SYLLABUS

FOR

VII and VIII semester B.E.

2024 - 2025

Sree Siddaganga Education Society®

Siddaganga Institute of Technology

(An Autonomous Institution affiliated to V.T.U., Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A++' Grade and ISO 9001:2015 Certified)

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Siddaganga Institute of Technology, Tumkur-572103
Department of Electronics & Instrumentation Engineering

Vision of the Institute

To develop thoughtful and creative young minds in a learning environment of high academic ambience by synergizing spiritual values and technological competence.

Mission of the Institute

1. To continuously strive for the total development of students by educating them in state-of-the-art-technologies and managerial competencies providing best in class learning experience with emphasis on skills, values and learning outcomes and helping them imbibe professional ethics and societal commitment.

2. To create a research ambience that promotes interdisciplinary research catering to the needs of industry and society.

3. To collaborate with premier academic and research institutions and industries to strengthen multidisciplinary education, applied research, innovation, entrepreneurship and consulting ecosystems.

Quality Policy

Siddaganga Institute of Technology is Committed to:

1. Impart Quality Education by establishing effective learning - teaching - learning processes to produce competent engineers and managers with high professional ethics and societal responsibility.
2. Create congenial environment and provide state-of the-art infrastructure.
3. Continually improve the effectiveness of the Quality Management System.
4. Satisfy applicable requirements.

Vision of the Department

To become a premier Electronics and Instrumentation Engineering Department by imparting quality education in the fields of electronics, instrumentation and cutting edge technologies developing competence to meet industrial norms and to pursue research and innovation contributing to socioeconomic development.

Mission of the Department

1. Develop competent professionals by offering industry aligned curriculum in Electronics, Instrumentation and VLSI and embedded systems along with an exposure to cutting edge technologies by providing best in class learning, promoting interdisciplinary research and innovation catering to industrial and societal needs.
2. Encourage and prepare students for higher studies to promote lifelong learning.

3. Imbibe professional ethics and skills in students to provide engineering service to the society.
4. Collaborate with industries to inculcate industry readiness, creativity, managerial competence, experiential learning and entrepreneurship skills.

Program Educational Objectives (PEOs)

Graduates of the Electronics and Instrumentation Programme

PEO 1: Contribute effectively in industry and excel in higher education by applying the knowledge of Science, Technology, Engineering and Math (STEM) principles.

PEO 2: Engage in lifelong learning by adapting emerging technologies, and excel in research pursuits and entrepreneur to meet the global challenges.

PEO 3: Exhibit professional skills, communication skills, team work and leadership qualities imbibing ethical values in their profession for the benefit of society.

Programme Outcomes (PO):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modeling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modeling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

Programme specific Outcomes (PSO):

Student will be able to

PSO1: Apply the technical knowledge of measurement techniques, instrumentation, control, communications and the state - of - the art technologies in process, healthcare and related domains.

PSO2: Apply the knowledge of Signal Processing, Electronic Circuits and Programming Skills to design embedded systems for real time applications.

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B.E. in Electronics and Instrumentation Engineering

