


DYNAMICAL SYSTEM AND CONTROL

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INTENDED AUDIENCE : UG/PG students of technical institutions/ universities/colleges.

PRE-REQUISITES : Basic concepts from Linear Algebra and Ordinary Differential Equations

COURSE OUTLINE :

This course 'Dynamical systems and control' is a basic course offered to PG students and final year UG students of Engineering/Science background. The objective of this course is to enhance the understanding of the theory, properties and applications of various dynamical and control systems. After completing the course one may be able to understand some of the important aspects of dynamical systems such as mathematical modeling, well posedness (existence, uniqueness and stability) of the considered problem. The participants will also be conversant with the controllability, stabilizability and optimal control aspects of a dynamical system.

ABOUT INSTRUCTOR :

Prof. N. Sukavanam received his Ph. D from the Indian Institute of Science, Bangalore in 1985. He served as a Scientist-B at Naval Science and Technological Laboratory, DRDO for two years (1984-86). Then joined as a Research Scientist in the Department of Mathematics, IIT Bombay (1987-90). Worked as a Lecturer at BITS Pilani from 1990 to 1996. In May 1996 he Joined the Department of Mathematics at IIT Roorkee (University of Roorkee at that time) as an Assistant Professor. Currently he is a Professor in the Department of Mathematics IIT Roorkee and Head of the Mathematics from Feb. 2018. His areas of research includes Nonlinear Analysis, Control Theory and Robotics. Professor Sukavanam has published about 80 papers in refereed journals, 30 papers in International Conference Proceedings. He has guided 19 Ph. Ds, 60 M. Sc./M. Phil/MCA Dissertations. Organized International Workshop on Industrial Problems. Developed Pedagogy online course on Mathematics I, offered NPTEL online video course on Dynamical Systems and Control and conducted more than six QIP/Continuing Education courses on Robotics and Control

Prof. D. N. Pandey is an Associate Professor in the Department of Mathematics, IIT Roorkee. Before joining IIT Roorkee, he worked as a faculty member in BITS-Pilani Goa campus and LNMIIT Jaipur. His area of expertise includes semigroup theory and functional differential equations of fractional and integral orders. He has already prepared e-notes for the course titled "Ordinary Differential Equations and Special Functions" under e-Pathshala funded by UGC. Also, he has published a book titled "Nonlocal Functional Evolution Equations: Integral and fractional orders, LAP LAMBERT Academic Publishing AG Germany". He has delivered several invited talks at reputed institutions in India and abroad. He has guided three PhD theses and has published more than 60 papers in various international journals of repute. Currently, he is supervising five research students.

COURSE PLAN :

Week 1 : Formulation of physical systems-I, Formulation of physical systems-II, Existence and uniqueness theorems-I, Existence and uniqueness theorems-II, Linear systems-I
Week 2 : Linear Systems-II, Solution of linear systems-I, Solution of linear systems–II, Solution of linear systems-III, Fundamental Matrix-I
Week 3 : Fundamental Matrix-II, Fundamental matrices for non- autonomous systems, Solution of non-homogeneous systems , Stability of systems: Equilibrium points, Stability of linear autonomous systems-I
Week 4 : Stability of linear autonomous systems-II, Stability of linear autonomous systems-III, Stability of weakly non- linear systems-I, Stability of weakly non- linear systems-II, Stability of non- linear systems using linearization
Week 5 : Properties of phase portrait, Properties of orbits, Phase portrait : Types of critical points, Phase portrait of linear differential equations-I, Phase portrait of linear differential equations-II
Week 6 : Phase portrait of linear differential equations-III, Poincare Bendixson Theorem, Limit cycle , Lyapunov stability-I, Lyapunov stability–II
Week 7 : Introduction to Control Systems-I, Introduction to Control Systems-II, Controllability of Autonomous Systems, Controllability of Non-autonomous Systems, Observability-I
Week 8 : Observability-II, Results on Controllability and Observability, Companion Form, Feedback Control-I, Feedback Control-II
Week 9 : Feedback Control-III, Feedback Control-IV, State Observer, Stabilizability, Introduction to Discrete Systems-I
Week 10 : Introduction to Discrete Systems-II, Lyapunov Stability Theory-I, Lyapunov Stability Theory-II, Lyapunov Stability Theory-III, Optimal Control- I
Week 11 : Optimal Control-II, Optimal Control-III, Optimal Control- IV, Optimal Control for Discrete Systems-I, Optimal Control for Discrete Systems-II
Week 12 : Controllability of Discrete Systems, Observability of Discrete Systems, Stability for Discrete Systems, Relation between Continuous and Discrete Systems-I, Relation between Continuous and Discrete Systems-II