Department of Instrumentation & Control Engineering
B.Tech. in Electronics and Instrumentation Engineering

Year	THIRD SEMESTER						FOURTH SEMESTER					
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
II	MAT ****	Engineering Mathematics - III	2	1	0	3	MAT ****	Engineering Mathematics - IV	2	1	0	3
	ICE ****	Analog Electronic Circuits	3	1	0	4	ICE ****	Linear Integrated circuits	3	0	0	3
	ICE ****	Digital Circuits & System Design	3	0	0	3	ICE ****	Microcontrollers	3	1	0	4
	ICE ****	Networks and Signals	3	1	0	4	ICE ****	Industrial Instrumentation	3	0	0	3
	ICE ****	Sensors and Transducers	3	0	0	3	ICE ****	Digital Signal processing	2	1	0	3
	ICE ****	Linear Control Theory	2	1	0	3	ICE ****	Communication Systems	3	0	0	3
	ICE ****	Digital Circuits and Systems Lab	0	0	3	1	ICE ****	Analog systems lab	0	0	3	1
	ICE ****	Sensors and Circuits lab	0	0	3	1	ICE ****	Microcontroller Lab	0	0	3	1
			16	**4**	**6**	**22**						**21**
	Total Contact Hours (L + T + P)						**Total Contact Hours (L + T + P)**					

Year	FIFTH SEMESTER						SIXTH SEMESTER					
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
III	HUM****	Essentials of Management	3	0	0	3	HUM ****	Engg Economics & Financial Management	3	0	0	3
	ICE ****	Industrial Automation & Drives	3	1	0	4	ICE ****	Flexible Core – 2 (MEMS/Internet of Things	3	0	0	3
	ICE ****	VLSI Design	3	0	0	3	ICE ****	Flexible Core – 3 (Wireless sensor networks/Digital Image Processing	3	0	0	3
	ICE ****	Process Instrumentation and control	3	0	0	3	ICE ****	PE – 1 / Minor Specialization	3	0	0	3
	ICE ****	Flexible Core – 1 (Smart sensors /Embedded System Design	3	0	0	3	ICE ****	PE – 2 / Minor Specialization	3	0	0	3
	XXX****	OE 1– Creativity, Problem Solving and Innovation** (MLC) - mandatory	3	0	0	3	XXX****	OE – 2** (MLC)	3	0	0	3
	ICE ****	Industrial Instrumentation Lab	0	0	3	1	ICE ****	Control and Signal Processing	0	0	3	1

								Lab				
	ICE ****	Process Control Lab	0	0	3	1	ICE ****	Industrial automation lab	0	0	3	1
							ICE ****	Virtual Instrumentation LAB	0	0	3	1
						21						**21**
	Total Contact Hours (L + T + P)						**Total Contact Hours (L + T + P)**					

*Courses of three independent tracks A, B, C

** Performance of students to be recorded in Eighth semester grade sheet

Year	**SEVENTH SEMESTER**						**EIGHTH SEMESTER**					
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
IV	ICE ****	PE – 3 / Minor Specialization	3	0	0	3	ICE ****	Industrial Training (MLC)				1
	ICE ****	PE – 4 / Minor Specialization	3	0	0	3	ICE ****	Project Work				12
	ICE ****	PE – 5	3	0	0	3	ICE ****	Project Work (B Tech – honours)* (V - VIII sem)				20
	ICE ****	PE – 6	3	0	0	3	ICE ****	B Tech – honours Theory – 1* (V semester)				4
	ICE ****	PE - 7	3	0	0	3	ICE ****	B Tech – honours Theory – 2* (VI semester)				4
	XXX****	OE – 3** (MLC)	3	0	0	3	ICE ****	B Tech – honours Theory – 3* (VII semester)				4
	ICE ****	Mini Project (Minor specialization)***				8						
						18/26* **						**13/33***
	Total Contact Hours (L + T + P)						**Total Contact Hours (L + T + P)**					

*Applicable to eligible students who opted for and successfully completed the B Tech – honours requirements

** Performance of students to be recorded in Eighth semester grade sheet

***Applicable to students who opted for minor specialization

<table>
<tr><th colspan="2">Minor Specialization</th><th>Other Electives</th></tr>
<tr>
<td>I. Control Systems
ICE **** : Modern Control Theory
ICE **** : Nonlinear control theory
ICE **** : Digital Control Systems
ICE **** : System Identification
II. Sensor Technology
ICE **** : Sensor Design
ICE **** : Biosensors and BioMEMS
ICE **** : Multi Sensor Data Fusion
ICE **** : Automotive Sensors
III. Systems Engineering
ICE **** Introduction to Systems Engineering
ICE **** System architecture and Design
ICE **** SysML and MBSE
ICE **** System Verification and validation
IV. Smart Transportation Systems
ICE **** : Automotive Electronics
ICE **** : In-vehicle Networking
ICE **** : Intelligent Transportation Systems
ICE **** : Advanced Driver Assistance Systems</td>
<td>V. Computational Intelligence
VI. Business Management
VII. VLSI Design
VIII. Electric Mobility</td>
<td>ICE ****: Neural Network and Fuzzy Logic
ICE **** : Real Time Operating System
ICE **** : DSP algorithms and Architecture
ICE **** : Analytical and optical Instrumentation
ICE **** : Biomedical Instrumentation and Equipment
ICE **** : Data Structures and algorithms
ICE **** : Cyber physical systems
ICE **** : Power Electronics
ICE **** : Robotic Control Systems
ICE **** : Reliability and safety Engineering
ICE **** : Robust Control
ICE **** : Electronic Measurement Systems
ICE **** : Machine learning for control systems
ICE**** : Advanced Sensor Technology

Open Electives
ICE **** : Feedback Control Theory
ICE **** : Industrial Automation
ICE **** : Industrial Instrumentation
ICE **** : Sensor Technology
ICE **** : Smart Sensor
ICE **** : Virtual Instrumentation
ICE**** : Farm Automation</td>
</tr>
</table>

THIRD SEMESTER

MAT XXXX: ENGINEERING MATHEMATICS - III [2 1 0 3]

Course objectives: This course will enable students to

CO1	Understand the concept of system of linear equations and solving for independent solutions.
CO2	Learn the geometric view of inner products and orthonormal projections.
CO3	Understand matrix decomposition methods such as diagonalization and SVD.
CO4	Understand the concept of Fourier series expansion and Transforms.
CO5	Apply the concepts of F.S/F.T to solve engineering problems.

Linear algebra: Systems of Linear Equations, Matrices, Solving Systems of Linear Equations, Vector Spaces, Linear Independence, Basis and Rank, Linear Mappings, Affine Spaces, Analytic geometry: Norms, Inner Products, Lengths and Distances, Angles and Orthogonality, Orthonormal Basis, Orthogonal Complement, Inner Product of Functions, Orthogonal Projections, Rotations. Matrix decompositions: Determinant and Trace, Eigenvalues and Eigenvectors, Cholesky Decomposition, Eigen decomposition and Diagonalization, Singular Value Decomposition, Matrix Approximation. Fourier Series and transforms: Periodic function, Fourier Series expansion. even and odd functions, functions with arbitrary periods, Half range expansions Fourier transform, basic properties, Parseval's identity and applications.

References:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. Grewal B.S. - Higher Engineering Mathematics, Khanna Publishers, 43rd edition, 2015
1. Stephen H. Friedberg Lawrence E Spence, Arnold J Insel, Elementary Linear Algebra: A Matrix Approach Introduction to Linear Algebra, Second Edition, 2019.
2. David Lay, Steven Lay, Judi McDonald, Linear Algebra and Its Applications, Pearson, 2019.
3. Gilbert Strang, Introduction to Linear Algebra, Fifth Edition (2016), Wellesley-Cambridge Press.
4. Mordechai Ben-Ari, Mathematical Logic for Computer Science, Third Edition, Springer.
5. Narayanan, Ramaniah and Manicavachagom Pillay , Advanced Engineering Mathematics, Vol 2 and 3, Vishwanthan Publishers Pvt Ltd. 1998
6. Erwin Kreyszig, Advanced Engineering Mathematics, 5th edn., Wiley Eastern, 1985.

ICE XXXX: ANALOG ELECTRONIC CIRCUITS [3 1 0 4]

Course Learning Outcomes: At the end of the course, the students will be able to:

CO1	Understand the operation of field effect transistors (FET)
CO2	Analyze various biasing and amplifier topologies of FET
CO3	Realize differential amplifiers using FET
CO4	Analyze frequency response of FET amplifiers
CO5	Design of various feedback amplifiers and power amplifiers

Structure and operation of MOSFET, I-V Characteristics, Channel-Length Modulation, Transconductance, Large-Signal and Small-Signal Model, Biasing, Amplifier topologies, Common-Source Amplifier, Common-Gate Amplifier, Source Follower, Cascode, Two stage CS Amplifiers, MOS Differential amplifier, Miller's Theorem, Frequency Response of CS, CG, CD, Cascode and differential amplifier Stage, Negative Feedback Amplifiers, Feedback Topologies, Power amplifiers, Push-Pull Stage, LC Oscillators, Hartley's and Colpitt's Oscillator, RC Phase Shift Oscillator, Ring Oscillator.

References:

1. Behzad Razavi, Fundamental of Microelectronics, Wiley, (2e), 2013.
2. A. S. Sedra, K. C. Smith, Microelectronic circuits, Oxford University Press, (6e), 2011.
3. R. L. Boylestad, L. Nashelsky, Electronic Devices and Circuit Theory, PHI, (11e), 2014.

