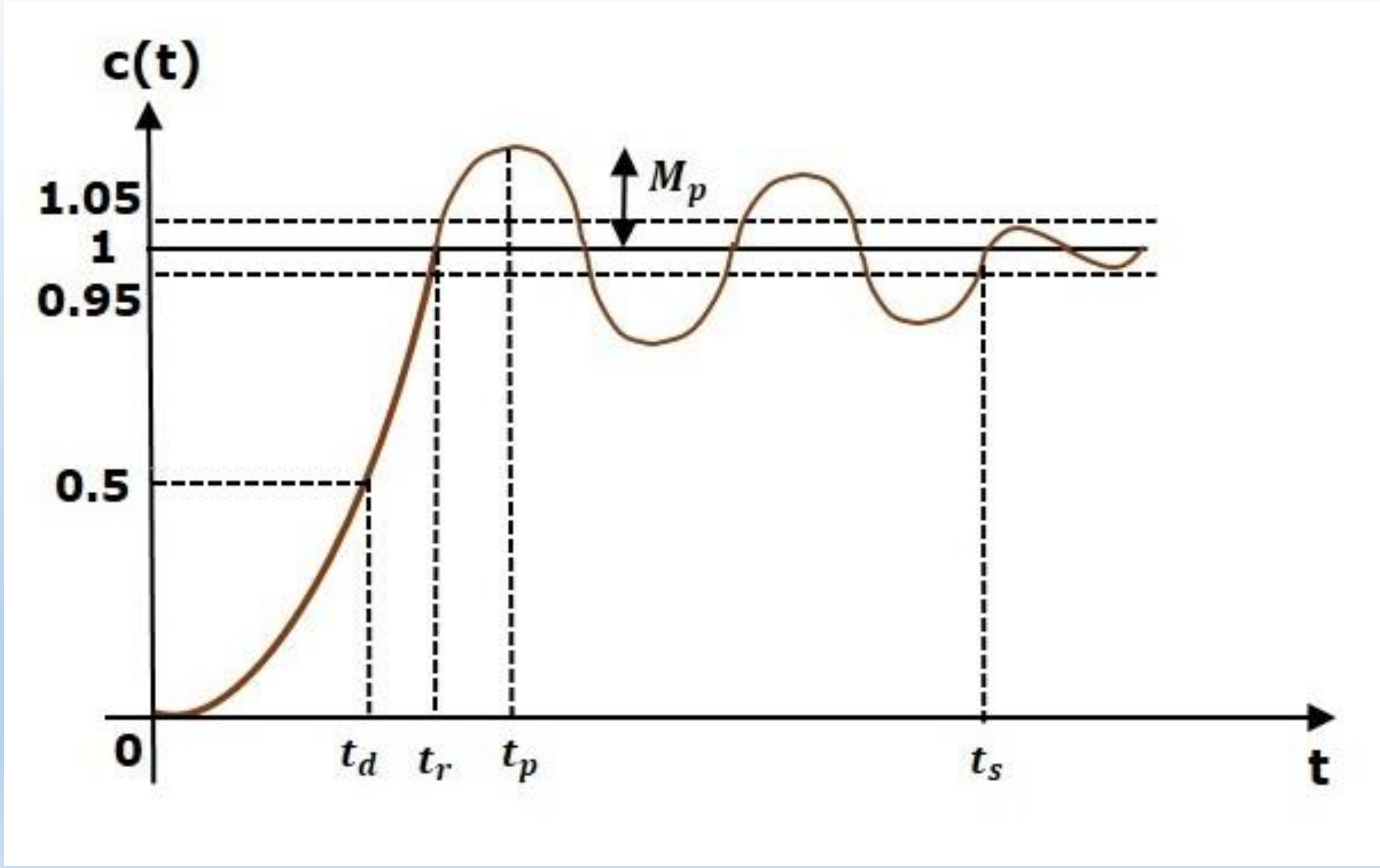
✓ Peak Time t_p

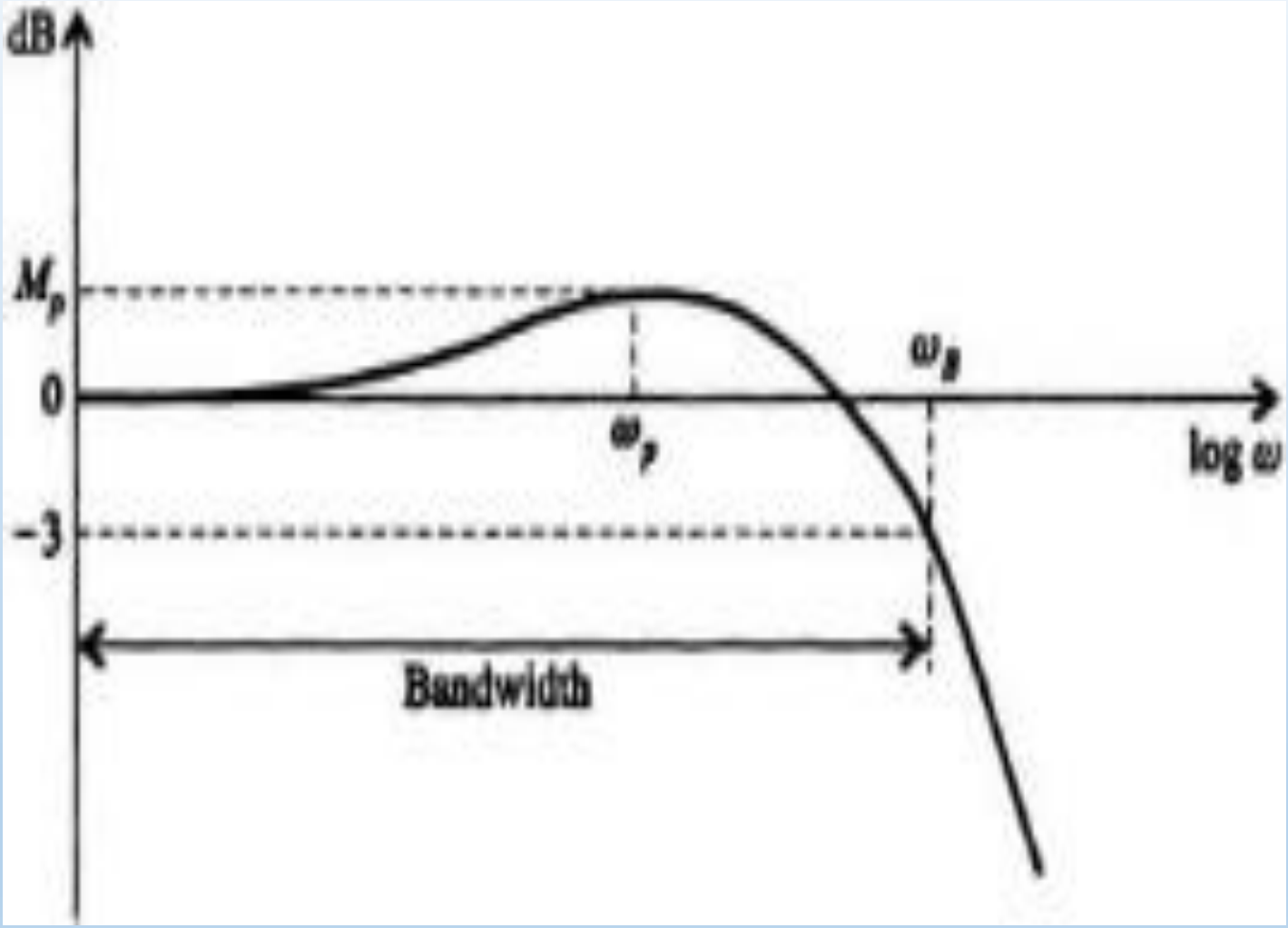
✓ Settling Time t_s

✓ Maximum Over shoot M_p

❖ Steady State Region (Accuracy)

✓ Steady state error e_{ss}


c(t)
1.05
1
0.95
0.5
0
M_p
t_d
t_r
t_p
t_s
t


dB
M_p
0
-3
ω_p
ω_B
log ω
Bandwidth

➢Frequency Domain

❖Closed Loop Performance Specifications

- ✓Resonance Frequency ω_r
- ✓Magnitude at resonance Frequency M_r
- ✓Bandwidth BW ω_b
- ✓Cutoff Rate

❖ Open Loop Performance Specifications

- ✓Gain Margin (Gain at Phase crossover frequency)GM
- ✓Phase Margin (Phase at Gain crossover frequency)PMϕ_m

❑Time domain and Frequency domain specifications are related to each other e.g.t_r α 1/ ω_b

Methods to Analyze The System Stability

- Algebraic Methods
  - ✓Routh – Hurwitz criterion
  - ✓Liapunov's Criterion
- Algebraic + Graphical methods
  - ✓ Nyquist Criterion (Frequency Domain)
- Graphical Methods
  - ✓Root Locus Method (s-Plane)
  - ✓Nichol's Chart (C.L.P Frequency Domain)
  - ✓M and N Circles (do)
  - ✓Bode Plots (O.L.P Frequency Domain)

Design To meet the Performance Specifications

- Achieve Stability (Add Zero)
- Achieve Accuracy (Add Pole)
- Achieve both of above(Add Both)

Root Locus/Bode Plot /State Feedback methodology can be used