


 MANJARA CHARITABLE TRUST
RAJIV GANDHI INSTITUTE OF TECHNOLOGY, MUMBAI

DEPARTMENT OF INSTRUMENTATION ENGINEERING

Course Objectives and Course Outcomes

SEM III			
Course Code	Course Name	Objectives	Outcomes
ISC301	Applied Mathematics - III	<ol style="list-style-type: none"> 1. To build the strong foundation in Mathematics of students needed for the field of Instrumentation Engineering. 2. To provide students with mathematics fundamentals necessary to formulate, solve and analyses complex engineering problems. 3. To prepare student to apply reasoning informed by the contextual knowledge to engineering practice. 4. To provide opportunity for students to work as part of teams on multi-disciplinary projects 	The students will be able to – <ol style="list-style-type: none"> 1. Demonstrate basic knowledge of Laplace Transform. 2. Obtain the time response of systems using inverse Laplace transform. 3. Find the Fourier series, Complex form of Fourier series, Fourier Integral and Fourier transform of the functions. 4. Study the differential vector algebra and its properties. 5. Study vector line integral and theorems in plane and surface. 6. Check for analytical functions and find the analytical function and study the mapping.
ISC302	Analog Electronics	<ol style="list-style-type: none"> 1. To familiarize the student with basic electronic devices and circuits. 2. To provide understanding of operation of diodes, bipolar and MOS transistors, DC biasing circuits, Transistors as switching device, Power circuits and systems. 3. To introduce the students the basic properties of OpAmp, analysis and design of electronic circuits using OpAmp 	Students will be able to <ol style="list-style-type: none"> 1. Understand working of Diode and Zener diode and its applications 2. Analyze, simulate, and design amplifiers using BJT biasing techniques, frequency response. 3. Analyze circuits using MOSFET. 4. Understand op-amp parameters. 5. Design various circuits using operational amplifiers. 6. Understand power amplifiers and power supply.
ISC303	Transducers-I	<ol style="list-style-type: none"> 1. To study need of metrology and basic terminology of metrology 2. To make students understand the Identification, classification, 	The students will be able to <ol style="list-style-type: none"> 1. Learn the measurement systems, errors of measurement,

		<p>construction, working principle and application of various transducers used for Displacement measurement, Temperature measurement, Level measurement, and Miscellaneous measurement.</p>	<ol style="list-style-type: none"> 2. Explain working principles of sensors and transducers. 3. Study the working principle of displacement transducers and their applications. 4. Understand principle of working of various transducers used to measure Temperature, comparative study of various transducers. 5. Learn the various types of level measurement transducers and their applications, basic principle of working. 6. Understand applications of various transducers in industry. 7. Miscellaneous other sensors.
ISC304	Digital Electronics	<ol style="list-style-type: none"> 1. To teach principles of digital electronics. 2. To teach topics including Boolean algebra, basic gates, logic circuits, arithmetic circuits flip-flops, registers, counters and computer memory 3. To teach state machine diagram 	<p>Students will be able to-</p> <ol style="list-style-type: none"> 1. Represent numerical values in various number systems and perform number conversions between different number systems. 2. Explain operation of logic gates using IEEE/ANSI standard symbols, use of different minimization techniques for combinational circuits. 3. Analyze and design digital combinational circuits. 4. Analyze and design sequential logic circuits. 5. Explain nomenclature and technology in memory devices. <p>Analyze state machine diagrams and design the digital system</p>
ISC305	Electrical Networks and Measurement	<ol style="list-style-type: none"> 1. To introduce the concept of circuit elements lumped circuits, circuit laws and reduction. 2. To study the concept of coupled circuits. 3. To study the transient response of series and parallel A.C. circuits. 4. To study two port model of circuit and circuit elements. 5. To introduce the concept of network synthesis. 	<p>Students will be able to -</p> <ol style="list-style-type: none"> 1. Analyze AC and DC circuits using different theorems. 2. Analyze transient and steady-state responses response of passive electrical networks. 3. Analyze network using poles and zeros and find their parameters like Z, Y, and ABCD. 4. Synthesize the networks using

