B. Tech. Degree
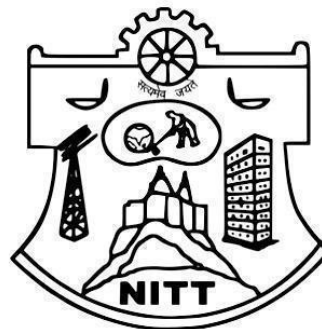
in

INSTRUMENTATION AND CONTROL ENGINEERING

SYLLABUS FOR

FLEXIBLE CURRICULUM

(For students admitted in 2015-16 onwards)

DEPARTMENT OF INSTRUMENTATION AND CONTROL ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY
TIRUCHIRAPPALLI – 620 015
TAMIL NADU, INDIA.

INSTITUTE VISION

- To provide valuable resources for industry and society through excellence in technical education and research.

INSTITUTE MISSION

- To offer state-of-the-art undergraduate, postgraduate and doctoral programmes.
- To generate new knowledge by engaging in cutting-edge research.
- To undertake collaborative projects with academia and industries.
- To develop human intellectual capability to its fullest potential.

DEPARTMENT VISION

- To constantly strive to make this department a world class school in Instrumentation and Control Engineering.

DEPARTMENT MISSION

- To provide high quality education which inspire the students to realize their aspiration and potential.
- To enhance knowledge, create passion for learning, foster innovation and nurture talents towards serving the society and the country.
- To encourage faculty members to update their knowledge and carryout advanced research in cutting edge technologies.
- To exhibit excellence in research projects and consultancy services, for the benefit of the global community.

Organization Chart / Various Committees of the Department
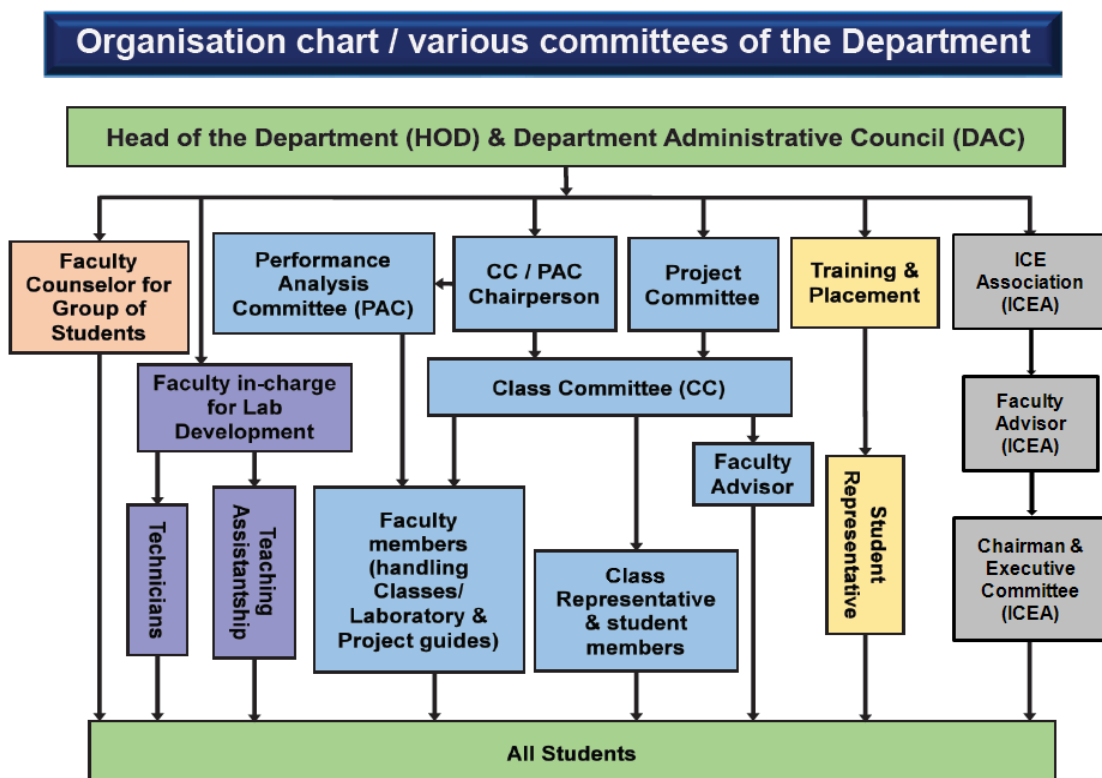
Programme Educational Objectives (PEOs)