ICE XXXX: DIGITAL CIRCUITS AND SYSTEM DESIGN [3 0 0 3]

Boolean Algebra – Theorems, DeMorgan's Law, Karnaugh map, Determination of Prime Implicants, Quine McCluskey method, Combinational Logic Design, Synchronous Sequential Logic Design, Introduction to Programmable circuits - Design of Read-Only Memory (ROM), Programmable Logic Arrays (PLA), Programmable Array Logic (PAL)., Programmable ASICs, Introduction to CAD Tools, Introduction to Verilog – Structural Specification; Behavioral Specification, Verilog for Combinational Circuits, Verilog for Sequential Circuits, Verilog Programming.

References:

1. Donald D. Givone, Digital Principles and Design, TMH, (1e), 2002.
2. C. H. Roth, Fundamentals of Logic Design, Thomson, (6e), 2000.
3. Anand Kumar, Switching Theory and Logic Design, PHI, (2e), 2014.
4. Samir Palnitkar, Verilog HDL: A guide to digital design and synthesis, Prentice Hall Professional, (2e), 2003.
5. J. Bhasker, A Verilog HDL Primer, BSP, (1e), 2001.
6. Stephen Brown, Fundamentals of Digital Logic with Verilog Design, TMH, (3e), 2013.
7. Cem Unsalan, Bora Tar, Digital System Design with FPGA, Mc Graw Hill Education (India) Private Limited, 2017.
8. Ming-Bo Lin, Digital System Designs and practices Using Verilog HDL and FPGAs, Wiley India Pvt. Ltd., 2012.

ICE XXXX: NETWORKS AND SIGNALS [3 1 0 4]

Analysis of circuits with dependent sources, Network theorems, Initial conditions and transient analysis of RL, RC and RLC circuits, Analysis of networks by Laplace transform method, Network functions, Two port network parameters. Continuous time signals and systems, LTI systems - convolution integral, Response of Continuous time LTI systems to complex exponentials, Fourier series, Fourier transform, Properties of Fourier series and Fourier transform

References:

1. Van Valkenberg, Network Analysis, 3e, PHI, 2010
2. Fundamentals of Electric Circuits, Charles K. Alexander, Matthew N. O. Sadiku, McGraw Hill (7e), 2022.
3. Allan Oppenheim, Allan Willsky with Ian S Hamid, Signals and Systems, PHI, 1999.
4. Hayt W. H., J. E. Kemmerly & S. M. Durbin, Engineering Circuit Analysis, 7e, TMH, 2010.

ICE XXXX: SENSORS AND TRANSDUCERS [3 0 0 3]

Configurations and functional description, Resistive Transducers, Capacitive Transducers, Inductive Transducers, Inductive Transducers, Piezo Electric Transducers, electrochemical sensors: use and design, optical sensors: use and design, miscellaneous industrial sensors for measurement of pH, gases, humidity.

References:

1. E.O. Doeblin, Measurement Systems: Application and Design, McGraw Hill, (5e), 2008.
2. DVS Murthy, Transducers & Instrumentation, PHI, (2e), 2008.
3. Skooj, Holler, Crouch, Principles of Instrumental Analysis (7e), Cengage Learning India, 2018.
4. B.G. Liptak, Process Measurement & Analysis, Chilton Book Company, (4e), 2003.

ICE XXXX: LINEAR CONTROL THEORY [2 1 0 3]

Mathematical modeling, transfer functions, Block diagram representation and reduction, signal flow graph, Masons gain formula, time domain specifications. Stability, Steady state errors, generalized error coefficients, Routh- Hurwitz criterion, Root-Locus plots, frequency domain specifications. Correlation between frequency domain and time domain specifications, Bode diagrams, Polar plots, Nyquist stability criterion, Qualitative analysis of compensator design using root-locus and frequency response approach. (Note: Theoretical concepts be demonstrated in class. Additional examples be solved using MATLAB on every topic during tutorials.)

References:

1. Norman S. Nise, Control Systems Engineering, Wiley India, (5e), 2009.
2. K. Ogata, Modern control engineering, PHI, (5e), 2011.
3. R.C Dorf and R.H Bishop, Modern Control Systems, Pearson, (11e), 2013.

ICE XXXX: DIGITAL CIRCUITS AND SYSTEMS LAB [0 0 3 1]

Implementation of Boolean functions using logic gates, Code Conversion Circuits, Design and implementation of combinational circuits, Study of Flip-flops, Design and implementation of Counters, Study of Basic operators and data types in Verilog HDL, Combinational circuit design using Verilog HDL, Sequential circuit design using Verilog HDL, Keypad Interfacing, LCD Interfacing.

References:

1. Anand Kumar, Switching Theory and Logic Design, PHI, (2e), 2014.
2. M. Morris Mano, Digital Design, PHI, (5e), 2002.
3. Samir Palnitkar, Verilog HDL: A guide to digital design and synthesis, Prentice Hall Professional, (2e), 2003.
4. J. Bhasker, A Verilog HDL Primer, BSP, (1e), 2001.
5. Cem Unsalan, Bora Tar, Digital System Design with FPGA, Mc Graw Hill Education (India) Private Limited, 2017.

ICE XXXX: SENSORS AND CIRCUITS LAB [0 0 3 1]

AC bridges, network theorems, measurement of energy, measurement of self and mutual inductance, series and parallel resonance, characteristics of sensors and transducers – temperature, torque, force, displacement and intensity of light. Electrochemical sensor design. Optic fiber based sensor design.

References:

1. E.O. Doeblin, Measurement Systems: Application and Design, McGraw Hill, (5e), 2004.
2. C S Rangan, G R Sharma and V S V Mani, Instrumentation Devices & Systems, TMH, (2e), 2017.

FOURTH SEMESTER

MAT ****: ENGINEERING MATHEMATICS IV [2 1 0 3]

Probability and Distributions: Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Distributions: Binomial, Poisson, uniform, normal, Chi-square and exponential distributions. Multivariate Random variables and Stochastic Process: Two and higher dimensional random variables, covariance, correlation coefficient. Moment generating function, functions of one dimensional and two dimensional random variables. Static probabilities: review and prerequisites generating functions, difference equations. Dynamic probability: definition and description with examples. Markov chains, transition probabilities. Vector Calculus: Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series. Optimization: Basic solution, Convex sets and function, Simplex Method, Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers.

Reference Books:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.
2. P L Meyer, Introductory Probability and Statistical Applications, Addison Wiley.
3. Medhi. J. Stochastic Processes, Wiley Eastern.
4. Murray R. Spiegel, Vector Analysis Theory and Problems, Schaum’s Outline Series, 2019.
5. Hamdy A. Taha, “Operations Research: An Introduction”, 8th Edn., Pearson Education (2008).
6. Sheldon M. Ross, Introduction to Probability Models Eleventh Edition Elsevier.
7. E. S. Page, L. B. Wilson, An Introduction to Computational Combinatorics, Cambridge University Press.
8. Bhat U R, Elements of Applied Stochastic Processes, John Wiley.

ICE XXXX: LINEAR INTEGRATED CIRCUITS [3 0 0 3]

Op Amp fundamentals, Current to Voltage, Voltage to current Converters, Current amplifiers, Difference Amplifiers, Instrumentation Amplifiers, Active Filters, Voltage comparators, Schmitt trigger, Precision rectifiers, Peak detector, Multi vibrators, Monolithic Timers, Triangular wave generators, Sine wave generators, Voltage to frequency and Frequency to voltage converters, Digital to Analog and Analog to Digital Converters.

References:

1. Franco Sergio, Design with Op amps & Analog Integrated Circuits, McGraw Hill, (3e), 2017.
2. Ramakant A. Gayakwad, Op-Amps and Linear Integrated Circuits, PHI, (4e), 2015.
3. Robert F. Coughlin and Frederick S. Driscoll, Operational Amplifiers and Linear Integrated Circuits. Pearson Education Pvt Ltd., (6e), 2020.
4. Sedra and Smith, Micro Electronic Circuits, Oxford university press, (8e), 2019.

ICE XXXX: MICROCONTROLLERS [3 1 0 4]

Computer Architecture, Architecture of 8051, 8051 Addressing Modes, 8051 Instruction Set, Programming 8051 using Assembly Language and C, 8051 Timer, Serial Port and Interrupt Programming using Assembly Language and C. Introduction to ARM, ARM Architecture, Introduction to LPC2148, Architecture of LPC2148 and Programming, Interfacing of I/O ports, ADC, DAC, LCD, Keyboard, Stepper motor, DC motor using 8051/LPC2148.

References:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Pearson Education, (2e), 2007.
2. Kenneth J. Ayala, The 8051 Microcontroller, Cengage Learning, (3e), 2004.
3. Steve Furber, ARM System - on – Chip Architecture, Pearson, (2e), 2015
4. William Hohl, Hinds Christopher, ARM Assembly Language, CRC Press, (2e), 2014.

5. LPC21XX User Manual, 2007.

ICE XXXX: INDUSTRIAL INSTRUMENTATION [3 0 0 3]

Temperature Measurement, Pressure Measurement: Manometers, Elastic types, Bell gauges, Electrical types, Differential Pressure transmitters, Dead weight Pressure gauges. Low Pressure Measurement. Flow Measurement. Multiphase flow meters, Measurement of Speed, velocity and Acceleration, Level Measurement, NEMA, ISA standards, IEI – hazard classifications and standards.

References:

1. Liptak B. G, Handbook of Process Measurement and Analysis, Chilton Book Company, (3e), 1995.
2. Gioia Falcone, Geoffrey Hewitt, C Alimonti, Multiphase Flow Metering- Principles and Applications, Elsevier Publication, 2009.
3. Patranabis D, Principles of Industrial Instrumentation, TMH, (3e), 2005.