		6. To study basic analog instruments as well as digital instruments to study measurement of R-L-C	canonical forms. 5. Students will get knowledge of construction and working principal and applications of analog and digital instruments Measure electrical parameter like R, L, C using electrical bridges.
SEM IV			
ISC401	Applied Mathematics-IV	<p>1. To develop analytical insight of the student to prepare them for graduate's studies in Instrumentation Engineering</p> <p>2. To enhance their ability to solve and analyse engineering problem.</p> <p>3. To provide students with a strong mathematical foundation to acquire the professional competence knowledge and skills.</p>	<p>The students will be able to:</p> <ol style="list-style-type: none"> 1. Check the given set of vectors is the vector space. 2. Find eigenvalues and eigenvectors of matrix and can diagonalize the matrix. 3. Find the probability distribution, expectation, variance and moments for the given data. 4. Use binomial distribution and Poisson distribution and normal distribution for the data for required probability. 5. Apply Cauchy's integral formula and theorem and residue theorem to solve the integral problem. 6. Find the correlation coefficients and rank correlation coefficients and lines regression between the two data.
ISC402	Transducer - II	<p>1. To make students understand the construction, working principle and application of various transducers used for flow measurement, strain measurement, pressure and vacuum measurement, force, torque and power measurement</p> <p>2. To study electro-chemical sensors and transducers used for density and viscosity measurement</p>	<p>The course would enable the students to:</p> <ol style="list-style-type: none"> 1. Explain working principle of strain gauges. 2. Explain working principle of pressure transducers 3. Learn transducers for vacuum measurement. 4. Identify types of flow and use different transducers for flow measurement. 5. Explain the terminologies of electrochemical sensors and their applications in industry. 6. Identify sensors for power,

			density, humidity, pH measurement
ISC403	Feedback Control System	<ol style="list-style-type: none"> 1. The students should be able to learn the type of System, dynamics of physical systems, classification of control system, analysis and design objective. 2. The students should learn how to represent system by transfer function and block diagram reduction method and Mason's gain formula. 3. The students should be able to learn time response analysis and demonstrate their knowledge to frequency response. 4. Students can be able to learn stability analysis of system using Root locus, bode plot, polar plot, and Nyquist plot. 	<p>Students will be able to -</p> <ol style="list-style-type: none"> 1. Identify open and closed loop control system 2. Formulate mathematical model for physical systems. 3. Simplify representation of complex systems using reduction techniques. 4. Use standard test signals to identify performance characteristics of first and second-order systems. 5. Apply root locus technique for stability analysis. 6. Analyze performance characteristics of system using Frequency response methods
ISC404	Analytical Instrumentation	<ol style="list-style-type: none"> 1. Introduce the basic concept of qualitative and quantitative analysis of a given sample. 2. Study various spectroscopic techniques and its instrumentation. 3. Study the concept of separation science and its applications. 4. Study the concept of radiochemical analysis along with industrial analyzers. 	<p>The students will be able to:</p> <ol style="list-style-type: none"> 1. Define and explain various fundamentals of spectroscopy, qualitative and quantitative analysis. 2. Discuss the terms, principle, instrumentation, operation and applications of Molecular spectroscopic techniques. 3. Differentiate between principle, instrumentation and operation of Atomic absorption and emission Spectroscopy. 4. Explain the various Separation techniques and its instrumentation. 5. Describe the principle and working of various Radiation detectors. 6. Discuss the principle and working of various Gas analyzers.
ISC405	Signal Conditioning Circuit Design	<ol style="list-style-type: none"> 1. To give the knowledge about the various components analog signal conditioning. 	<p>The students will be able to:</p> <ol style="list-style-type: none"> 1. Explain principle of analog signal conditioning circuits

