



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

MATHEMATICAL MODELLING

LINEARIZATION OF NONLINEAR SYSTEMS

DR ANIL KUMAR

DEPARTMENT OF MECHANICAL AND INDUSTRIAL ENGINEERING



LINEAR VS NONLINEAR SYSTEMS

- A linear system possesses two properties: superposition and homogeneity
- Although many physical relationships are often represented by linear equations, in most cases actual relationships are not quite linear.
- A careful study of physical systems reveals that even so-called 'linear systems' are really linear *only in limited operating ranges*.
- Electromechanical systems, hydraulic systems, pneumatic etc. involve nonlinear relationships among the variables



EXAMPLES OF NONLINEAR SYSTEMS

- An electric amplifier is linear over a specific range but exhibits the nonlinearity called **saturation** at high input voltages
- A motor that does not respond at very low input voltages due to frictional forces exhibits a nonlinearity called **dead zone**
- Dampers used in physical system may be linear for low-velocity operations but may become nonlinear at high velocities, and the damping force may become proportional to the square of the operating velocity

REFERENCE BOOKS

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

