

Course Number & Title: RA602 & Control Engineering for Robotics	
L-T-P-C: 3-0-0-6	
Type of Letter Grading (Regular Letter Grades / PP or NP Letter Grades): Regular	
Kind of Proposal (New Course / Revision of Existing Course): New	
Offered as (Compulsory / Elective): Elective	
Offered to: PG/PhD	
Offered in (Odd/ Even / Any): Any	
Offered by (Name of Department/ Center): Center for Intelligent Cyber Physical Systems (CICPS)	
Pre-Requisite: None	
<p>Preamble / Objectives (Optional):</p> <p>Control Engineering is a vast domain involving multiple engineering disciplines. The development of control algorithms for advanced systems like robots is still an ongoing process. There is a need to put forth the foundations of control engineering from the point of view of Robotics Engineers. This is an introductory PG course intended to present to participants certain important topics in control engineering which are useful for more advanced courses in Robot Control.</p>	
<p>Course Content/ Syllabus:</p> <p>Overview of Mathematical preliminaries: Linear Algebra; Signal and System Norms; Laplace and Fourier transformations; Introduction to Linear Matrix Inequalities (LMI). Overview of Basics of Feedback Control: Signals and Systems, Mathematical Modeling of Physical Systems, Time response, Steady-state analysis, Frequency response, Notion of different types of Stability, P/PI/PID Controller design, Compensator design.</p> <p>Modern Control Theory: State variable representation, Canonical structures, Jordon form, Solution of state equations, Properties of the state transition matrix, Controllability, Observability, PBH test, concept of state feedback and pole-placement, Ackermann's formula, State observer (or estimator) design, Separation principle, Observer-based state feedback controller design, Introduction to optimal control and Linear Quadratic Regulator (LQR), Riccati Equation, Design of optimal state feedback control. Application Case Studies in Robotics.</p>	
Books (In case UG compulsory courses, please give it as "Text books" and "Reference books". Otherwise give it as "References".	
Texts: (Format: Authors, <i>Book Title in Italics font</i> , Volume/Series, Edition Number, Publisher, Year.)	
References: (Format: Authors, <i>Book Title in Italics font</i> , Volume/Series, Edition Number, Publisher, Year.)	
1.	N.S. Nise, <i>Control Systems Engineering</i> , Wiley India (special edition), 2018
2.	M. Gopal, <i>Modern Control System Theory</i> , New Age International Publishers, 4 th Edition, 2021
3.	K. Ogata, <i>Modern Control Engineering</i> , Pearson, 5 th Edition, 2015.
4.	A. Anand Kumar, <i>Control Systems</i> , Prentice Hall of India, 2 nd Edition, 2014
5.	D. Roy Choudhury, <i>Modern Control Engineering</i> , Prentice Hall of India, 1 st Edition, 2005
6.	R. K. Bansal, A. K. Goel and M. K. Sharma, <i>Matlab and its Applications in Engineering</i> , Pearson, 2 nd Edition, 2016
7.	K. Ogata, <i>System Dynamics</i> , Pearson, 4 th Edition, 2014
8.	S. M. Shinnars, <i>Modern Control System Theory and Design</i> , Wiley, 2 nd Edition, 2014
9.	B. Friedland, <i>Advanced Control Systems Design</i> , Pearson, 1 st Edition, 2015