ICE ****: DIGITAL SIGNAL PROCESSING [2 1 0 3]

Z-transform, its properties, inverse Z-transform, solving difference equation, discrete Fourier transform, and its properties, FFT algorithms, Frequency response of analog and digital filters, FIR and IIR filter design, FIR filter design using windows, digital Butterworth and Chebyshev filter design, realization of FIR and IIR filters, architecture of C6x processor, various addressing modes, programs.

References:

1. John G Proakis, Dimitris G Manolakis, Digital Signal Processing, Pearson Education,(4e), 2007.
2. Sanjit K Mitra, Digital Signal Processing: A Computer - Based Approach, McGraw Hill Education,(4e), 2013
3. Thomas J. Cavicchi, Digital Signal Processing, Wiley, 2009
4. Steven W Smith, Digital Signal Processing: A Practical Guide for Engineers and Scientists, Elsevier, 2002
5. Rulph Chassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK. Vol. 16. John Wiley & Sons, 2004.

ICE XXXX: COMMUNICATION SYSTEMS [3 0 0 3]

Elements of communication systems; Analog Communication techniques: Amplitude modulation schemes, Power distribution, Angle modulation-frequency and phase, frequency spectrum, Sampling, Quantization, Pulse modulation schemes; Shift keying techniques – frequency, phase and amplitude, Noise in analog and digital communication systems, Detection of signal in noise, Spread spectrum and mobile communications.

References:

1. Simon Haykin, Communication Systems, John Wiley & Sons, (4e), 2009.
2. Tomasi W, Electronic communication systems, Pearson, 2012.
3. Simon Haykin and Michael Moher, Introduction to analog and digital communications, John Wiley & Sons, (2e), 2013.

ICE XXXX: ANALOG SYSTEMS LABORATORY [0 0 3 1]

RC Coupled Amplifier, Applications of Op-Amp: Inverting Amplifier, Non-inverting amplifier, Integrator, Differentiator, Voltage follower, Active Filters, Instrumentation amplifier, Precision Rectifier, Schmitt trigger, Multivibrators. Astable/Monostable Multivibrators using IC 555 Timer, Data converters, IC Regulators

References:

1. Albert Malvino, *Electronic Principles*, McGraw Hill, (7e), 1999.
2. Ramakant A. Gayakwad, *Op-Amps and Linear Integrated Circuits*, PHI, (4e), 2015.
3. Sedra and Smith- *Micro Electronic Circuits*, Oxford university press, (6e), 2000.

ICE ****: MICROCONTROLLERS LAB [0 0 3 1]

8051 programming for data transfer, arithmetic operations, code conversion, array handling, delay generation and waveform generation. Interfacing of LED, stepper motor, DC motor, seven segment displays, alphanumeric LCD panel and hex keypad to LPC 2148.

References:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Pearson Education, (2e), 2007.
2. Kenneth J. Ayala, The 8051 Microcontroller, Cengage Learning, (3e), 2004.
3. Steve Furber, ARM System - on – Chip Architecture, Pearson, (2e), 2015
4. William Hohl, Hinds Christopher, ARM Assembly Language, CRC Press, (2e), 2014.
5. LPC21XX User Manual, 2007.

FIFTH SEMESTER

HUM****: ESSENTIALS OF MANAGEMENT [2 1 0 3]

Definition of management and systems approach, Nature & scope. The Functions of managers, Principles of Management. Planning: Types of plans, steps in planning, Process of MBO, how to set objectives, strategies, policies and planning premises, Strategic planning process and tools. Nature and purpose of organizing, Span of management, factors determining the span, Basic departmentation, Line and staff concepts, Functional authority, Art of delegation, Decentralization of authority. HR theories of planning, Recruitment, Development and training. Theories of motivation, Special motivational techniques. Leadership – leadership behavior & styles, Managerial grid. Basic Control Process, Critical Control Points & Standards, Budgets, Non-budgetary control devices. Profit and Loss control, Control through ROI, Direct, Preventive control. PROFESSIONAL ETHICS - Senses of Engineering Ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral Autonomy, Kohlberg’s theory, Gilligan’s theory, Consensus and Controversy, Models of professional roles, Theories about right action, Self-interest, Customs and Religion, Uses of Ethical Theories. GLOBAL ISSUES - Managerial practices in Japan and USA & application of Theory Z. The nature and purpose of international business & multinational corporations, unified global theory of management, Entrepreneurship and writing business plans. Multinational Corporations, Environmental Ethics, Computer Ethics, Weapons Development, Engineers as Managers, Consulting Engineers, Engineers as Expert Witnesses and Advisers, Moral Leadership, Code of Conduct, Corporate Social Responsibility.

References:

1. Harold Koontz & Heinz Weihrich (2020), “Essentials of Management”, McGraw Hill, New Delhi.
2. Peter Drucker (2004), “The practice of management”, Harper and Row, New York.
3. Vasant Desai (2007), “Dynamics of entrepreneurial development & management”, Himalaya Publishing House.
4. Poornima M Charantimath (2006), “Entrepreneurship Development”, Pearson Education.
5. Mike W. Martin & Ronald Schinzinger (2003), “Ethics in engineering”, Tata McGraw Hill, New Delhi.
6. Govindarajan M, Natarajan S, & Senthil Kumar V S (2004), “Engineering Ethics”, Prentice Hall of India, New Delhi.

7. R. S. Nagarazan. (2004), "A text book on professional ethics and human values", New age international publishers, New Delhi.

ICE XXXX: INDUSTRIAL AUTOMATION & DRIVES [3 1 0 4]

Drives, Computers in Process Control, Interface and Backplane Bus Standards for Instrumentation Systems, Programmable Logic Controller (PLC), Ladder logic Programming, Alternate Programming Languages, Distributed Control Systems (DCS), PLC Maintenance, Interface and Backplane Bus Standards, Field bus, HART protocol, Smart transmitters, Valves and Smart actuators, Communications for DCS

References:

1. John. W. Webb Ronald A Reis, Programmable Logic Controllers - Principles and Applications, PHI, (4e). 1998.
2. Lukcas M.P, Distributed Control Systems, Van Nostrand Reinhold Co., 1986.
3. Frank D. Petruzella, Programmable Logic Controllers, MGH, (2e), 1997.

ICE XXXX: VLSI DESIGN [3 0 0 3]

Introduction to integrated circuit technology, CMOS logic, fabrication techniques, basic electrical properties of MOS circuits, CMOS circuit design processes and design parameters, Delay estimation, stick diagrams, VLSI Design methodologies, problems associated with VLSI Design, Design for testability.

References:

1. Douglas A. Pucknell & Kamran Eshraghian, Basic VLSI Design, Prentice-Hall of India, 1995.
2. Neil H.E. Weste, David Harris, Ayan Banerjee, CMOS VLSI Design, A Circuits and Systems Perspective, Pearson Education, 2006.
3. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design Tata Mc-Graw-Hill, 1993.
4. John P. Uyemura. Introduction to VLSI Circuits and Systems, Wiley Publishers, 2001.
5. Jab M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, Prentice-Hall of India Pvt. Limited, 2003.
6. Michal John Sebastian smith, Application-Specific Integrated Circuits, Pearson Education, 2004.

ICE XXXX: PROCESS INSTRUMENTATION AND CONTROL [3 0 0 3]

Process control terminology – mathematical model, self-regulation, control actions, control modes, electronic controllers, Two Degrees of Freedom PID controllers, Anti-Reset windup, I/P converter, Control Valves, performance based controller design, tuning, advanced control strategies, multivariable control, RG Analysis, model based controller design.

References:

1. Stephanopoulis, G, Chemical Process Control, Prentice Hall of India, New Delhi, 1990.
2. Eckman. D.P., Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993.
3. Curtis D. Johnson, Process Control Instrumentation Technology, (8e) PHI, 2009.
4. Pollard A. Process Control, Heinemann educational books, London, 1971.
5. Harriott. P., Process Control, Tata McGraw-Hill Publishing Co., New Delhi, 1991.
6. Donald Coughanower, Process Systems Analysis and Control, McGraw-Hill Inc., 1991.

FLEXI CORE 1 - ICE XXXX: SMART SENSORS [3 0 0 3]

Introduction: Block diagram of smart sensor, Sensor interface needs, sensor electronics, sensor models, sensor signal enhancement, Compensation schemes, sensor integration, Need for smart sensing, Sensor IQ. Sensor Communication, Standards and Implications of Smart Sensors, Smart Sensor systems: Centralised and decentralised system of the measurement chains, Process control over the Internet, intelligent transportation system- ITS user services, ADAS, Smart grid, case studies.

References:

1. Randy Frank, Understanding Smart Sensors, (2e). Artech House Publications, 2000.
2. Paul W. Chapman, Smart Sensors, ISA Press, 1996.
3. Krzystof Iniewski, Smart Sensors for Industrial Applications, CRC Press, 2013.
4. Raghavendra C S, Sivalingam Krishna, Wireless Sensor Network, Springer, 2004.

FLEXI CORE 1 - ICE XXXX: EMBEDDED SYSTEM DESIGN [3 0 0 3]

Introduction to embedded systems, Core of embedded systems and firmware, Architecture of ARM Cortex-M processor, Features and Instructions of ARM Cortex-M, Input/Ouput Programming, Phase-locked loop, Real-time operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Communication MicroC/OS II, Robotic systems, PID controller, Fuzzy logic control.

