# NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI
## DEPARTMENT OF CHEMICAL ENGINEERING

| COURSE PLAN | | | |
|---|---|---|---|
| **Course Title** | LOGIC AND DISTRIBUTED CONTROL SYSTEMS | | |
| **Course Code** | CL 662 | **No. of Credits** | 3 |
| **Course Code of Pre-requisite subject(s)** | Fundamental knowledge of process control | | |
| **Session** | Jan 2019 | **Section (if, applicable)** | |
| **Name of Faculty** | Mr. S T Krishnakumar, Siemens CoE<br>Mr.S Harisraj,Siemens CoE | **Department** | ICE |
| **Official Email** | nsk@nitt.edu | **Telephone No.** | 04312503362 |
| **Name of Course Coordinator(s) (if, applicable)** | Dr. N. Sivakumaran and Mr P. Karthick | | |
| **Course Type** | Core course | | |

**Syllabus (approved in BoS)**

**Course Content:**

Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. Functional block diagram of computer control systems. alarms, interrupts. Characteristics of digital data, controller software, linearization. Digital controller modes: Error, proportional, derivative and composite controller modes.

Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions. PLC intermediate functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions.

Interface and backplane bus standards for instrumentation systems. Field bus: Introduction, concept. HART protocol: Method of operation, structure, operating conditions and applications. Smart transmitters, examples, smart valves and smart actuators.

Distributed control systems (DCS): Definition, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, configuration of DCS, displays, redundancy concept - case studies in DCS.

**Text Books:**

1. John.W.Webb, Ronald A Reis, Programmable Logic Controllers - Principles and Applications, 4th Edition, Prentice Hall Inc., New Jersey, 1998.

2. M.P Lukcas, Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.

3. Frank D. Petruzella, Programmable Logic Controllers, 2nd Edition, McGraw Hill, New York, 1997.

Reference Books:

1. P.B.Deshpande and R.H Ash, Elements of Process Control Applications, ISA Press, New York, 1995.
2. Curtis D. Johnson, Process Control Instrumentation Technology, 7th Edition, Prentice Hall, New Delhi, 2002
3. Krishna Kant, Computer-based Industrial Control, Prentice Hall, New Delhi, 1997.

**COURSE OBJECTIVES**

This course is designed to expose students to understand the process automation concepts like Programmable logic controller and Distributed control system.

**COURSE OUTCOMES (CO)**

| Course Outcomes | Aligned Programme Outcomes (PO) |
|---|---|
| 1. Understand the popular process automation technologies. | 1,2,3,4,5,6,7,8,9,10,12 |
| 2. Design and development of different PLC programming for simple process applications. | 1,2,3,4,5,6,7,8,9,10,12 |
| 3. Understand the different security design approaches, Engineering and operator interface issues for designing Distributed control system. | 1,2,3,4,5,6,7,8,9,10,12 |
| 4. Know the latest communication technologies like HART and Field bus protocol. | 1,2,3,4,5,6,7,8,9,10,12 |

**COURSE PLAN – PART II**

**COURSE OVERVIEW**

Logic and Distributed Control System is a specially designed control system used to control complex, large and geographically distributed applications in industrial processes. In this, controllers are distributed throughout the entire plant area.

**COURSE TEACHING AND LEARNING ACTIVITIES**

| S.No. | Week | Topic | Mode of Delivery |
|---|---|---|---|
| 1 | 1 | Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC). | Lecture, video and PPT |
| 2 | 2 | Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. | Chalk and Talk, PPT |
| 3 | 3 | ***Assessment -2 :*** *(Hands on experience/lecture in Automation and Process Instrumentation Lab, Siemens CoE )* | 10% |

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|---|---|---|---|
| 4 | 3 | Functional block diagram of computer control systems. alarms, interrupts. Characteristics of digital data, controller software, linearization. | Chalk and Talk, PPT |
| 5 | 4 | Digital controller modes: Error, proportional, derivative and composite controller modes. | Chalk and Talk, PPT |
| 6 | 5 | Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, isolators. | Chalk and Talk, PPT – By Siemens Center of Excellence (CoE) |
| 7 | 5 | Cycle test 1 | 20% |
| 8 | 6 | General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: | Chalk and Talk, PPT – By Siemens Center of Excellence (CoE) |
| 9 | 6 | PLC Basic Functions: Register basics, timer functions, counter functions. | |
| 10 | 7 | PLC intermediate functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. | Chalk and Talk |
| 11 | 7 | ***Assessment -2 :*** *(Hands on experience/lecture in Automation and Process Instrumentation Lab, Siemens CoE )* | 10% |
| 12 | 8,9 | PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, | Chalk and Talk, PPT – By Siemens Center of Excellence (CoE) |
| 13 | 10 | Cycle Test 2 | 20% |
| 14 | 11 | Introduction, concept. HART protocol: Method of operation, structure, operating conditions and applications. | Chalk and Talk, PPT – By Siemens Center of Excellence (CoE) |

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|---|---|---|---|
| 15 | 11 | Smart transmitters, examples, smart valves and smart actuators. | |
| 16 | 12 | Definition, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, | |
| 17 | 12 | Communication facilities, configuration of DCS, displays, redundancy concept - case studies in DCS. | |

**COURSE ASSESSMENT METHODS (shall range from 4 to 6)**

| S.No. | Mode of Assessment | Week/Date | Duration | % Weightage |
|---|---|---|---|---|
| 1 | Assignment 1 | 3 | - | 10% |
| 2 | Cycle Test 1 | 5 | 1 hour | 20% |
| 3 | Assignment 2 | 7 | - | 10% |
| 4 | Cycle Test 2 | 10 | 1 hour | 20% |
| 5 | Compensation Assessment | One week before end sem | 2 hour | 20% |
| 6 | Final Assessment | Last week | 3 hour | 40% |

**COURSE EXIT SURVEY (mention the ways in which the feedback about the course shall be assessed)**

1. Exit survey through questionnaire at the end of course
2. Feedback from the students during the class committee meetings

**COURSE POLICY (preferred mode of correspondence with students, policy on attendance, compensation assessment, academic honesty and plagiarism etc.)**

**MODE OF CORRESPONDENCE (email/ phone etc)**

**ATTENDANCE POLICY** (A uniform attendance policy as specified below shall be followed)

- At least 75% attendance in each course is mandatory.
- A maximum of 10% shall be allowed under On Duty (OD) category.

Students with less than 65% of attendance shall be prevented from writing the final assessment and shall be awarded 'V' grade.

**COMPENSATION ASSESSMENT**

Students who have missed first or second cycle test can register with the consent of the faculty for the Re-Test which shall be conducted soon after the completion of the second cycle test. The students who need to appear before the regular semester examinations.

The Compensation Assessment shall be conducted for 20 marks comprising the syllabus of first and second cycle test.

**No retest for end semester exam.**

**ACADEMIC DISHONESTY & PLAGIARISM**

- Possessing a mobile phone, carrying bits of paper, talking to other students, copying from others during an assessment will be treated as punishable dishonesty.
- Zero mark to be awarded for the offenders. For copying from another student, both students get the same penalty of zero mark.
- The departmental disciplinary committee including the course faculty member, PAC chairperson and the HoD, as members shall verify the facts of the malpractice and award the punishment if the student is found guilty. The report shall be submitted to the Academic office.

The above policy against academic dishonesty shall be applicable for all the programmes.

**ADDITIONAL INFORMATION**

**NIL**

**FOR APPROVAL**

**Course Faculty** _____ **Course Coordinators** _____

**CC-Chairperson** _____ **HOD** _____