SCHEME OF TEACHING AND EXAMINATION FOR THE AY 2024-25 NEP1

VII and VIII Semester

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching hours per semester				Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	SDA/SSC/ TW	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
VII Semester													
1.	HSMC	NSH06	Management and Entrepreneurship	ME, IM, MBA	42	0	0	48	3	50	50	100	3
2.	PEC	N7EIPE2x	Professional Elective Course-II	EIE	42	0	0	48	3	50	50	100	3
3.	PEC	N7EIPE3x	Professional Elective Course-III	EIE	42	0	0	48	3	50	50	100	3
4.	OEC	N7EIOE0x	Open Elective Course-II		42	0	0	48	3	50	50	100	3
5.	AEC	NSH09	Research Methodology and IPR		28	0	0	32	3	50	50	100	2
6.	Project	N7EIP1	Project Work	EIE	Monday to Thursday shall be earmarked for carrying out Project work (22 Hours)				3	100	100	200	10
			Total		**196**	**0**	**0**	**224**	**18**	**350**	**350**	**700**	**24**
		AAP	AICTE Activity Points	40 hours community service to be documented and produced for the examination									
VIII Semester													
1.	Seminar	N8EITS	Technical Seminar	EIE	One contact hour /week for interaction between the faculty and students. (2.5 hours)				-	100	--	100	1
2.	Internship	N8CCA01	**INTERNSHIP – III** (Research/Industry Internship)		Two contact hours /week for interaction between the faculty and students. (33 Hours)				-	100	100	200	15
3.	NCMC	NMC01	National Service Scheme (NSS)	NSS	Completed during III semester to VIII semester.				-	50	50	100	0
		NMC02	Physical Education (PE) (Sports and Athletics)	PE									
		NMC03	Yoga	Yoga									
		NMC04	National Cadet Corps (NCC)	NCC									
			Total							**250**	**150**	**400**	**16**
		AAP	AICTE Activity Points							**100**	---	**100**	**0**

Professional Elective -II		Professional Elective - III	
N7EIPE21	Thin Film Instrumentation	N7EIPE31	Micro-electromechanical Systems - MEMS
N7EIPE22	AI for Biomedical Applications	N7EIPE32	Aircraft Instrumentation
N7EIPE23	Instrumentation for Agriculture and Food processing industries.	N7EIPE33	Artificial Neural Networks and Fuzzy Logic
N7EIPE24	RISC-V Processor Design	N7EIPE34	VLSI Process Technology

7th Semester

MANAGEMENT AND ENTREPRENEURSHIP

Contact Hours/ Week:	3+0+0 (L+T+P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	NSH06
Course Type:	Theory (HSMC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Understand the principles and functions of management through planning.
2.	Analyze the importance of organizing and staffing in an organization
3.	Analyze the importance of leading and controlling in an organization
4.	Inculcate entrepreneurial qualities and understand the need of rural entrepreneurship
5.	Acquire knowledge about funding agencies, understand procedure in applying for funds and analyze the cases of successful entrepreneurs

UNIT I

Introduction to Management: Definition of management, management skills, productivity and effectiveness, efficiency, functions and principles of management.
Planning: Nature of planning, types of plans- purpose of vision, mission, goals, objectives strategies, policies; steps in planning, MBO, Strategic planning.

8 Hours

UNIT II

Organizing: Formal and informal organization, span of management, the structure and Process of organizing, Organizational structure: line and staff organization, Functional organization, matrix organization.
Staffing: Definition, systems approach to HRM, factors affecting staffing, recruitment and selection, job design, skill and characteristics of a manager, selection process and techniques

9 Hours

UNIT III

Leading: Human factors in managing, motivation, Theory X and Y, the hierarchy of needs theory, leadership behavior and styles.

Controlling: Basic control process, critical control points and standards, Benchmarking requirements for effective control**.**

7 Hours

UNIT IV

Entrepreneur & Entrepreneurship: Introduction, concept of Entrepreneur, characteristics of an entrepreneur, and qualities of an entrepreneur, functions of an entrepreneur, characteristics of entrepreneurship, factors affecting entrepreneurial growth. Entrepreneurship and economic development-rural, woman and social entrepreneurship.

Financing and Institutional Support for Entrepreneurship: Startups, business plans, venture capitalists, angel investors, funding agencies -commercial banks, development banks, NBFCS and incubation
centres. Innovations and project trends.

12 Hours

UNIT V

Taxation benefits: Depreciation allowances, rehabilitation allowance, investment allowance and other tax concession benefits to an entrepreneur.