References:

1. Joseph Yiu, The Definitive Guide to the ARM Cortex-M3, 2nd Edition, Newnes, (Elsevier), 2010.
2. Shibu K V, Introduction to Embedded Systems, Tata McGraw Hill Education Private Limited, 2nd Edition.
3. J. W. Valvano, Embedded Systems: Real-Time Operating. Systems for ARM ® Cortex - M Microcontrollers, Volume 3, ISBN: 978-1466468863

ICE XXXX: INDUSTRIAL INSTRUMENTATION LAB [0 0 3 1]

Design of measurement system for Temperature, flow, level, pressure, thickness, torque, humidity, vibration, load, distance/ speed/ volume, and object detection using optical sensor.

References:

1. C S Rangan, G R Sharma and V S V Mani, Instrumentation Devices & Systems, TMH, (2e), 2004.
2. E. O. Doeblin, Measurement Systems – Application and Design, McGraw Hill, (4e), 1992.

ICE XXXX: PROCESS CONTROL LAB [0 0 3 1]

Study of control actions using temperature, flow, pressure and level Control Trainers, Study of Control valve characteristics, cascade control, Feed Forward Control, Ratio Control and gain scheduling control, Empirical model estimation PID tuning, Smith Predictor control, Study of PID control in a heat exchanger system, Study of DAQ system.

References:

1. Curtis D. Johnson, Process Control Instrumentation Technology, PHI, (8e), 2009.
2. Donald R Coughanower, Process Systems Analysis and Control, MGH, (3e), 2017.
3. Wayne Bequette, Process control, Modelling, simulation & Control, PHI, (1e), 2004.

SIXTH SEMESTER

HUM xxxx: ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT [2 1 0 3]

Time value of money, Interest factors for discrete compounding, Nominal & effective interest rates, Present and future worth of Single, Uniform, and Gradient cash flow. Related problems and case studies. Bases for comparison of alternatives, Present worth amount, Capitalized equivalent amount, Annual equivalent amount, Future worth amount, Capital recovery with return, Rate of return method, Incremental approach for economic analysis of alternatives, Replacement analysis. Break even analysis for single product and multi product firms, Break even analysis for evaluation of investment alternatives. Physical & functional depreciation, Straight line depreciation, declining and double declining balance method of depreciation, Case Study. Balance sheet and profit & loss statement. Meaning & Contents. Ratio analysis, financial ratios such as liquidity ratios, Leverage ratios, Turn over ratios, and profitability ratios, Drawbacks. Safety and Risk, Assessment of Risk and safety, Case study, Risk Benefit Analysis and Reducing Risk.

References:

1. Chan S. Park, "Contemporary Engineering Economics", 4th Edition, Pearson Prentice Hall, 2007.
2. Thuesen G. J, “Engineering Economics”, Prentice Hall of India, New Delhi, 2005.
3. Blank Leland T. and Tarquin Anthony J., “Engineering Economy”, McGraw Hill, Delhi, 2002.
4. Prasanna Chandra, “Fundamentals of Financial Management”, Tata McGraw Hill, Delhi, 2006.
5. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
6. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, NewDelhi,2004.

FLEXI CORE 2 - ICE XXXX: MICRO ELECTROMECHANICAL SYSTEMS [3 0 0 3]

Introduction to micro electromechanical systems (MEMS) Microsystem design considerations, MEMS design using COMSOL Multiphysics and finite elements. Microsystem Fabrication Processes and techniques: mask writing, lithography and advanced fabrication processes, MEMS Sensors and Actuators, case studies, Microsystem Characterization and Packaging.

References:

1. Thomas Jones and Nenad Nenadic, Electromechanics and MEMS, Cambridge University Press, (1e), 2013.
2. Tai-Ran-Hsu, MEMS & Microsystems Design and Manufacture, TMH, 2002.
3. Chang Liu, Foundations of MEMS, Pearson International Edition, 2006.
4. Sergey Edward Lyshevski, MEMS and NEMS systems, Devices and Structures, CRC Press, 2002.
5. Stephen D. Senturia, Microsystem Design, Kluwer Academic Publishers, Springer, 2000.

FLEXI CORE 2 - ICE XXXX: INTERNET OF THINGS [3 0 0 3]

IOT Platform, Interfaces, API, clouds, Architectures of IOT, IOT System components, Role of sensors in IOT, sensor architecture, special requirements, Protocols, IOT cloud platforms, Business models, web security, Security model, Node.js programming for developers, JSON file format. Introduction to Arduino and Raspberry Pi, Node-Red, Interfacing sensors / actuators and accessing clouds. Python for windows, programming, control statement, string operation, list, tuple, tkinter GUI.

References:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press, 2014.
2. Nasreddine Bouhai, “Internet of Things: Evolutions and Innovations”, Wiley, 2017.
3. Bernd Scholz-Reiter, Florian, Michahelles, “Architecting the Internet of Things”, Springer, 2011.
4. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2018
5. Qusay F. Hassan, “Internet of Things A to Z: Technologies and Applications”, Wiley, 2018.

6. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willy Publications, 2013.

FLEXI CORE 3 - ICE XXXX: WIRELESS SENSOR NETWORKS [3 0 0 3]

Overview of wireless sensor techniques, Challenges for Wireless Sensor, Enabling Technologies, Architectures, Networking sensors: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, WSN protocols: IEEE 802.15.4 MAC – Zigbee, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing, Introduction to Time Synchronization, Localization and Positioning, Sensor Tasking and Control. Sensor network platforms and tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming, Tiny OS for WSN and IOT, M2M communication, Alljoyn network, Case studies.

References:

1. Holger Karl & Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach, Elsevier, 2007.
3. Kazem Sohraby, Daniel Minoli, & Taieb Znati, Wireless Sensor Networks- Technology, Protocols and Applications, John Wiley, 2007.
4. Anna Hac, Wireless Sensor Network Designs, John Wiley, 2003.

FLEXI CORE 3 - ICE XXXX: DIGITAL IMAGE PROCESSING [3 0 0 3]

Digital image fundamentals, Intensity transformations, Spatial filtering, Fuzzy techniques for intensity transformations, Filtering in frequency domain, Image restoration, Various noise models, Inverse filtering, Image Segmentation using thresholding, region growing, clustering and superpixels.

References:

1. Rafael C Gonzalez, Richard E Woods, Digital Image Processing, Pearson, (4e), 2018.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, (1e), 2015.

ICE XXXX: CONTROL AND SIGNAL PROCESSING LAB [0 0 3 1]

Time domain analysis and steady state errors, Compensator design, PID controller design, State - space analysis, System modeling and controller design for dynamic systems, Convolution, DFT computation and filter design.

References:

1. K. Ogata, Modern Control Engineering, PHI, (5e), 2011.
2. R.C. Dorf and R. H. Bishop, Modern Control systems, Wesley Longman, 1998.
3.John G Proakis, Dimitris G Manolakis, Digital Signal Processing, Pearson Education,(4e), 2007
4.Sanjit K Mitra, Digital Signal Processing: A Computer - Based Approach, McGraw Hill Education,(4e), 2013
5. Thomas J. Cavicchi, Digital Signal Processing, Wiley, 2009

ICE XXXX: INDUSTRIAL AUTOMATION LAB [0 0 3 1]

Implementation of logic gates, flip flops, multiplexers and de multiplexers, Timers, Counter, Compare, arithmetic instructions in L&T and Siemens PLCs, study of ON/OFF control simulation using delta DIAView SCADA, Interfacing process station with HMI, Real time implementation of PLC with SCADA, Control of bottle filling station and conveyor control using PLC, Motor control with VFD and VVFD, Understanding features of CENTUM DCS, interfacing process stations with DCS.

References:

1. John. W. Webb Ronald A Reis, Programmable Logic Controllers - Principles and Applications, PHI, (4e), 1998.
2. Lukcas M.P, Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.
3. Yokogawa Centum VP R6 Manual: https://web-material3.yokogawa.com/TI33J01A11-01EN.pdf
4. Yokogawa Centum VP R6 Manual: https://web-material3.yokogawa.com/TI33J01A10-01EN.pdf

ICE XXXX: VIRTUAL INSTRUMENTATION LAB [0 0 3 1]

Introduction to Lab VIEW, Arithmetic and logical operations, Operations on arrays, Operations on Clusters, Operations using Loops, Types of structures and operations using them, Types of Graphs and use of graphs and timing pallets, Operations using strings and file I/O, Basics of Imaq vision, Measurement and automation explorer, Simulation of DAQ, acquisition and control using USB DAQ, NI c-RIO and PXI.

References:

1. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI learning, 2010.
2. Gary Johnson, LabVIEW Graphical Programming, McGraw Hill, (2e), 1997.

MINOR SPECIALIZATION

Minor: I Control Systems

ICE XXXX: MODERN CONTROL THEORY [3 0 0 3]

State Space Analysis, Phase variable and canonical form representation, Derivation of state models, Stability analysis, Eigen values, Eigen vectors, Solution of state equations, Cayley Hamilton theorem, Controllability and observability, Pole placement, Observer design, Non Linear Systems, Phase plane analysis, Construction of the phase trajectory, Describing function, Lyapunov's stability analysis, Sylvester's criterion, Lyapunov theorems of stability, Lyapunov function for continuous time state equations.