		<p>2. To impart knowledge of design considerations of analog signal conditioning of components.</p> <p>3. To give the students knowledge about various components digital signal conditioning.</p> <p>4. To make the students capable to apply knowledge to design various transducer signal conditioning circuits</p> <p>5. To give the students knowledge about the adjustable power supply design</p>	<p>2. Design analog signal conditioners</p> <p>3. Design digital signal conditioners</p> <p>4. Apply knowledge of signal conditioning circuits to design temperature and pressure transducers signal conditioning</p> <p>5. Apply knowledge of signal conditioning circuits to design optical and miscellaneous transducers signal conditioning</p> <p>6. Apply knowledge to design different power supplies.</p>
SEM V			
ISC501	Signals and Systems	<p>1. To introduce students to the idea of signal and system analysis and characterization in time and frequency domain.</p> <p>2. To provide foundation of signal and system concepts to areas like communication, control and comprehend applications of signal processing in communication systems.</p>	<p>1. Students will be able to understand significance of signals and systems in the time and frequency domains.</p> <p>2. Students will be able to interpret and analyze signal and report results.</p> <p>3. Students will be able to evaluate the time and frequency response of continuous and discrete time, system which is useful in understanding behavior of communication and control systems.</p>
ISC502	Applications of Microcontroller-I	<p>1. To make the students understand the fundamentals of 8051 Microcontroller.</p> <p>2. Students should understand the working of these systems and should be able to determine hardware and software interfacing with real time systems.</p> <p>3. They should further understand how to design any application based on these systems.</p>	<p>The students will be able to</p> <p>1. Define Microprocessor and Microcontroller family with comparison.</p> <p>2. Understand working of 8051/8052 and MCS251 Microcontroller Architecture and Programming model.</p> <p>3. Understand the concept of Timer, Interrupt, I/O Port interfacing with 8051 Microcontroller.</p> <p>4. Understand the concept of Interfacing with Real time</p>

			System.
ISC503	Control System Design	1. To make students understand the concept of state –space analysis, to design the compensator in time and frequency domain, to design the PID compensator.	The students will be able to 1. Represent any system in any canonical form. 2. Determine response of system 3. Design Lead, Lag and Lead – lag compensator using frequency domain method or time domain method. 4. Design PID compensator.
ISC504	Signal Conditioning Circuit Design	1. To make students understand the working principle and design of various analog and digital signal conditioning circuits used in industrial applications.	The students will be able to 1. Understand principle of working of various signal conditioners used with Temperature, Displacement, Optical and various miscellaneous other sensors. 2. Design signal conditioning circuits for various transducers. 3. Understand applications of various signal conditioners used in industry. 4. Capable of selecting best suited signal conditioners for any given application.
ISC505	Control System Components	1. This course develops the students approach to identify different Control system components like Hydraulic, Pneumatic, Electrical and Electronic. 2. Students are expected to learn different types of Transmitters. 3. Students are expected to understand concept of Control Valve, different types of Control valve, their schematic, operation, etc. 4. They should able to understand different auxiliary process components like feeders, dampers etc.	1. The students will demonstrate different control system components like pumps, compressors, flapper nozzle. 2. The students will demonstrate working of different pneumatic circuits like Single acting cylinder, Double acting cylinder, hydraulic braking systems by using directional control valves. 3. The students will demonstrate the knowledge of different transmitters, how to use SMART transmitter. 4. The students will demonstrate the knowledge of control valves, installation, different valve