Case studies

1. Happily Bootstrapping: Zoho CEO Sridhar Vembu (2007)
2. Thought Leaders in Cloud Computing: Sridhar Vembu, CEO of Zoho (2016)
3. Building India's Amazon: Flipkart CEO Sachin Bansal
4. Rohith Bhat's Exhilarating Journey with Robosoft from Udupi, Karnataka

6 Hours

TEXT BOOKS		
1	Harold Koontz, Heinz Weihric	Essentials of Management, McGraw Hill Education, 10th Edition, 2015
2	Lucy C. Morse	Managing Engineering and Technology, Pearson Education, 6th Edition, 2015.
3	S.S. Khanka	Entrepreneurial Development, S. Chand Publishing, 4th Edition, Reprint, 2020, ISBN 978-81-219-1801-5

REFERENCE BOOKS		
1	James A.F. Stoner, R. Edward Freeman, Daniel R. Gilbert	Management, Pearson Education, 6th Edition, 2018

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Explain various functions of management (L2).
CO2	Apply the knowledge of management principles and strategies in various functional areas such as organizing and staffing. (L3).
CO3	Apply the knowledge of management principles and strategies in various functional areas such as Leading and Controlling. (L3).
CO4	Describe entrepreneurship, its characteristics, and benefits and identify various funding sources for starting a business venture (L3).
CO5	Explain various taxation benefits enjoyed by an entrepreneur and analyze the characteristics and strategies adopted by successful entrepreneurs. (L2 & L3)

Professional Elective Course - II

THIN FILM INSTRUMENTATION

Contact Hours/ Week:	3+0+0 (L-T-P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	N7EIPE21
Course Type:	Theory (PEC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Study the basics of vacuum technology
2.	Learn the operation of pumps to create vacuum in a chamber
3.	Understand the different techniques to measure vacuum level
4.	Learn thin film deposition and characterization techniques

UNIT I

Kinetic Theory of gasses and Vacuum Terminology: Ideal gas equations, Mean free path, Conduction of gas flow, Molecular flow, molecular velocity or speeds, Gas impingement on surfaces, Gas flow Regimes, adsorption, out gasing & throughput.

09 Hours

UNIT II

Rotary, Roots and sorption Pumps: Introduction, Rotary Vacuum pumps, Roots Pumps & Sorption pumps

High Vacuum Pumps: Principles, Selection of backing Pumps, Selection of vapor fluid, Diffusion pump fluids, Turbo molecular pumps, cryopumps, sputter ion pumps & integrated vapor pumps.

09 Hours

UNIT III

Measurement of Vacuum: Introduction, Different types of Vacuum gauges: Hydrostatic gauges, Thermal conductivity gauges, Ionization gauges, capacitance gauge and Spinning rotor gauge.

Leak Detection Techniques: Introduction, Leak rate & units, Rate Rise measurement, Leak Detector: Tesla Coil, Halogen leak Detector, Thermal Conductivity gauge, Helium leak detector.

08 Hours

UNIT IV
Thin Film Deposition Techniques : Introduction, classification of thin film deposition techniques, Physical vapor Deposition (PVD): Introduction, Resistive Evaporation, flash Evaporation, E-beam Evaporation, Sputter deposition- DC diode bias, Triode, Magnetron, RF sputtering, Chemical Deposition Methods: Introduction, overview and history-Electro deposition (Electrolytic, Electroless, Anodization), Chemical Vapor deposition: Plasma CVD, AP-CVD and LP-CVD.
08 Hours

UNIT V
Thin film Characterization: Overview of thin film characterization, Imaging techniques: Scanning electron microscopy (SEM), AFM, Structural properties: X-ray diffraction (XRD), Electrical properties: Resistance/resistivity – four point probe, Vander Pauw, Mechanical properties: Stress-curvature measurements.
08 Hours

Text Books:		
1	John A. Venables	Introduction to Surface and Thin Films Processes, Cambridge University Press, 2000.