The major objectives of the 4-year B.Tech (ICE) programme offered by the department of Instrumentation & Control Engineering are, to prepare students

1. For employment in the core industrial/manufacturing sector
2. For employment in research and development organizations
3. For employment in electronics & IT/ITES industry
4. For graduate studies in engineering and management
5. For entrepreneurship in the long run

Programme Outcomes (POs)

The students, after undergoing the 4-year B.Tech (ICE) programme,

1. Would have developed an ability to apply the knowledge of mathematics, sciences, and engineering fundamentals to the field of instrumentation & control,
2. Would have possessed a comprehensive understanding of a wider range of electronic devices, analog and digital electronic circuits and the state-of-the-art advanced electronic systems invariably found in every measurement and instrumentation system,
3. Would have the right knowledge of and exposure to a variety of sensors, data acquisition systems, actuators, and control methodologies to readily provide innovative solutions to the day-to-day problems in the core industry (e.g. processes, power plants, automotive),
4. Would have gained adequate knowledge in microprocessors and microcontrollers, embedded systems, data structures, algorithms, computer programming and simulation software to be able to offer services in IT and management sectors,
5. Would have learnt necessary skills to develop mathematical models, and deploy appropriate techniques and IT tools to design advanced control systems and associated instrumentation for problems dealt in R & D organizations,
6. Would be thoroughly prepared and confident to take up complex problems in the field of I & C and provide sustainable solutions by (i) surveying the literature and patents, (ii) designing and conducting experiments, (iii) interpreting the data, (iv) drawing relevant conclusions, with due consideration and responsibility towards the immediate social, cultural, environmental and legal issues, and (v) documenting the research carried out,
7. Would be able to evaluate and deliver the solutions by optimally utilizing the available resources, including finances and project time, by adapting appropriate resource management techniques,
8. Would be competent to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
9. Would be proficient in English language (spoken and written) in order to communicate effectively on complex engineering activities on a global scale, make comprehensive reports and presentations, and give and receive clear instructions,
10. Would have committed to be professionally ethical,
11. Would pledge to function efficiently in various capacities as members, leaders, and directors in multi-disciplinary teams to accomplish projects of different magnitudes, and
12. Would have recognized the need for engaging themselves in independent and life-long learning in the broadest context of technological change.

CURRICULUM

The total minimum credits required for completing the B.Tech. programme in Instrumentation and Control Engineering is **176.**

MINIMUM CREDIT REQUIREMENT FOR THE VARIOUS COURSE CATEGORIES:

S.No.	COURSE CATEGORY	NO. OF COURSES	NO. OF CREDITS
1.	GENERAL INSTITUTE REQUIREMENT (GIR)	24	68
2.	PROGRAMME CORE (PC)	20	62
3.	ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)	8	16
4.	ELECTIVE COURSES (PE+OE+MI)	10	30
	TOTAL	**62**	**176**

Programme Electives (PE) are offered by the Department of Instrumentation and Control Engineering for the students of B.Tech. in Instrumentation and Control Engineering programme. A minimum of nine credits out of the thirty credits allotted for Electives category must be earned from the courses listed in the PE section.

To meet the minimum credit requirement for Electives, the remaining elective courses can be chosen from either PE courses offered by the Department of Instrumentation and Control Engineering, or Open Electives offered by any other Department within National Institute of Technology, Tiruchchirappalli. In addition to the above, the courses registered under B.Tech. (Minor) programme of any other Department, will be considered for Electives category.