			<p>accessories.</p> <p>5. The students will learn importance of Alarm annunciators system, square root extractor , pressure and level switches</p>
SEM VI			
ISC601	Process Instrumentation Systems	<p>1. The objective of the course is to make the students familiar with different process dynamics in Process industries and different control schemes generally used to get best output.</p> <p>2. It also makes students aware of various analysis and design methods for multivariable systems. In addition, the subject also introduces about discrete state process control and Batch process.</p>	<p>1. The students will be able to handle any kind of process by framing it in block diagram, mathematical model and different process variables.</p> <p>2. The students will be able to handle different types of controller like electronic, pneumatic and hydraulic.</p> <p>3. The students will be able to implement different control schemes to various processes.</p> <p>4. The students will be able to design relay logic for various processes.</p> <p>5. The students will be able to understand batch process with an example.</p>
ISC602	Power Electronics and Drives	<p>1. To equip the students with the basic knowledge of Power semiconductor Devices</p> <p>2. To study the controlled Rectifiers, Inverters and DC to DC converters .</p> <p>3. To Understand the working AC and DC Drives.</p> <p>4. To Study the application of Power Electronics.</p>	<p>Students will be able to</p> <p>1. Understand the working of Power Electronics Devices.</p> <p>2. Understand working of Controlled Rectifiers ,Inverters and DC to DC converters.</p> <p>3. Understand the Working of AC/DC Drives</p>
ISC603	Digital Signal Processing	<p>1. The principle of the syllabus is to give an introduction to basic concepts of system transforms, fundamental principles and applications of signals and filters.</p> <p>2. This subject provides understanding and working knowledge of design,</p>	<p>Upon successful completion of this subject, student will be able to,</p> <p>1. Determine the frequency response of FIR and IIR filters.</p> <p>2. Understand the relationship between poles, zeros, and</p>

		implementation, analysis and comparison of digital filters for processing of discrete time signals.	stability. 3. Determine the spectrum of a signal using the DFT, FFT, and spectrogram. 4. Design, analyze, and implement digital filters in Matlab and C,C++.
ISC604	Applications of Microcontroller-II	1. To make the students understand the fundamentals of PIC Microcontroller. 2. Students should understand the working of these systems and should be able to determine hardware and software 3. Interfacing with real time systems. They should further understand how to design any application based on these systems.	The students will be able to 1. Define Embedded system and its Applications in industry. 2. Understand working of PIC 18F Microcontroller Architecture and Programming model. 3. Understand the concept of Timer, Interrupt, I/O Port interfacing with PIC 18F Microcontroller. 4. Understand the concept of Interfacing with Real time System.
ISC605	Industrial data communication	1. To make students understand the OSI reference model, LAN network, different Open control network, Networks at different levels such as sensor level, device network control, HART, Foundation field bus, Wireless technologies	The students will be able to 1. Understand basic reference model, LAN for networking. 2. Understand various architecture/working of different protocol. 3. Make comparative study of various wireless technology. 4. Understand applications of various protocols in industry.
ISC606	Analytical Instrumentation	1. To introduce the basic concept of qualitative and quantitative analysis of a given sample. 2. To study various spectroscopic techniques and its instrumentation. 3. To study the concept of separation science and its applications. 4. To study the concept of industrial analyzers and its applications.	The students get well versed with the principle, construction and working of various analytical instruments. Students get detailed information about the applications of analytical techniques in medicine, industry etc.

SEM VII

ISC701	Industrial Process Control	<p>1. To make the students understand all the processes involved in the industries, the various unit operations and be able to apply control schemes to these processes to get the output with desired specifications.</p> <p>2. To make the students acquainted with safety and hazards in industry.</p>	<p>The students will be able to</p> <ol style="list-style-type: none"> 1. Get a complete overview of strategies for process control. 2. Know all the industrial processes and demonstrate their knowledge in designing the control loops for these processes.. 3. Understand the safety related terms such as classification of hazards in the industry and design Hazard free plant.
ISC702	Biomedical Instrumentation	<p>1. To make students understand the Identification, classification, and working principle of various Biomedical Instruments used for Bio-potential measurement and application of these instruments in diagnosis, therapeutic treatment and imaging fields.</p>	<p>The students will be able to</p> <ol style="list-style-type: none"> 1. Identify various Bio-potential and their specifications in terms of amplitude and frequency. 2. Understand principle and working of various Biomedical Instruments for diagnosis applications. 3. Decide the applications of therapeutic instruments for treatment purpose. 4. Understand applications of imaging instruments and the modalities involved in each technique.
ISC703	Advanced Control System	<p>1. To make students understand the concept of non linear control, Internal Model Control and Optimal Control.</p> <p>2. To Study the stability of Non Linear and Linear systems .</p>	<p>The Students will be able to</p> <ol style="list-style-type: none"> 1. Linearize the non linear physical systems. 2. Study the non linear system behavior by phase plane and describing function methods 3. Study the stability of linear and nonlinear systems by Lyapunov method. 4. Design IMC with Uncertainty and Disturbances.
ISC704	Process Automation	<p>1. To make the students understand the fundamentals of automation and various automation</p>	<p>The students will be able to</p> <ol style="list-style-type: none"> 1. Define automation, it's