References:

1. K. Ogata, Modern Control Engineering, Prentice Hall India, (5e), 2011.
2. Nagrath and Gopal, Control System Engineering, New age international Limited, (2e), 1984.
3. M Gopal, Control Systems Engineering: Principles and Design, McGraw Hill, (4e), 2012.
4. Thomas Kailath, Linear Systems, Prentice-Hall, 1980

ICE XXXX: NONLINEAR CONTROL THEORY [3 0 0 3]

Lyapunov stability using Krasovskii's method, Variable Gradient method, L_2 stability of state models**,** L_2 gain, small gain theorem, Passivity, Memory less functions, L_2 gain and Lyapunov stability, passivity theorems, passivity based control, Review of describing function method, Absolute Stability Circle criterions, Popov Criterion, stabilization via linearization and Integral control, Gain scheduling, Graphical Linearization Methods, Analytical Linearization Method, Evaluation of Linearization Coefficients by Least-Squares Method, Local linearization, Feedback linearization, Input-state linearization, Input-output linearization, Internal dynamics, Zero dynamics, Model Reference Adaptive Control (MRAC). Sliding mode Control, sliding surfaces, continuous approximations of switching control laws, modeling performance trade off, tracking regulation via Integral control, Lyapunov redesign, non-linear damping, back stepping, and high gain observers. Back stepping algorithm.

References:

1. H.K. Khalil, Nonlinear Systems**,** (3e), PHI, 2002.
2. R. Marino and P. Tomei Nonlinear Control Design - Geometric, Adaptive and Robust, Prentice Hall, 1995.
3. J.J.E. Slotine and W.Li, Applied Nonlinear control, Prentice Hall, 1998.
4. Alberto Isidori, Non-linear Control Systems, Springer Verlag, 1999.
5. Zoran Vukic, Ljubomir Kuljaca, Nonlinear Control Systems, Marcel Dekker Inc., 2003.

ICE XXXX: DIGITAL CONTROL SYSTEMS [3 0 0 3]

Sampling, Data acquisition, Quantization, sample and hold, zero order hold, frequency domain consideration in sampling and reconstruction, Difference equations, pulse transfer function, Block diagram analysis of sample data systems, time response of discrete time control systems, Steady State error analysis, Stability, Jury's stability test, bilinear transformation, Root locus technique, W transformation, Bode Plot. Nyquist Stability analysis, Design of Lag, Lead, Lag-lead compensator using root locus and Bode plot, Design of PID controller, Lyapunov Stability Analysis, State Space Analysis, Diagonalization, Solution of state equations, Controllability, Observability, Representation of the system in different canonical forms, Pole Placement-Ackermann's Formula, Dead beat Algorithm.

References:

1. K. Ogata, Discrete time control systems, PHI, (7e), 2011.
2. M. Gopal, Digital control and state variable methods, TMH, 2001.
3. C.H Houpis and G.B Lamont, Digital Control Systems – Theory and Hardware, MGH, 1992.
4. G.F.Franklin, J.David Powell, M. L.Workman, Digital Control of Dynamic Systems, A-Wesley Publishing Company, (2e), 1990.
5. V. I. George and C.P. Kurian, Digital Control Systems, Cengage publishers, 2012.

ICE XXXX: SYSTEM IDENTIFICATION [3 0 0 3]

Introduction to system modeling, Types of system models, Importance of system models, Model development techniques – first principle based and data driven based, Introduction to System Identification, Procedure for identification, Concept of Identifiability, Signal to Noise Ratio, Overfitting, LTI System Modeling using time and frequency, Direct impulse response identification, Direct step response identification, Impulse response Identification using step response, Empirical Transfer function Identification, Correlation Methods, Linear Regression, Least Square Estimation, Equation Error Models – ARX Models, ARMAX Models, ARIMAX Models, OE Models, Box Jenkins Model, Model Validation Techniques.

References:

1. L. Ljung, System Identification: Theory for the User, Prentice Hall, 1992.
2. Arun. K. Tangirala, Principles of System Identification Theory and Practice, CRC Press, 2016.
3. Karel. J. Keesman, System Identification – An Introduction, Springer, 2011.
4. Philip D. Cha, Fundamentals of Modeling and Analyzing Engineering Systems, Cambridge, 2000.

Minor:II SENSOR TECHNOLOGY

ICE XXXX: BIOSENSORS AND BIOMEMS [3 0 0 3]

Bio-recognition elements: Whole cells, Enzymes, Antibodies, Nucleic Acids, Aptamers and Molecularly Imprinted Polymers. Nanostructured substrates for biosensing and integration of the bio-recognition elements on the substrates. Transduction Platforms: Electrochemical, Optical, Mass, Thermal, Hybrid and Lateral Flow Assays. Fundamentals of microfabrication, Lab on chip for biosensing applications and case studies.

References:

1. Mohamed Gad-el-Hak (R), MEMS handbook, CRC Press, 2002.
2. Anthony P.F.Turner, Isao Karube and George S. Wilson, Biosensors: fundamentals and applications, Oxford University Press, 1987.
3. A Sadana, Engineering biosensors: kinetics and design applications, Academic Press, 2002.
4. D Voet & JG Voet, Biochemistry, J Wiley & Sons, 1990.

ICE XXXX: AUTOMOTIVE SENSORS [3 0 0 3]

Automotive Management systems, Application areas of electronics in the automobiles, Possibilities and challenges in the automotive industry, Power train sensors, sensors for chassis management, Sensors for vehicle body management, Sensors for automotive vehicle convenience and security systems, Two wheeler and Four wheeler security systems, parking guide systems, anti-lock braking system, future safety technologies, Vehicle diagnostics and health monitoring, Safety and Reliability, Traction Control, Vehicle dynamics control, Air Bag and Seat Belt Pre tensioner Systems, Principal Sensor Functions, Passenger Convenience Systems, Electromechanical Seat, Seat Belt Height, Steering Wheel, and Mirror Adjustments, Central Locking Systems, Electromechanical Window Drives. Enabling Connectivity by Networking:-In vehicle communication standards (CAN & LIN), Telematic solutions, Portable or embedded connectivity- Endorsing Dependability in Drive-bywire systems - Terminology and concepts, Why by-wire, FLEXRAY, Requirements on cost and dependability, Drive-by-wire case studies- prototype development-future of In vehicle communication.

References:

1. Automotive Electrics, Automotive Electronics: Systems & Components, (5e), BOSCH, 2014.
2. Automotive Sensors Handbook, (8e), BOSCH, 2011.
3. Jiri Marek, Hans-Peter Trah, Yasutoshi Suzuki, Iwao Yokomori, Sensors for Automotive Technology, (4e), Wiley, New York, 2010.
4. John Turner, Automotive Sensors (1e), Momentum Press, New York, 2010.

ICE XXXX: MULTI SENSOR DATA FUSION [3 0 0 3]

Concept of fusion, Role of fusion, comparison between sensor and data fusion, fusion types, I/O types, Sensor configuration, Architecture of fusion nodes, fusion topologies, Benefits of fusion. Fusion Architectures - Centralized Fusion, Distributed Fusion, Hybrid Fusion, Introduction to process of data fusion: Need for data refinement, Spatial alignment, Temporal alignment, Semantic and radiometric alignment, Concept and need for data association and decision making, data registration, data association techniques, Decision making techniques - Biological and puzzle solving types, Command and control, Evidence combination, Information requirement for decision making. Bayesian and Dempster–Shafer Fusion Methods - Bayesian Method, Bayesian Method for Fusion of Data from Two Sensors, Dempster–Shafer Method, Comparison of the Bayesian Inference Method and the Dempster–Shafer Method. JDL framework, Revised JDL, Dasarathy's model, Boyd model, Thompolus framework, Luo-Key framework, Pau's framework, Waterfall and omnibus framework, Distributed black box, Esteban framework. Introduction to data filters, Kalman filter, Baysien filter, extended information filter, estimation, Approximate agreement, Optimization filter, Distributed dynamic fusion, Dynamic data flow analysis

References:

1. David L. Hall, Mathematical Techniques in Multisensor Data Fusion, Artech House, 2004.

2. H B Mitchell, Data Fusion: Concepts and Ideas, Springer Publishers, 2012.
3. Multi Sensor Data Fusion with MATLAB, Jitendra R. Raol, CRC Press, 2009.
4. Sensor and Data Fusion, Lawrence A. Klein, (2e), SPIE Press, 2012.

ICE XXXX: SENSOR DESIGN [3 0 0 3]

Review of basic performance characteristics of sensors, Fractional order elements and electrochemical sensor design, Design and development of a dedicated sensor system: Requirement analysis; Definition of technical and functional requirements; Cost analysis; Development of a measurement system prototype using necessary tools, Practical realization of a sensor system; Planning and documenting. Factors Influencing Sensor-based System Design. Limited field trials and sensor calibrations. Case studies of novel sensor design. Multi-spectral sensor Concept of Operation (CONOPS) development, sensor requirements allocation and derived requirement development, Sensor Architecture development, hardware and software partitioning, functional and physical interface requirements and design, signal processing requirement definition, subcomponent performance modeling and testing, observable measurement definition, Key sensor design trade parameters, Multi-spectral sensor systems design methodology, Modern target tracking techniques. Design of sensor packaging, installation and wiring considerations based on hazard classifications. Safety considerations in sensor design and commissioning.

Reference:

1. Jacob Fraden - Handbook of Modern Sensors, Physics, Designs, and Applications, Springer, 2010.
2. T. Grandke, W. H. Ko, Sensors: Fundamentals, Volume 1, Wiley publisher, 1990.