I. GENERAL INSTITUTE REQUIREMENT (GIR)

1. MATHEMATICS

S.No.	Course Code	Course Title	Credits
1.	MAIR11	Mathematics – I	4
2.	MAIR21	Mathematics – II	4
3.	MAIR36	Algebra and Probability Theory	3
4.	MAIR43	Numerical Methods	3
		Total	**14**

2. PHYSICS

S.No.	Course Code	Course Title	Credits
1.	PHIR11	Physics- I	3
2.	PHIR13	Physics- II	4
		Total	**7**

3. CHEMISTRY

S.No.	Course Code	Course Title	Credits
1.	CHIR11	Chemistry- I	3
2.	CHIR13	Chemistry- II	4
		Total	**7**

4. COMMUNICATION

S.No.	Course Code	Course Title	Credits
1.	HSIR11	English for Communication	3
2.	HSIR12	Professional Communication	3
		Total	**6**

5. HUMANITIES

S.No.	Course Code	Course Title	Credits
1.	HSIR13	Industrial Economics and Foreign Trade	3
		Total	**3**

6. PROFESSIONAL ETHICS

S.No.	Course Code	Course Title	Credits
1.	HSIR14	Professional Ethics and Human Values	3
		Total	**3**

7. ENERGY AND ENVIRONMENTAL ENGINEERING

S.No.	Course Code	Course Title	Credits
1.	ENIR11	Energy and Environmental Engineering	2
		Total	**2**

8. BASIC ENGINEERING

S.No.	Course Code	Course Title	Credits
1.	CEIR11	Basics of Civil Engineering	2
2.	MEIR11	Basics of Mechanical Engineering	2
		Total	**4**

9. ENGINEERING GRAPHICS

S.No.	Course Code	Course Title	Credits
1.	MEIR12	Engineering Graphics	3
		Total	**3**

10. ENGINEERING PRACTICE

S.No.	Course Code	Course Title	Credits
1.	PRIR11	Engineering Practice	2
		Total	**2**

11. INTRODUCTION TO COMPUTER PROGRAMMING

S.No.	Course Code	Course Title	Credits
1.	CSIR11	Basics of Programming	3
		Total	**3**

12. BRANCH SPECIFIC COURSE

S.No.	Course Code	Course Title	Credits
1.	ICIR15	Introduction to Instrumentation and Control Systems Engineering	2
		Total	**2**

13. SUMMER INTERNSHIP

S.No.	Course Code	Course Title	Credits
1.	ICIR16	Internship / Industrial Training / Academic Attachment (2 To 3 Months Duration During Summer Vacation)	2
		Total	**2**

Each student should undergo an industrial training / internship for a minimum period of two months during the summer vacation of the third year. Attachment with an academic institution within the country (CFTIs such as IISc / IITs / NITs / IIITs, etc.) or university abroad is also permitted in place of industrial training. The course will be evaluated at the beginning of the fourth year (VII semester) by assessing the report and seminar presentations.

14. PROJECT WORK

S.No.	Course Code	Course Title	Credits
1.	ICIR17	Project Work	6
		Total	**6**

15. COMPREHENSIVE VIVA

S.No.	Course Code	Course Title	Credits
1.	ICIR18	Comprehensive Viva-Voice Examination	3
		Total	**3**

Note: A student can appear for the Comprehensive Viva-Voce Examination only after completing all the Programme Core (PC) courses.

16. INDUSTRIAL LECTURE

S.No.	Course Code	Course Title	Credits
1.	ICIR19	Industrial Lecture	1
		Total	**1**

A minimum of five lectures of two hours duration by industry experts will be arranged by the Department. The evaluation methodology, will be based on objective type questioning at the end of each lecture.

