School of Interdisciplinary Research
IIT Delhi

Syllabus for the written comprehensive examination

December 23, 2020

Name: Mr. Udayan Banerjee
Entry Number: 2019SRZ8482
Topic: **Impedance Control as an approach for Manipulation of Collaborative Robots**

1. Linear Algebra

Vector spaces, matrix algebra, singularity, condition numbers, LU, LL^T, QR, SVD decompositions, Sensitivity analysis, Eigen value problems.

2. Differential Calculus

Differential equations- linear and non-linear, Analytical and numerical solutions (Runge-Kutta, Adams-Bashforth and others), Stability of numerical solutions, Error and tolerances in numerical methods.

3. Robotics

Mathematical Representation of Robots, Kinematics of manipulators, Statics and Dynamics of manipulators, Control of manipulators (Feedback control in joint and cartesian space, Force control, Impedance control).

4. Linear and Nonlinear Systems

State variable methods, Controllability and Observability, Pole placement controller design, Lyapunov stability, Lasalle's invariance principle, Feedback linearization, Back-stepping methods

5. Optimal and Adaptive Control

LQR problem and controller design, Ricatti equation, Time optimal control, HJB equations-based controller design, Direct and Indirect model reference adaptive control (MRAC), Linear parameterisation and adaptive command tracking, adaptive control of manipulators, Robust adaptive control

Supervisors: Prof. S.K. Saha
Prof. I.N. Kar

SRC Team: **Chairperson**: Prof. Sunil Jha
Experts: Prof. Ramakrishna K and Prof. Janardhanan S