REFERENCE BOOKS		
1	M. Ohring	Materials Science of Thin Films: Deposition and Structure, 2nd Edition, Academic Press, 2002.
2	Leon I. Maissel and Reinhard Glang.	Handbook of Thin Film Technology, McGraw-Hill Publishing Company, New Delhi (1970)

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Apply basic kinetics theory principles for the analysis of gas dynamics
CO2	Describe the operation of pumps required for creation of vacuum
CO3	Explain the operation of gauges for vacuum measurement
CO4	Analyze and select appropriate techniques for deposition of thin films
CO5	Analyze the material properties of thin films using characterization techniques

AI FOR BIOMEDICAL APPLICATIONS

Contact Hours/ Week:	3+0+0 (L-T-P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	N7EIPE22
Course Type:	Theory (PEC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Understand scope of AI in medicine and healthcare applications.
2.	Learn mathematical models for Computer-Assisted Decision Making.
3.	Learn Reasoning Methodologies in biomedical expert systems.
4.	Study Supervised and Unsupervised Learning algorithms for biomedical applications.
5.	Understand scope and use of AI in Personalized Healthcare and treatment planning.

UNIT I

Introduction: Artificial Intelligence in Medicine, Definition and scope of AI in healthcare, Historical perspective and milestones in AI research, Applications of AI in clinical practice and biomedical research. AI in Diagnostics and Disease Prediction, Predictive modeling for disease risk assessment, Diagnostic decision support systems, Early detection of diseases using AI algorithms.

9 Hours

UNIT II

AI- Foundations of Computer-Assisted Decision Making: Mathematical Modeling and Simulation, Pattern Recognition, Bayesian Analysis, Decision Theory, Symbolic Reasoning Techniques. Knowledge Representation: Production Rules- Introduction, Frames, Databases, Knowledge Acquisition: Introduction, Learned Knowledge, Meta-Knowledge.

9 Hours

UNIT III
Reasoning Methodologies: Introduction, problem representations, blind searching, ordered search, AND/OR trees, searching game trees, searching graphs, rule base searching, higher-level reasoning methodologies, cognitive models, automatic deduction, examples in biomedical expert systems.
8 Hours

UNIT IV
Supervised Learning: Decision Surfaces, Two-Category Separation, Linearly Separable Sets, Nonlinearly Separable Sets, Unsupervised Learning- Clustering, Kohonen Networks and Competitive Learning, Hebbian Learning, Biomedical Applications, Diagnosis of CAD as a Clustering Problem, Other Biomedical Applications.
8 Hours

UNIT V
AI in Personalized Medicine and Treatment Planning: Pharmacogenomics and precision medicine, Treatment recommendation systems, Drug discovery and repurposing using AI approaches. Natural Language Processing (NLP) in Healthcare, Text mining and information extraction from clinical notes, Clinical language understanding and medical coding, Applications of NLP in electronic health records (EHR) analysis and clinical documentation.
8 Hours

TEXT BOOKS		
1	Mesko B	A guide to artificial intelligence in healthcare: The Medical Futurist, Wiley-IEEE Press, 2017
2	Donna L. Hudson, Maurice E. Cohen	Neural Networks and Artificial Intelligence For Biomedical Engineering, IEEE Press Series in Biomedical Engineering, 1999.

REFERENCE BOOKS		
1	B Yegnanarayana	Artificial Neural Networks, PHI, 2001
2	Jacek M Zurada	Introduction To Artificial Neural Systems, Jaico publishing, 6th Edition, 2007

Course Outcomes: Upon completion of this course, the student will be able to:	
CO1	Describe the applications of AI in clinical practice and biomedical research.
CO2	Develop a mathematical models for Computer-Assisted Decision Making systems.
CO3	Analyze and apply reasoning methodologies to solve problems in biomedical expert systems.
CO4	Analyze and apply Machine learning algorithms to develop computer aided diagnosis.
CO5	Apply AI approaches to analyze and create electronic health records (EHR) and clinical documentation.