17. NSS/NCC/NSO

S.No.	Course Code	Course Title	Credits
1.	SWIR11	NSS/NCC/NSO	0
		Total	**0**

II. PROGRAMME CORE (PC)

LIST OF ESSENTIAL PROGRAMME CORE COURSES			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	ICPC10	Engineering Mechanics	3
2.	ICPC11	Sensors and Transducers	3
3.	ICPC12	Materials Science	3
4.	ICPC13	Thermodynamics and Fluid Mechanics	4
5.	ICPC14	Circuit Theory	4
6.	ICPC15	Digital Electronics	3
7.	ICPC16	Signals and Systems	3
8.	ICPC17	Industrial Instrumentation	3
9.	ICPC18	Analog Signal Processing	3
10.	ICPC19	Electrical and Electronic Measurements	3
11.	ICPC20	Microprocessors and Microcontrollers	3
12.	ICPC21	Control System – I	4
13.	ICPC22	Instrumentation Practices in Industries	3
14.	ICPC23	Principles of Communication Systems	3
15.	ICPC24	Control System – II	3
16.	ICPC25	Process Control	4
17.	ICPC26	Product Design and Development (Theory)	2
18.	ICPC27	Product Design and Development (Practice)	2
19.	ICPC28	Analytical Instrumentation	3
20.	ICPC29	Logic and Distributed Control System	3
		TOTAL	**62**

III. ELECTIVE COURSES

1. PROGRAMME ELECTIVES (PE)

Students pursuing B.Tech. in Instrumentation and Control Engineering should complete at least three courses from the Programme Electives listed below.

S. No.	Course Code	Course Title	Pre-Req.	Credits
		LIST OF PROGRAMME ELECTIVES		
1.	ICPE10	Optical Instrumentation	**-**	3
2.	ICPE11	Medical Instrumentation	**-**	3
3.	ICPE12	Micro Electro Mechanical System	ICPC11	3
4.	ICPE13	Automotive Instrumentation	ICPC11 ICPC17	3
5.	ICPE14	Instrumentation and Control for Power Plant	ICPC17 ICPC25	3
6.	ICPE15	Instrumentation and Control for Petrochemical Industries	ICPC17 ICPC25	3
7.	ICPE16	Instrumentation and Control for Paper and Cement Industries	ICPC17 ICPC25	3
8.	ICPE17	Instrumentation for Agricultural and Food Processing Industries	ICPC11 ICPC17	3
9.	ICPE18	Piping and Instrumentation Diagram	ICPC17 ICPC25	3
10.	ICPE19	Measurement Data Analysis	ICPC19	3
11.	ICPE20	Building Automation	-	3
12.	ICPE21	Digital Control Systems	ICPC16 ICPC21 ICPC24	3
13.	ICPE22	Neural Networks and Fuzzy Logic	**-**	3
14.	ICPE23	Non Linear Control	ICPC21 ICPC24	3

15.	ICPE24	System Identification and Adaptive Control	ICPC24	3
16.	ICPE25	Fault Detection and Diagnosis	-	3
17.	ICPE26	Computational Techniques in Control System	ICPC21 ICPC24	3
18.	ICPE27	Process Modelling and Optimization	ICPC24 ICPC25	3
19.	ICPE28	Control System Components	ICPC21 ICPC25	3
20.	ICPE29	Network Control System	ICPC23 ICPC29	3
21.	ICPE30	Digital Signal Processing	ICPC16	3
22.	ICPE31	Power Electronics	ICPC18	3
23.	ICPE32	Embedded System	ICPC15 ICPC20	3
24.	ICPE33	Smart and Wireless Instrumentation	ICPC20 ICPC23	3
25.	ICPE34	Digital Image Processing	ICPE29	3
26.	ICPE35	Multi Sensor Data Fusion	ICPC24	3
27.	ICPE36	Medical Imaging System	ICPE34	3
28.	ICPE37	Industrial Data Communication	ICPC29	3
29.	ICPE38	Energy Harvesting Techniques	-	3
30.	ICPE39	Smart Materials and Systems	-	3
31.	ICPE40	Hydraulics and Pneumatics	-	3
32.	ICPE41	Internet of Things System Design	-	3
33.	ICPE42	Software Design Tools for Sensing and Control	-	3
34.	ICPE43	Industrial Electric Drives	ICPE31	3

2. OPEN ELECTIVES (OE)

The courses listed below are offered by the Department of Instrumentation and Control Engineering for students of other Departments.