Minor: III SYSTEMS ENGINEERING

ICE ** INTRODUCTION TO SYSTEMS ENGINEERING [3 0 0 3]**

Definitions and concepts of system-system science and systems engineering, life cycle stages, definitions of requirement, architecture, design. System analysis, interface management, system integration, system verification, system transition, system validation, system operation, system maintenance, system disposal. Project planning, project management and control, decision management, risk management, configuration management, quality assurance, acquisition/supply, tailoring processes and application. Introduction to system modeling and simulation, lean and agile systems engineering, specialty areas (interoperability/logistics/safety /reliability/maintainability/security/usability)

References:

1. Kossiakof, Alexander and William N. Sweet; Systems Engineering: Principles and Practice, Wiley, 2011.
2. INCOSE Systems Engineering handbook, (4e), Wiley, 2015.
3. System Engineering Book of Knowledge, V 2.6, www.sebokwiki.org, 2022.
4. National Aeronautics and Space Administration, NASA Systems Engineering Handbook, (Rev 1), 2007.
5. Faulconbridge, R. I. and Ryan, M. J, Systems Engineering Practice, Canberra: Argos Press, Revised Edition, 2018.
6. ISO/IEC/IEEE 1528-Systems and Software engineering- System life cycle processes, https://www.iso.org/standard/63711.html
7. Blanchard, Benjamin S., Wolter J Fabrycky Systems Engineering and Analysis, Pearson (5e), 2010.

ICE XXXX: SYSTEM ARCHITECTURE AND DESIGN [2 1 0 3]

Architecture definition, architecture view points, concept analysis, models and views of architecture (functional/behavioral/data/performance etc.) – Structure and behavior-Evaluating candidate architectures-System/subsystem analysis- tradeoff analysis- Architecture frameworks and standards-design progression-architecture domains (software/IT/ Manufacturing/social etc)-architecture heuristics- acquisition management-tailoring processes-industrial design-design for manufacturability-robustness design-patents and intellectual property.

References:

1. Rechtin, E., and M.W.Maier, The art of Systems Architecting, Boca Raton, FL: CRC Press, 2000.
2. Oliver, D. W., T. P. Kelliher, and J. G. Keegan, Jr., Engineering Complex Systems with Models and Objects, McGraw Hill, 1997.
3. Ulrich K. T and S D Eppinger Product Design and Development, 2ed, NY, McGraw Hill Inc, 2000.
4. ISO/IEC/IEEE 42010:2011-Systems and software engineering- Architecture and description, https://www.iso.org/standard/50508.html.
5. 1220-2005-IEEE standard for application and Management of the systems engineering process, https://standards.ieee.org/ieee/1220/3372/

ICE XXXX SYSML AND MBSE [2 0 2 3]

Introduction to MBSE-MBSE concepts- MBSE Ontology-Introduction to Object Process modelling OPM- Object process language-Overview of SysML-Block definition diagrams-Internal block diagrams-Use case diagrams-Activity diagrams-Sequence diagrams-State machine diagrams-Parametric diagrams-Requirements diagram-package diagrams-Operational analysis modeling-functional analysis modeling-logical architecture modeling-Physical architecture modeling-architecture frameworks-Case studies of MBSE-MBSE deployment-Introduction to Digital Twins.

References:

1. SysML distilled: A brief guide to the Systems modeling language. Lenny Deligatti-Addison Wesley Professional, (1e), 2013.
2. Jon Holt and Simon Perry, SysML for Systems Engineering- A model based approach. IET 2013.
3. Jean-Luc Voirin, Model based System and Architecture Engineering with the Arcadia Method (Implementation of Model Based System Engineering) ISTE Press, Elsevier, 2017.
4. Dov Dori, Model-Based Systems Engineering with OPM and SysML. Springer, 2016.

ICE XXXX SYSTEM VERIFICATION AND VALIDATION [3 0 0 3]

System verification-System validation-various approaches to system validation and verification-inspection/testing/analysis/demonstration-Generation of Test cases using the Markov Chain model-Writing verification/validation plans-introduction to formal methods-formal approaches to system validation/verification-focus on specialty areas(eg.. EMI/EMC)-test automation models (computation/timed automation)-simulation-model checking verification-verification validation activities prescribed in standards for safety critical systems (DO-178C/DO-254/APR4754)

References:

1. Engel, Avner, Verification, Validation and Testing of Engineered Systems, John Wiley & Sons, 2010.
2. Jean Francois Monin, Understanding Formal Methods, Springer, 2003.
3. Jean-Louis Boulanger (Editor), Industrial use of Formal Methods: Formal Verification, Wiley, 2012.

4. Eds. Alex Gorod, Leonie Hallo Vernon Ireland, Indra Gunawan, Evolving Toolbox for Complex Project Management, CRC press, Taylor and Francis Group, Auerbach, 2019.
5. McShea, R. E. Test and Evaluation of Aircraft Avionics and Weapon Systems, (2e), IET, 2010.

Minor IV Smart Transportation System

ICE **: Automotive Electronics [3 0 0 3]**

Introduction to Electronic systems in Automotives, Sensors and Actuators for body electronics, power train and chassis systems, Power train and chassis control domain, Engine management, Transmission control Battery- types and maintenance, Automotive Electronics, Sensors and Actuators, Basic sensor arrangement, Types of sensors, Electronic Fuel Injection and Ignition Systems, Digital engine control systems, Open loop and closed loop control systems.

References:

1. Bosch, Automotive Electrics and Automotive Electronics. System and components, Networking and Hybrid drive, (5e), Springer view 2014
2. Najamuz Zaman, Automotive Electronics Design Fundamental (1e), Springer 2015.
3. Hillier's, Fundamentals of Motor Vehicle Technology on Chassis and Body Electronics, (5e), Nelson Thrones, 2007.

ICE **: In-vehicle Networking [3 0 0 3]**

Basics of Data Communication Networks and Automotive Communication Protocols, Need for networks, Types of networks, Need for standards, TCP/IP model, Topologies, Controller Area Network (CAN) Protocol, CAN Higher Layer Protocols and LIN, FlexRay and MOST Protocol, Process of Automotive Fault Diagnostics, Fault Codes, Vehicle Systems (open-loop and closed-loop) On- and Off- Board Diagnostics, OBD-I, OBD-II, Engine Analyzers, Steps taken to diagnose a fault, Diagnostics Protocol-KWP2000, SAE-J1587, SAE-J1708 and Case Study.

References:

1. Gilbert Held. Inter- and Intra-Vehicle Communications, CRC Press, (2007)
2. Behrouz Forouzan. Data Communications and Networking, McGraw-Hill. 2003
3. Ronald k. Jurgen. Automotive Electronics Handbook, McGraw-Hill. 1999

ICE **: Intelligent Transportation Systems [3 0 0 3]**

Fundamentals of ITS, Definition of ITS, the historical context of ITS from both public policy and market economic perspectives, Types of ITS; Historical Background, Benefits of ITS, Sensor technologies and Data requirements of ITS, ITS User Needs and Services and Functional areas, ITS Architecture, Regional and Project ITS architecture; Concept of operations; ITS Models and Evaluation Methods, ITS applications, Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.

References:

1. Mashrur A. Chowdhury, Adel Wadid Sadek, Fundamentals of intelligent transportation systems planning, ARTECH House, 2013.
2. Lawrence A. Klein, Sensor technologies and Data requirements of ITS, Artech House, 2011.

ICE **: Advanced Driver Assistance Systems [3 0 0 3]**

Advanced driver assistance system, human factors of automated driving systems, human factor of vehicle automation, legal issue surrounding cyber security and privacy on automated vehicle, user perspective on autonomous driving systems, ADAS technology A review on challenges, legal risk mitigation and solutions, localization and mapping for autonomous driving, open pit mine autonomous bot.

References:

1. Chapmann and Hall, Autonomous driving and advanced driver assistance system (ADAS), CRC Press, 2021

2. Dietmar P.F. Möller, Roland E. Haas, Guide to Automotive Connectivity and Cybersecurity: Trends, Technologies, 2017

V. Minor Computational Intelligence

VI. Minor Business Management

VII. Minor VLSI Design

VIII. Minor Electric Mobility

PROGRAM ELECTIVES

ICE XXXX: NEURAL NETWORK AND FUZZY LOGIC [3 0 0 3]

Introduction, ANN, BNN and difference between ANN and BNN, McCulloch–Pitts model, Activation functions, Feedforward and feedback networks, Learning rules, Supervised Learning network, Multi-layer Feedforward Networks, Back propagation network, Unsupervised Learning network, Maxnet, Mexican Hat net, Kohonen self-organizing feature map, Vector quantization, Fuzzy sets, Membership functions, Fuzzification, Defuzzification methods, Fuzzy rule base and approximate reasoning, Fuzzy inference systems, Fuzzy logic control system, Applications.

References:

1. Laurence Fausett, Fundamentals of Neural networks, Architecture, Algorithm and Applications, Pearson Education India, (1e), 2004.
2. Timothy J. Ross, Fuzzy logic with engineering applications, John Wiley & Sons, (4e), 2016.
3. S. N. Sivanandan, S. N. Deepa, Principles of soft computing, Wiley India, 2010.
4. B. Yegnanarayana, Artificial Neural Networks, PHI, 2004.

ICE XXXX: REAL TIME OPERATING SYSTEMS [3 0 0 3]

RTOS introduction, Essential features of an OS and batch processing, Process scheduling, scheduling queues, Types of schedulers, Multithreaded programming, Threading issues, scheduling criteria and algorithms, synchronization, classical problem of synchronization, deadlocks, methods for handling deadlocks, memory management strategies and virtual memory management.

References:

1. Abraham Silberschatz, Peter Galvvin, Grag Gagne, Operating System principles, John Wiley Publications, (7e), 2006.
2. Allan Burns, Andy Wellings, Real-Time Systems and Programming Languages, Addison Wesley, (3e), 2001.

3. Milan Milenkovic, Operating Stems Concepts and Design, McGraw Hill Education, (2e), 2001.
4. Maurice Bach, Design of Unix Operating System, Pearson, (1e), 1986.
5. Rajib Mall, Real Time Systems, Pearson Education, 2007.