INSTRUMENTATION FOR AGRICULTURE AND FOOD PROCESSING INDUSTRIES

Contact Hours/Week:	3+0+0 (L-T-P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	N7EIPE23
Course Type:	Theory (PEC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Study various sensors required for soil testing
2.	Learn instrumentation for green house monitoring
3.	Learn Instrumentation techniques for Food processing and quality analysis

UNIT I

Introduction: Necessity of instrumentation and control for food processing and agriculture sensor requirement, remote sensing, biosensors in Agriculture, standards for food quality.
Soil science and sensors: pH, conductivity, resistivity, temperature, soil moisture and salinity, ion concentration, measurements, methods of soil analysis. Instrumentation for environmental conditioning of seed germination and growth.

9 Hours

UNIT II

Green houses and Instrumentation: Ventilation, cooling and heating wind speed, temperature and humidity, rain gauge, carbon dioxide enrichment measurement and control. Leaf area, length, evapo-transpiration, temperature, wetness and respiration measurement and data logging. Electromagnetic, radiation, photosynthesis, infrared and CV, bio sensor methods in agriculture. Agro meteorological instrumentation weather stations.

9 Hours

UNIT III
Food Processing: Flow diagram of sugar plant, sensors and instrumentation set-up, Flow diagram of fermenter and control (Batch process), Oil extraction plant and instrumentation set-up, Pesticides manufacturing process and control, Flow diagram of Diary and confectionary industry and instrumentation set-up and Juice extraction control set-up.
8 Hours

UNIT IV
Instrumentation for food quality assurance: Instrumental measurements and sensory parameters. Inline measurement for the control of food processing operations: color measurements of food, food composition analysis using infrared, microwave measurements of product variables, pressure and temperature measurement in food process control, level and flow measurement in food process control, ultrasonic instrumentation in the food industry. Instrumental techniques in the quality control, Food Safety and Standard Authority of India (FSSAI) specifications.
8 Hours

UNIT V
Food Industry instrumentation: Instrumentation in Brewing, Level control, Temperature and pressure monitoring in Canning industry, principle of roasting, roasting equipment. Pasteurization: purpose, microorganisms and their reaction to temperature and other influences. Methods of heating, design and mode of operation of heating equipment, plate heat exchanger in Baking industry. Application of SCADA and PLC in the packaging industry.
8 Hours

TEXT BOOKS		
1	Erika Kress-Rogers, Christopher J.B. Brimelow	Instrumentation and Sensors for the Food Industry, Woodhead Publishing, 2001
2	Manabendra Bhuyan	Measurement and control in food processing, CRC/Taylor & Francis Publications, 2007
3	Singh and Sahay	Agricultural Process Engineering, Vikas Publishing House, New Delhi.2014.

REFERENCE BOOKS		
1	Desrosier N.W	Technology of food preservation, CBS Publisher and Distributor, New Delhi, 4th Edition, 2016.
2	P.J. Fellows	Food Processing Technology, Principles and Practice, Woodhead Publishing, 3rd Edition, 2009
3	Semioh Otles	Methods of analysis of food components and additives, CRC Press, Taylor and Francis group, 2nd Edition, 2012

Course Outcomes:
Upon completion of this course the student will be able to:

CO1	Describe the necessity of instrumentation in agriculture and food processing and identify a suitable sensor to measure soil parameters.
CO2	Analyze various parameters to be controlled in Green house monitoring.
CO3	Analyze and develop flow diagrams for food processing techniques.
CO4	Describe the quality standards and instrumentation for food processing.
CO5	Describe instrumentation and control techniques for food processing applications.

RISC-V Processor Design

Contact Hours/ Week:	3+0+0 (L-T-P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	N7EIPE24
Course Type:	Theory (PEC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Understand the architecture of RV32I
2.	Learn the Instructions and programming of RISC-V
3.	Learn the Micro-architecture design for single and Multi-cycle processor.
4.	Learn the Single cycle RISC-V processor design.
5.	Learn the Pipelined processor data-path and control design.