S. No.	Course Code	Course Title	Pre-Req.	Credits
		LIST OF OPEN ELECTIVES		
1.	ICOE10	Building Automation	-	3
2.	ICOE11	Project Engineering and Management	-	3
3.	ICOE12	Medical Instrumentation	-	3
4.	ICOE13	Micro Electro Mechanical System	-	3
5.	ICOE14	Measurement and Control	-	3
6.	ICOE15	Industrial Measurements	-	3
7.	ICOE16	Virtual Instrument Design	-	3
8.	ICOE17	Neural Networks and Fuzzy Logic	-	3
9.	ICOE18	Network Control Systems	-	3
10.	ICOE19	Control System	-	3
11.	ICOE20	Energy Harvesting Techniques	-	3
12.	ICOE21	Internet of Things	-	3
13.	ICOE22	Intellectual Property Rights	-	3
14.	ICOE23	Smart Materials and Systems	-	3

3. MINOR (MI)

Students registered for B.Tech. (Minor) in Instrumentation and Control Engineering can opt to study any five of the courses listed below.

S. No.	Course Code	Course Title	Pre-Req.	Credits
		LIST OF COURSES FOR B.Tech. (MINOR) PROGRAMME		
1.	ICMI10	Measurement and Control	-	3
2.	ICMI11	Test and Measuring Instruments	-	3

3.	ICMI12	Measurements in Process Industries	**-**	3
4.	ICMI13	Essentials of Control Engineering	**-**	3
5.	ICMI14	Industrial Automation and Control	**-**	3
6.	ICMI15	Experimental Techniques	**-**	3

However, the above courses will also be offered as open electives for other branch students.

Note: A student is allowed a minimum of 50% of the total electives of a programme from Open electives and Minor, if so desired.

IV. ESSENTIAL PROGRAMME LABORATORY REQUIREMENT (ELR)

LIST OF ESSENTIAL PROGRAMME LABORATORY REQUIREMENT			
S. No.	**Course Code**	**Course Title**	**Credits**
1.	ICLR10	Thermodynamics and Fluid Mechanics Laboratory	2
2.	ICLR11	Circuits and Digital Laboratory	2
3.	ICLR12	Sensors and Transducers Laboratory	2
4.	ICLR13	Analog Signal Processing Laboratory	2
5.	ICLR14	Instrumentation Laboratory	2
6.	ICLR15	Microprocessors and Microcontrollers Laboratory	2
7.	ICLR16	Control Engineering Laboratory	2
8.	ICLR17	Industrial Automation and Process Control Laboratory	2
		TOTAL	**16**

Note: Students can register for 2 laboratory courses during one session along with the regular courses (PC / PE / OE / MI), from the second year.

V. ADVANCED LEVEL COURSES FOR B.Tech. (HONOURS)

1. A student is eligible to register for B.Tech. (Honours) degree provided the student has:
   i. registered at least for twelve theory courses and two ELRs in the second year.
   ii. consistently obtained a minimum GPA of 8.5 in the first four sessions.

2. The student should continue to maintain the same GPA of 8.5 in the subsequent sessions (including the Honours courses)

3. The student can obtain B.Tech. (Honours) degree
   i. on completion of the three additional theory courses registered for the Honours degree of the programme.
   ii. on completion of all the courses registered, in the first attempt during the four years of study.

LIST OF ADVANCED LEVEL COURSES FOR B.Tech. (HONOURS)				
S. No.	**Course Code**	**Course Title**	**Co-Req.**	**Credits**
1.	ICHO10	Design of Sensors and Transducers	ICPC11	3
2.	ICHO11	Instrumentation System Design	ICPC17 ICPC22	3
3.	ICHO12	Micro System Design	ICPE12	3
4.	ICHO13	Advanced Control System Design	ICPC21 ICPC24	3
5.	ICHO14	Advanced Process Control	ICPC21 ICPC25	3
6.	ICHO15	Optimal and Robust Control	ICPC21 ICPC24	3
7.	ICHO16	Electronics for Sensor Design	ICPC14 ICPC18 ICPC20	3
8.	ICHO17	System on Chip	ICPC18	3