ICE XXXX: DSP ARCHITECTURE AND APPLICATION [3 0 0 3]

Architectures for Programmable Digital Signal Processing Devises, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External Interfacing, Programmable Digital Signal Processors, Architecture of DSP processors, Data Addressing Modes, On-chip Peripherals, Interrupts, Pipeline Operation, Implementation of Basic DSP Algorithm, FIR Filters, IIR Filters, Interpolation and Decimation Filters, FFT Algorithm for DFT Computation, Bit-Reversed Index Generation, Signal Spectrum, Interfacing Peripherals to DSP Devices, External Bus Interfacing Signals. Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA), Synchronous Serial Interface, Multichannel Buffered Serial Port. Applications of DSP Processor.

References:

1. Avatar Singh and S. Srinivasan, Digital Signal Processing Implementations: Using DSP Microprocessors with Examples from TMS320C54xx, Thomson/Brooks/Cole, 2004.
2. B. Venkataramani, M. Bhaskar, Digital Signal Processors: Architecture, Programming and Applications, Tata McGraw-Hill Education, 2002.
3. Sen-Maw Kuo, Woon-Seng Gan Digital Signal Processors: Architectures, Implementations, and Applications, Pearson Prentice Hall, 2005.

ICE XXXX: ANALYTICAL AND OPTICAL INSTRUMENTATION [3 0 0 3]

Optical Instrumentation Systems, UV-Vis Spectroscopy, IR Spectroscopy, Chromatography and mass spectroscopy, Nuclear Magnetic Resonance, Electron Microscopy, Crystallography and elemental analysis, Case studies with sophisticated analytical instrumentation systems.

References:

1. Skooj, Holler, Crouch, Principles of Instrumental Analysis (7e), Cengage Learning India, 2018.
2. R S Kandpur, Handbook of Analytical Instruments, (2e), TMH, 2003.
3. Willard, Merritt, Dean and Settle, Instrumental Methods of Analysis, (7e), CBS Publishers, 1988.
4. J.Wilson & J F B Hawkes, Opto Electronics: An Introduction, (2e), PHI, 1993.

ICE XXXX: BIO-MEDICAL INSTRUMENTATION & EQUIPMENT [3 0 0 3]

Bioelectric Potential measurement: Cell structure, basic cell functions, origin of bio-potentials, electrical activity of cells, biological control concept, electrode-electrolyte interface, half-cell potential, polarizable and non-polarizable electrode, The Cardiovascular system: Structure of heart, rhythmicity, Electrocardiograph (ECG), ECG electrodes, vector cardiograph, ECG analysis, Central Nervous System and muscular system Receptors, sensory pathways and motor systems, processing sensory information, neural, neuromuscular, sensory muscular and sensory measurements, biofeedback, evoked response, Electroencephalography (EEG), Therapeutic equipment’s and life saving devices Blood flow meter, oximeter, cardiac output measurement, plethysmography, ultrasound therapy unit, nerve stimulators, Modern Imaging systems, Electrical safety.

References:

1. R.S. Khandpur, Handbook of Biomedical Instrumentation, McGraw Hill, (2e), 2008.

2. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, Biomedical Instrumentations and Measurements, Prentice Hall, (2e), 2012.
3. J.G. Webster, Medical instrumentation application & design, Wiley, (4e), 2009.
4. Joseph J. Carr & John. M. Brown, Introduction to Biomedical Equipment technology, Pearson education, (4e), 2003.
5. J.G. Webster, Encyclopedia of Medical Devices and Instrumentation, John Willey and Sons, 1988.

ICE XXXX: DATA STRUCTURES AND ALGORITHM [3 0 0 3]

Structure of C++ Program: Data Types. Basic, user-defined and derived, operators: assignment, arithmetic, relational, logical, increment/decrement, conditional, precedence of operators, manipulators, decision statements, programming control statements, Functions. Main Function, Function Prototyping, Call and return by reference, Inline functions, Default and constant arguments, Pointers, Classes, Inheritance, Linked List Data structure, Linked list traversal, insert function, remove function, Linked list with tail and doubly linked lists, Recursion, Trees, Stacks, Queues, Sorting and searching algorithms: Sorting, Searching, hashing, Radix sort.

References:

1. Nell Dale, C++ Plus Data Structures, Jones and Bartlett Publishers, (4e), 2010.
2. Maria Litvin, Gary Litvin, Programming with C++ and Data Structures, Vikas Publishing House Pvt. Ltd., 2001.
3. E Balagurusamy, Object-oriented Programming with C++, TMH, (2e), 2001.
4. Yashavant P Kanetkar, Let us C++, BPB Publications, 2003.

ICE XXXX: CYBER-PHYSICAL SYSTEMS [3 0 0 3]

Overview of cyber physical system, key features, Applications, The Design Process. CPS - Platform components, Synchronous Model, Asynchronous Model: Asynchronous Processes, Asynchronous Design Primitives, Asynchronous Coordination Protocols, Dynamical Systems, Timed Model and Real-Time Scheduling: Timed Processes, Hybrid systems: Hybrid Dynamical Models, Designing Hybrid Systems, Linear Hybrid Automata, Secure Deployment of CPS.

References:

1. Rajeev Alur, Principles of Cyber-Physical Systems, MIT Press, 2015.
2. Lee, Edward Ashford, Sanjit Arunkumar Seshia, Introduction to embedded systems: A cyber-physical systems approach, MIT Press, 2016.
3. Platzer, André. Foundations of Cyber-Physical Systems, Lecture Notes CMU, Carnegie Mellon University, Pittsburgh, PA, USA, 2014.

ICE XXXX: POWER ELECTRONICS [3 0 0 3]

Introduction to power electronics, SCR: device structure, characteristics and design, UJT trigger circuits, GTO, Power MOSFET, IGBT, single-phase half converters, single-phase full converters, semi-converters, three-phase half converters, three-phase full converters, dual converters, step-up choppers, step-down choppers, step up/down choppers, morgans' chopper, AC voltage converters, cyclo-converters, bridge inverters, three-phase inverters, series, and parallel inverters.

References:

1. M. H. Rashid, Power Electronics, PHI, (3e), 2005.
2. Ned Mohan, Undeland, Robbins, Power Electronics, John Wiley, (3e), 2002.

3. Bimbhra P.S, Power Electronics, Khanna Publication, (3e), 1999.
4. M. Ramamurthy, Thyristors and their Application, East-West Press, 1977.

ICE XXXX: ROBOTIC CONTROL SYSTEMS [3 0 0 3]

Robotic Systems: Components and Structures of Robots, Degrees of Freedom and Workspace, Rotation representation, Homogenous Transformations. Types of Joints, Kinematics of Manipulators, Differential transformation and Jacobian, Static force and torque, Trajectory Planning, Dynamics of Manipulators (Lagrangian and Newton-Euler methods), Feedback control of a single link manipulator, PID control of multi-link manipulator, Force control.

References:

1. Mark. W. Spong, Robotics Dynamics and Control, Wiley, (1e), 1989.
2. John. J. Craig, Introduction to robotics – Mechanics and Control, Pearson Education, (4e), 2017.
3. Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford Press, (1e), 2006.
4. S.K Saha, Introduction to Robotics, TMH, (1e), 2008.
5. D.K Pratihar, Fundamentals of Robotics, Narosa, (1e), 2017.

ICE XXXX: RELIABILITY AND SAFETY ENGINEERING [3 0 0 3]

Sampling distributions, Testing of hypotheses, Failure data, Failure modes, Hazard rates and failure density function, Hazard models and bath-tub curve, Reliability of systems, Redundancy, Fault Tree Analysis, Reliability improvement methods, Reliability Tests, Test - retest method, Split half method, Alternate or parallel forms Method, Rational Equivalence Method, Component reliability and MIL standards, Safety policy, Safety Organization, Measurement and prediction of human reliability and operator training, Safety margins in critical devices, Incident Recall Technique, Disaster control, Job Safety Analysis, Safety Audit.

References:

1. Govil, A.K., Reliability Engineering, TMH, 1983.
2. Sinha and Kale, Introduction to Life-Testing, Wiley Eastern, New Delhi, 1992.
3. Wisley, Human Engineering - Guide for Equipment Designers, University of California Press, 1973.
4. Hoang Pham, Handbook of Reliability Engineering, Springer, 2003.
5. Krishnan N.V, Safety Management in Industry, Jaico Publishing House, Bombay, 1997.

ICE XXXX: ROBUST CONTROL [3 0 0 3]

Issues in Control System Design, need for Robust control, Norms for signals and systems, Input- Output Relationships, Computing the Norm by State-Space Methods, Eigen values and singular values, Condition for Internal stability, sensitivity and complementary sensitivity function, Asymptotic tracking, Performance, Sources of Model Uncertainties, Plant Uncertainty Model, Small Gain Theorem, Robust Stability, Robust Performance, Trade-off between robust stability and robust performance, Existence of Stabilizing Controllers, Parameterization of All Stabilizing Controllers, Coprime Factorization. Loop shaping Controllers, Shaping S, T, or Q, P^{-1} Stable, P^{-1} Unstable, The Modified Problem, Spectral Factorization, Case Studies-Robust Control for Mass Damper Spring Systems, Spacecraft and Inverted Pendulum.

References:

1. Doyle, J.C., B.A. Francis and A. Tannenbaum, Feedback Control Theory, Macmillan publishing co., 1990.

2. Kemin Zhou, Doyle J.C and Glover K., Robust and Optimal Control, Prentice Hall Inc, 1995.
3. Willian A. Wolovich, Automatic Control Systems, Saunders college publishing, 1994.
4. Kemin Zhou and Doyle J.C, Essential of Robust Control", Prentice Hall Inc, 1998.

