



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

TRANSIENT RESPONSE ANALYSIS

POLES AND ZEROS

DR ANIL KUMAR

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING



POLES AND ZEROS

The concept of poles and zeros is fundamental to the analysis and design of control systems. It simplifies the evaluation of a system's response.

Poles: The Poles of a transfer function (TF) are

- The values of the Laplace Transform (LT) variable s , that cause the TF to become infinite, or
- All the roots of the denominator

Zeros: The Zeros of a transfer function are

- The values of the LT variable s , that cause the TF to become zero, or
- All the roots of the numerator

POLES AND ZEROS

- A pole of the input function generates the *form of the FORCED RESPONSE*
- A pole of the TF generates the *form of the NATURAL RESPONSE*
- The zeros and poles generate the AMPLITUDES for both the forced and natural responses
- A pole on the real axis generates an EXPONENTIAL RESPONSE of the form $\exp(A \cdot t)$, where A is the pole location on the real axis
- The farther to the left a pole is on the negative real axis, the faster the exponential transient response will decay to zero

REFERENCE BOOKS

- Norman S. Nise, Control Systems Engineering, Wiley, 2013
- Katsuhiko Ogata, Modern Control Engineering, Prentice Hall, 2010.