UNIT I

Introduction: Evolution of the RISC-V Architecture, RISC-V Base Instruction Sets and Extensions. Comparison of RISC-V, MIPS, ARM and x86 Architectures, Programmers model for RV32I, Operation and addressing modes of Data Processing instructions, Control transfer instructions, Conditional branches, Assembly level programming examples.

9 Hours

UNIT II

RISC-V Instructions and programming: Data Transfer Instructions, Control and Status Register Instructions, Pseudo Instructions, Assembler directives, RISC-V Machine level instruction formats: Base Instruction formats for R, I, S/B, U/J type instructions, immediate encodings. RISC-V memory map, Compiling, Assembling, Linking and Loading RISC-V programs, Exception handlers. Assembly level programming examples.

9 Hours

UNIT III
RISC-V Microarchitecture design: Architectural state and Instruction set, Design process, Performance analysis, Single cycle processor design: Single cycle data-path and control. Multi-cycle processor design: Multicycle data-path and control.
8 Hours

UNIT IV
Single cycle RISC-V processor Design and representation using Verilog HDL: Controller, Main decoder, ALU decoder, Resettable flip-flop with enable, Data path, Extend unit, Multiplexers, Test bench, Top level module, Instruction memory and data memory.
8 Hours

UNIT V
Pipelined RISC-V processor Design: Pipelined processor design, Pipelined processor data-path and control. Hazards, Branch predictions, Superscalar processors, out-of-order processors, register renaming, Multithreading, Multiprocessors.
8 Hours

TEXT BOOKS		
1	Sarah L Harris David Money Harris	Digital Design and Computer Architecture RISC-V Edition, Morgan Kaufmann Publishers, 2022.
2	David Patterson, Andrew Waterman	RISC-V Reader: An Open Architecture Atlas, Strawberry Canyon, 1st Edition, 2017

REFERENCE BOOKS		
1	David A. Patterson John L. Hennessy	Computer Organization and Design: The Hardware/Software Interface RISC-V Edition, Morgan Kaufmann Publishers, 2020
2	Edson Borin	Introduction to Assembly programming with RISC-V, 1st Edition, 2021, ISBN:978-65-00-15811-3
3	Anthony J Dos Reis	RISC-V Assembly Language, 2019 ISBN-13 : 978-1088462003

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Develop Assembly level programs using the RISC-V processor.
CO2	Interpret Assembly level instructions of RISC-V into its Machine level code.
CO3	Design RISC-V Microarchitectures.
CO4	Develop Verilog HDL for different elements of RISC-V design.
CO5	Design pipelined RISC-V processor architecture.

Professional Elective III

MICRO-ELECTROMECHANICAL SYSTEMS - MEMS

Contact Hours/Week:	3+0+0 (L-T-P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE marks:	50
Total Practical Hours:	0	Course Code:	N7EIPE31
Course Type:	Theory (PEC)	Exam Hours:	3

Course objectives: This course will enable students to:	
1.	Study the fundamentals of MEMS and their applications in Industry
2.	Understand the importance and working of various Micro sensors and Micro actuators
3.	Study the Micro fabrication and packaging techniques

UNIT I
Introduction: MEMS and microsystems, typical MEMS and microsystems products, evolution of micro fabrication, microsystems and microelectronics. Multidisciplinary nature of microsystems design and manufacture, application of microsystems in automotive industry, and other industries.
09 Hours

UNIT II
Microsensors and Microactuators-I: introduction, micro sensors: acoustic wave sensors, biomedical sensors and biosensors, chemical sensors, optical sensors, pressure sensors, thermal sensors. Micro actuation: actuation using thermal forces, actuation using shape-memory alloys, actuation using piezoelectric crystals, actuation using electrostatic forces, MEMS with micro actuators, micro accelerators.
09 Hours