		<p>systems used in industry such as PLC, DCS, and SCADA.</p> <p>2. Students should understand the working of these systems and should be able to determine hardware and software requirements of PLC, DCS and SCADA.</p> <p>3. They should further understand how to design any application based on these systems.</p> <p>4. Also they should understand the requirements of safety and design safety instrumented systems.</p>	<p>importance, expectations from automation and applications in industry.</p> <p>2. Understand working of PLC, I/O modules of PLC, Programming languages and instructions of PLC, design PLC based application by proper selection and sizing criteria, developing GUI and ladder program.</p> <p>3. Understand evolution and architecture of DCS, hierarchical control in DCS, programming DCS through function Block Diagram (FBD) method.</p> <p>4. SCADA architecture, communication in SCADA, develop any application based on SCADA along with GUI using SCADA software.</p> <p>5. Understand the need of SIS, risk reduction methods, evaluation of SIL(Safety Integrity Levels)</p>
ISE7051	Advanced Embedded Systems	<p>1. To make students understand the 32bit processors and higher architectures and configuration.</p> <p>2. Use of Real Time systems and there design in Instrumentation systems.</p>	<p>The students will be able to</p> <p>1. Designing using ARM processors</p> <p>2. Use Real time software for designing instrumentation systems</p> <p>3. Design with configurable hardware systems</p>
ISE7052	Image Processing	<p>1. The principle of the syllabus is to give an introduction to basic concepts and methodologies for digital image processing .The students are expected to develop a foundation that can be used as the basis for further study and research in this field.</p> <p>2. The syllabus gives great emphasis on basic principles as well as more advanced techniques</p>	<p>Student will be able to</p> <p>1. understand the basic concepts and methodologies for digital image processing.</p> <p>2. Students will be able to study and program advanced techniques for image enhancement , segmentation morphological operations etc.</p>

		for image enhancement, segmentation, morphological operations etc.	
ISE7053	Functional safety	1. To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.	The students will be able to 1. Understand the role of Safety instrumented system in the industry. 2. Identify and analyze the hazards, 3. Select the Safety integrity level.
ISE7054	Process Modeling & Optimization	1. To make students understand the basic approach to the problem of mathematical modeling and identifying the variables by using direct methods. 2. To translate a descriptive statement of the design problem into a mathematical statement for optimization. 3. To use numerical methods for solving engineering optimization problems.	Students will be able to 1. Formulate mathematical models of the complex engineering systems. 2. To use an optimization algorithm to solve linear and nonlinear optimization problems. 3. Explain the kind of interaction possible with an optimization algorithm.
ISE7055	Wireless Communication	1. To make students understand concept of Wireless Communication in real time process control application.	The students will be able to 1. Basics of Wireless Communication Systems 2. Understands Wireless Transceivers and Advanced Transceivers 3. Understands Wireless Application Protocol 4. Understands Different Wireless trends in Industry
SEM VIII			
ISC801	Digital control system	1. To equip the students with the basic knowledge of discretization. 2. To study the stability analysis of digital control system. 3. To study the canonical forms of digital control systems 4. To determine steady state	The students will be able to 1. Understand mathematical models of linear discrete-time control systems using transfer functions and state-space models. 2. Analyze transient and steady-state behaviours of linear

