EE617A: INDUSTRIAL AUTOMATION AND CONTROL

1. **Objectives:** The course is designed to give a solid grounding of fundamental concepts of industrial automation systems and their control. The course specifically focusses on architecture, components, and techniques for automation in industries. The current state-of-the-art suggests paradigm shift from partial to fully automated operations in industries. The level of the course is chosen to be such that all students aspiring to be a part of industrial advancements directly or indirectly in near future should acquire these concepts.

2. **Course Contents:** Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems, Measurement Systems, Specifications, Temperature, Pressure, Force, Flow, pH, Humidity, Current, Voltage, Power, Frequency, Speed, Displacement (Linear and Angular) Instruments, Signal Conditioning Circuits, Data Acquisition System, Error and Calibration, Basics of Pattern Recognition and Knowledge Discovery. Monitoring, Automation and Control, Introduction to Process Control, PID Control, Controller Tuning, Implementation of PID Controllers, Special Control Structures (Feed Forward, Ratio Control, Predictive Control, Control of Systems with Inverse response, Cascade, Override and Split Range Control), Sequence and Logic Control, PLCs, CNC machines, Actuators (Control Valve, Hydraulic Actuator Systems, Industrial Hydraulic Circuits, Pneumatic Control Components and Pneumatic Control Systems), Electrical Machine Drives, Electrical Actuators, Introduction to Real Time Embedded Systems, Real-Time Operating Systems. Smartphones for Automation and Control. Impact of wireless Internet and broadband access on distributed control systems and new SCADA/DCS architectures, Use of animation and other advanced techniques for operator interface and predictive control, real time IF and THEN analysis.

3. **Lecture, Tutorial & Lab Schedule & Venue:**

   Course Instructor: Nishchal K Verma, PhD (nishchal@iitk.ac.in)

   Course TA(s): Mohd. Aquib (aquib@iitk.ac.in) and Seetaram Maurya (seetaram@iitk.ac.in)

   Lecture Schedule: Monday and Thursday (10:30 AM to 12:00 PM)

   Lecture Venue: TB-204

4. **Mode of Contact:** All Notices for the course will be sent by email to the course email list.

5. **Evaluation Components & Policies:** The grading policy and marks distribution for the course is as follows:

Journal/Research Paper Analysis/Course Project	40 %
Class Performance (Attendance, Surprise Quizzes/Assignments etc.)	10 %
Mid Semester	20 %
End Semester	30 %
Total	**100 %**

Exams and Quizzes: Examination will be held during the prescribed examination period. There may be random quizzes during the regular class hour.

Assignments: At the end of every topic, assignments will be given. The students are strongly recommended to solve and send the assignments by due date.

6. **Books & References:** This being a PG course there is no prescribed text. However, the following books and references are recommended:

- Nishchal K. Verma and Al Salour, "Intelligent Condition Based Monitoring: For Turbines, Compressors, and other Rotating Machines," *Studies in Systems, Decision and Control, Springer*, 2020, ISBN 978-981-15-0512-6. (https://www.springer.com/gp/book/9789811505119)
- M. B. Stout: Basic Electrical Measurements, 2/e, Prentice Hall of India, New Delhi, 1981.
- R. Pallas-Areny and J. G. Webster: Analog Signal Processing, John Wiley, NY, 1999.
- R. B. Northrup: Introduction to Instrumentation and Measurements (2/e), CRC Press, Boca Raton, 2005.
- J. W. Dally, W.F. Riley and K.G. McConnell: Instrumentation for Engineering Measurements (2/e), John Wiley & Sons, NY, 2003.
- N. K. Verma, Handbook of Intelligent Condition Based Monitoring of Rotating Machines open access from Intelligent Informatics and Automation Laboratory, EE, IIT Kanpur, 2012.
- J. P. Bentley: Principles of Measurement Systems (3/e), Longman, U.K., 1995.
- E. O. Doeblin: Measurement System Application and Design (4/e), McGraw-Hill, Singapore, 1990.
- L. K. Baxter: Capacitance Sensors Design and Applications, IEEE Press, New Jersey, 1997.
- D. Patranabis: Sensors and Transducers (2/e), PHI, New Delhi, 2003.
- C.W. de Silva: Control Sensors and Actuators, Prentice Hall, New Jersey, 1989.
- B. Liptak: Process Control: Instrument Engineers Handbook.
- D. R. Coughanowr: Process systems analysis and control (2/e), McGraw-Hill, NY, 1991.
- D. Eckman: Process Control, Wiley, NY, 1958.
- K. Ogata: Modern Control engineering (2/e), Prentice Hall of India, new Delhi, 1995.
- G. Stephanopoulos: Chemical Process Control, Prentice Hall of India, New Delhi, 1996.
- C. Johnson: Process Control Instrumentation Technology (4/e), Prentice Hall of India, New Delhi, 1996.
- J. M. Jacob: Industrial Control Electronics, Prentice Hall International, NJ, 1989.
- W. L. Luyben and M.L. Luyben: Essentials of Process Control, McGraw-Hill, NY, 1997.
- K. J. Astrom and B.J. Witten mark: Computer Controlled Systems, Prentice Hall of India, New Delhi, 1994.
- V. B. Ginzburg: High Quality Steel Rolling: Theory and practice, Marcel Dekker Inc., NY, 1993.
- W. Zhang, X. Xu and Y. Sun: Quantitative Performance Design for Inverse-Response Processes, *Ind. Eng. Chem. Res.,* vol. 39, pp. 2056-2061, 2000.
- P. Harriott: Process Control, Tata-McGraw-Hill, New Delhi, 1991.
- F. H. Raven: Automatic Control Engineering (4/e), McGraw-Hill, NY, 1987.
- D. P. Eckman: Automatic process Control, Wiley Eastern, New Delhi, 1958.
- T. Wildi: Electrical Machine Drives and Power Systems.