ICE XXXX: ELECTRONIC MEASUREMENT SYSTEMS [3 0 0 3]

Signal Conditioning, Instrumentation and isolation amplifiers, analog filters, analog switches. Signal measurement in the presence of noise: synchronous detection, signal averaging. Noise in electronic systems, Digital Time Measurement Techniques Parallel Port Buses: PC based DAS, Data loggers; PC based industrial process measurements like flow, temperature, pressure and level development system, CRT interface and controller with monochrome and colour video display. Transmission measurements.

Reference:

1. Derek Frederick Alfred Edwards, Electronic Measurement Techniques, Butterworths, 1971.
2. T. S. Rathore, Digital Measurement Techniques, CRC Press, 2003.
3. Nihal Kularatna, Digital and Analogue Instrumentation: Testing and Measurement, IET, 2003.

ICE XXXX: MACHINE LEARNING FOR CONTROL SYSTEMS [3 0 0 3]

Machine learning fundamentals - Support Vector Machines, Kernel methods–Clustering, Principal Component Analysis, Singular Value Decomposition, Independent Component - Analysis semi supervised learning – Reinforcement Learning-Applications to Control Problems: State estimation using neuro observer- Kalman Filter and reinforcement learning - Identification of non-linear dynamical systems using neural networks - Reinforcement learning Modelling - Optimal control problems using support vector machines, regression methods, Monte-Carlo method - Model Predictive Control and Adaptive reinforcement learning - Robust control using differential neural networks - Path planning using dynamic neural networks, density based machine learning techniques - Adaptive control using self-organizing map or RBF networks -Trajectory tracking using dynamic (recurrent) neural networks.

References:

1. Frank Leroy Lewis, Suresh Jagannathan, A. Yeşildirek, Neural Network Control of Robot Manipulators and Non-Linear Systems, Taylor and Francis group, 1999.
2. Frank L. Lewis, Derong Liu, Reinforcement Learning and Approximate Dynamic Programming for Feedback Control, Wiley and IEEE press, 2013.
3. Zi-Xing Cai, Intelligent Control: Principles, Techniques and Applications World Scientific, 1997.
4. Bishop, C. M., Pattern Recognition and Machine Learning, Springer, 2006.
5. Alexander S. Poznyak, Edgar N. Sanchez, Wen Yu, Differential Neural Networks for Robust Nonlinear Control Identification, State Estimation and Trajectory tracking, World Scientific, 2001.
6. Alex Smola, S.V.N. Vishwanathan, Introduction to Machine Learning, Cambridge University Press, 2010.
7. Simon Haykins, Neural Networks and Learning Machines, Prentice Hall, 2009.

ICE ** ADVANCED SENSOR TECHNOLOGY [3 0 0 3]**

Features of Advanced sensing techniques, Sensor classifications according to the energy domains, Introduction of advanced sensing materials, Properties (physical, electrical, chemical, and biological) of materials which make it suitable for sensing in different domain. Review of sensors for measurement of temperature, level, pressure and flow. Design and commissioning considerations of such sensors. Optical Sensors: Sources and detectors in optical systems. Aerospace Sensor: Accelerometers: Capacitive, Piezoelectric, Piezoresistive, Thermal, Chemical sensor.

References:

1. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, Springer, 2010.
2. P Ripka, A Tipek, Modern Sensors Handbook, Wiley Publication, 2007.
3. Sabaree Soloman, Sensors Hand Book, MGH, 1998

OPEN ELECTIVES

ICE XXXX: FEEDBACK CONTROL THEORY [3 0 0 3]

Feedback control systems, Mathematical modeling, Derivation of transfer functions for electrical networks, Mechanical systems, Signal flow graph, Masons gain formula, State variable representation of linear systems, Solution of state equations, Time domain specifications for second order systems, Steady state errors of unity feedback systems, Definitions of stability, Routh Hurwitz criterion, Frequency response - gain margin, phase margin.

References:

1. Nagrath and Gopal, Control Systems Engineering, New age international Limited, (2e), 1984.
2. Norman S. Nise, Control Systems Engineering, (5e), Wiley India, 2009.
3. R.C Dorf and R.H Bishop, Modern Control Systems, (11e), Addison- Wesley Longman Inc., 2013.

ICE XXXX: INDUSTRIAL AUTOMATION [3 0 0 3]

Evolution of PLC, PLC Vs PC, Architecture of PLC - I/O Modules, CPU, Program Memory, Process Image Tables, Bus System and Power Supply, Sequential Flow Chart technique for programming style, Programming a PLC, Timers & Counters, Special Instructions, Levels of Industrial control, Networking, Buts Networks, Protocols., SCADA & DCS, Profibus, Modbus, SMART devices.

References:

1. John W.Webb and Ronald A.Reis, Programmable Logic Controllers – Principles and Applications, (5e), PHI, 2003.
2. W. Bolton, Programmable Logic Controllers, 94e), Newnes Publications, 2006.
3. Frank D. Petruzella, Programmable Logic Controllers, MGH, 1989.

ICE XXXX: INDUSTRIAL INSTRUMENTATION [3 0 0 3]

Measurement System, Classification of transducers, Temperature and Pressure measurement, Level and Thickness measurement, Flow measurement-Variable head type, variable area type, Mass flowmeters, Measurement of Thermal conductivity, velocity, acceleration, pH and Force, Semiconductor sensors, Optical sensors.

References:

1. E.O. Doeblin, Measurement Systems: Application and Design, McGraw Hill, (5e), 2004.
2. Patranabis D, Principles of Industrial Instrumentation, TMH, (3e), 2005.
3. A.K. Sawhney, A course in Mechanical Measurement and Instrumentation, (7e), Dhanpat Rai and Co, 2002.

ICE XXXX: SENSOR TECHNOLOGY [3 0 0 3]

Basic sensor technology, characteristics, Capacitive and Inductive Sensors, Displacement Sensors, Temperature Sensors, Force/Torque Sensors, Humidity and Moisture Sensors, Acoustic Sensors, Flow Sensors, Occupancy-Motion Detectors, Acceleration and Vibration Sensors, Chemical and Biosensors, Optical and radiations Sensors, Introduction to Wireless Sensor Networks (WSN) and Applications.

References:

1. Jon S Wilson, Sensor Technology Handbook, Newnes Elsevier Publication, 2005.
2. Jacob Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, Springer, 2004.

ICE XXXX: SMART SENSOR [3 0 0 3]

MCUs and DSPs, integrated signal conditioning, IEEE1451 standards, Plug and play, Sensor Communication, Wireless zone sensing, Surface acoustical wave devices, Intelligent transportation system, RF-ID, RF MEMS basics, Micro optics, Micro grippers, Microprobes, Micro mirrors, FEDs, Centralized and decentralized measurement chains, Intelligent sensors, Nano sensors, Biosensors

References:

1. Randy Frank, Understanding Smart Sensors, (2e), Artech House Publications, 2000.
2. Paul W. Chapman, Smart Sensors, ISA Press, 1996.
3. Krzystof Iniewski, Smart Sensors for Industrial Applications, CRC Press, 2013.

ICE XXXX: VIRTUAL INSTRUMENTATION [3 0 0 3]

Architecture of a virtual instrument, Virtual instruments V/s Traditional instruments, Advantages of VI, Graphical programming, Creating Virtual Instruments using LabVIEW- Loops, Arrays, Clusters, String and file I/O, Graphs, Data Acquisition, Common Instrument Interfaces, Current loop, System buses, Interface buses, VISA, Image acquisition and processing, Design of ON/OFF controller for a mathematically described processes using VI software

References:

1. Gary Johnson, LabVIEW Graphical Programming, (2e), MGH, 1997.
2. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, National Instruments, 1997.
3. S. Sumathi, P Surekha, LabVIEW based Advanced Instrumentation systems, Springer, 2007.
4. Rick Bitter, Taqi Mohiuddin, Matt Nawrocki, LabVIEW Advanced Programming Techniques, CRC Press, 2007.
5. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI, 2010.

ICE XXXX: FARM AUTOMATION [3 0 0 3]

Farm mechanization, sources of farm power, renewable energy sources, IC engines, tillage, sowing, plant protection, intercultural operations, harvesting, threshing, biomass management techniques. Watershed concept and theory, soil erosion, measures, hydrological cycle, irrigation methods, devices, Water conveyance systems, Water harvesting, aquifer and its types, interaction of water resources with the changing environment. Engineering properties of biological materials, heat and mass transfer, devices for cleaning, grading, milling and storage of farm produce. Drying and dehydration, function and features of green house. Resource conservation management, precision farming, automated irrigation scheduling, variable rate seed and chemical applicators, robotics, Rainfall-runoff prediction models, watershed modeling, climate change impact analysis on bio-resources, drying characteristics, storage or process kinetics, simulation and modeling in tillage implements.

References :

1. Jagdshwar Sahay, Elements of Agricultural Engineering, (4e), Standard Publishers Distributors, 2006
2. A. M. Michael & T. P. Ojha, Principles of Agricultural Engineering, Vol I & II., (10e), Jain Brothers, 2018
3. K M Sahay, K. K. Singh, Unit operations of Agricultural Processing, (2e),Vikas Publishing House Pvt Ltd, 2004.
4. Qin Zhang, Francis J. Pierce, Agricultural Automation Fundamental and Practices, CRS Press, Taylor and Francis group, 2013.
5. Darwin Caldwell, Robotics & Automation in the food Industries (Current & Future Technologies), Wood Head Publishing Ltd, Oxford, 2012.
5. A. M. Chandra, S. K. Ghosh, Remote Sensing and Geographical Information System, Alpha Science, 2006