UNIT III
Microsensors and Microactuators-II: Scaling laws in miniaturization: introduction, scaling in geometry, scaling in rigid-body dynamics, scaling in electrostatic forces, scaling in fluid mechanics, scaling in heat transfer. Piezoresistive sensors, piezoresistive sensor materials, stress analysis of mechanical elements.
08 Hours

UNIT IV
Microfabrication Techniques: Introduction. Chemical vapor deposition (CVD): APCVD (Atmospheric-pressure CVD)-LPCVD (Low-pressure CVD)-PECVD (Plasma-enhanced CVD). Physical vapor deposition (PVD): Evaporative-Sputtering-Electron Beam PVD, oxidation, Ion implantation, Diffusion, Etching, Photolithography.
08 Hours

UNIT V
Microfabrication and Packaging: Micro Manufacturing - Bulk and Surface micromachining - LIGA. General considerations in packaging design, the three levels of microsystems packaging, Interfaces in microsystems packaging, essential packaging technologies, polymers in MEMS.
08 Hours

TEXT BOOK		
1	Tai Ran Hsu	"MEMS & Microsystems: Design and Manufacture" Tata McGraw Hill, New Delhi, 1st edition, 2017.

REFERENCE BOOKS		
1	Chang Liu	'Foundations of MEMS', Pearson Education Inc., 2nd edition, 2012.
2	M.Madou	"Fundamental of Microfabrication", CRC Press, 2nd edition, 2002
3	Stephen D Senturia	'Microsystem Design', Springer Publication, 2nd edition, 2004.
4	Ai Qun Liu	"RF MEMS Switches and Integrated Switching Circuits", Springer publication, 2012.

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Describe the fundamentals of Micro Electro Mechanical System (MEMS).
CO2	Describe the microsensors and microactuators for engineering applications.
CO3	Identify and explain the various scaling laws for the miniaturization
CO4	Analyze the different types of MEMS fabrication process.
CO5	Select and describe an appropriate packaging technique for microsystems.

AIRCRAFT INSTRUMENTATION

Contact Hours/ Week:	3+0+0 (L-T-P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE marks:	50
Total Practical Hours:	0	Course Code:	N7EIPE32
Course Type:	Theory (PEC)	Exam Hours:	3

Course objectives: This course will enable students to:	
1.	Learn various measuring and display instruments used in Aircraft
2.	Study working principles of gyroscopes and fuel quantity indicating system
3.	Study Engine power and control instruments of an Aircraft

UNIT I
Aircraft instruments: Introduction, instrument grouping, instrument display, quantitative and qualitative displays, director displays, cockpit layout, standard atmosphere, basic air data system, pitot static probe, heating circuit arrangements.
9 Hours

UNIT II
Air data instruments: Air speed indicator, square law characteristics, match/air speed indicator, altimeters, effects of atmospheric temperatures, vertical air speed indicators, air temperature indicator, air data alternating system, match warning system, altitude alert system.
9 Hours

UNIT III
Gyroscopic flight instruments: Gyroscope and its properties, determining direction of precession, limitations of gyroscopes, operating gyroscopic instruments, gyro horizons, erection systems for gyro horizons, errors due to acceleration and turning, direction indicator, turn and bank indicator.
8 Hours

UNIT IV
Fuel quantity indicating systems: Capacitance type system, indicating system, effects of fuel temperature changes, measurement of fuel quantity by weight, construction of probes, and location of probes.
8 Hours

UNIT V
Engine power and control instruments: RPM measurement, generator and indicating system, tacho probe and indicator system, torque monitoring, exhaust gas temperature, engine pressure ratio measurement, fuel flow measurement, integrated flow meter system.
8 Hours

TEXT BOOK		
1	EHJ Pallet Longman.	Aircraft Instruments, Pearson, 2nd Edition, 2009

REFERENCE BOOKS		
1	S Nagabhushan	Aircraft Instrumentation and System, IK International, 2013
2	C A Williams.	Aircraft Instruments, Golgotia Publications, New Delhi. 2007

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Identify and explain the parameters to be analyzed in Aircraft.
CO2	Describe the principle and operation of indicators and gyroscope used in Aircraft.
CO3	Analyze the technique of measuring fuel quantity and its Indication
CO4	Describe the working of engine power and control instruments.