		<p>performance of Digital control systems.</p> <p>5. To design the controller and observer for digital control systems.</p> <p>6. To study PID discrete controller</p>	<p>discretetime control systems.</p> <p>3. Determine whether performance of linear discrete-time control systems meet specified design criteria.</p> <p>4. Design controllers and observers for linear discrete-time control systems so that their performance meet specified design criteria.</p> <p>5. Design PID controllers.</p>
ISC 802	Instrumentation Project Documentation & Execution	<p>1. To provide knowledge of Instrumentation Project & Detailed Engineering techniques in the EPC Consultancy.</p> <p>2. The course aims to explain Project Deliverables and Engineering activities of Project Documentation.</p>	<p>Design & Develop Basic & Detailed Engineering Project Deliverables.</p> <p>1. Understand Types of Project Executed in I & C Projects.</p> <p>2. Develop skills to Execute and carry different activities in process industry.</p> <p>3. Understand Procedures, Guidelines and Thumb Rules for performing Precommissioning activities.</p> <p>4. Overall Development of the students by Hands on working Experience.</p>
ISC803	Instrument and System Design	<p>To make students to understand</p> <p>1. Control Valve Sizing concepts and its usual terms for applications like liquid, gas, vapour and flashing fluids.</p> <p>2. Control room and Control Panel details</p> <p>3. The process of Electronic product design</p>	<p>The students will be able to</p> <p>1. Design and Analyse CV Sizing</p> <p>2. Identify various Control panels and Control Room details</p> <p>3. tDesign of Electronic product.</p>
ISE8041	Nuclear Instrumentation	<p>1. To introduce the basic concept of radioactivity, properties of alpha,beta and gamma rays</p> <p>2. To study various radiation detectors, detector classification</p> <p>3. To study the electronics and</p>	<p>The students get well versed with construction and working of various radiation detectors.</p> <p>1. Students also get thorough knowledge of electronics and counting systems used in nuclear instrumentation</p>

		counting systems 4. To study applications of nuclear instrumentation in medicines, Industry and in Agriculture.	2. Students get detailed information about applications of nuclear instrumentation in medicine, industry etc.
ISE8042	Power Plant Instrumentation	1. To create awareness of energy resources and its scenario in India. 2. To study the concept of power generation using various resources. 3. To study the role of Instrumentation in power plants. 4. To study and compare various power plants for optimal performance.	The students get well versed with all power generation plants. 1. Students also get thorough knowledge of Instrumentation involve in power plants.
ISE8043	Optimal Control Theory	1. To make students understand the optimal control problems their types and how to solve them by calculus of variation and dynamic programming approaches. 2. To make student to understand the linear regulator and tracking systems, discrete time optimal control systems.	The students will be able to 1. Identify various optimal control problems with performance measure with minimum time, minimum fuel, minimum energy, terminal cost and general problems. 2. Understand principle of calculus of variation, optimality, dynamic programming and their applications. 3. Make comparative study of problems based on calculus of variation, linear regulator, tracking and dynamic programming problems. 4. Understand applications of these methods for solving various optimal control problems.
ISE8044	Nano Technology	1. To explain students to basic concepts of nanodevices and various sensors. 2. To provide knowledge about the applications of nanotechnology	The students will be able to 1. Understand the working of MEMS and NEMS 2. Understand the applications of nanosensors and detectors

ISE8045	Fiber Optic Instrumentation	<ol style="list-style-type: none"> 1. To expose the students to the basic concepts of optical fibres and their properties. 2. To provide adequate knowledge about the Industrial applications of optical fibres. 	<p>The students will be able to:</p> <ol style="list-style-type: none"> 1. Identify various sensors, Fiber optic and its specifications. 2. Understand principle of working of Fiber Optic used to measure Temperature, Displacement, Level, and various miscellaneous other sensors 3. Understand applications of Fiber Optics in industry
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