ARTIFICIAL NEURAL NETWORKS AND FUZZY LOGIC

Contact Hours/ Week:	3+0+0 (L-T-P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	N7EIPE33
Course Type:	Theory (PEC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Study the mathematical foundations of artificial neural networks and fuzzy logic systems
2.	Learn different artificial neural network architecture
3.	Learn fundamentals of Fuzzy logic

UNIT I

Introduction: Introduction to Artificial Intelligence and Machine Learning.

Basics of Artificial Neural Networks: Trends in computing, Pattern and Data, Pattern recognition tasks. Basic methods of pattern recognition, Basics of Artificial Neural Networks, Biological Neural Network, Models of neuron: McCulloch-Pitts (MP) Model, Perceptron, Adaline, topology, supervised and unsupervised learning, Basic learning laws, Realization of logic functions using MP neuron.

9 Hours

UNIT II

Functional units of ANN & Single layer perceptron: Basic ANN Models (architectures) for Pattern recognition task**,** Pattern recognition tasks by feed-forward, feed-back and competitive learning Neural networks. Feed-forward neural network: Linear associative network, Analysis of pattern classification networks, Linear separability, Perceptron convergence theorem.

9 Hours

UNIT III
Multi-Layer perceptron: Linear Inseparability**:** Hard problems, Multilayer feed forward neural network (MLFFNN): Back propagation learning, Drawbacks of back propagation algorithm, Heuristics to improve the performance of Back propagation learning discussion on error back propagation, Convolution neural network (CNN).
8 Hours

UNIT IV
Introduction to Fuzzy Logic, Classical sets and Fuzzy sets. Introduction to Fuzzy Logic, Classical sets (crisp sets) - Operations on Classical sets, Properties of Classical sets, Function of Mapping of Classical sets. Fuzzy sets – Fuzzy set operations, Properties of fuzzy sets. Simple Problems **Classical Relations and Fuzzy Relations** – Introduction, Cartesian Product of Relation, Classical Relation, Fuzzy Relation, Tolerance and Equivalence Relations, Non-interactive Fuzzy sets, Simple Problems.
8 Hours

UNIT V
Membership Functions – Introduction, Features of the Membership functions, Fuzzification, Methods of Membership Value Assignments, Simple Problems **Defuzzification**- Introduction, Lamba-cuts for Fuzzy sets (Alpha-Cuts), Lamba-Cuts for Fuzzy Relation, Defuzzification Methods. **Fuzzy Logic Control (FLC) Systems** – Introduction, Control System Design, Architecture and Operation of FLC system, FLC system Models, Application of FLC systems.
8 Hours

TEXT BOOKS		
1	B.Yegnanarayana,	Artificial Neural Networks. Pill, New Delhi PHI Learning Pvt. Ltd., 2010.
2	Timothy J. Ross,	"Fuzzy logic with engineering applications", McGraw Hill International Edition, 2004

REFERENCE BOOKS		
1	J.M. Zurada,	Introduction to Artificial Neural Systems, Jaico Publications, 2007
2	Satish Kumar	Neural Networks A Classroom Approach -, McGraw Hill Education (India) Pvt. Ltd, Second Edition 2017.
3	Simon Haykin	Neural Networks for Pattern Recognition, Pearson Education Limited, 2008

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Describe machine intelligence and differentiate supervised and unsupervised machine learning
CO2	Analyze learning methods for neural networks.
CO3	Develop Neural network models.
CO4	Describe the fundamentals of fuzzy logic, Classical Relations and Fuzzy Relations
CO5	Apply fuzzy logic concepts for building automated systems

VLSI PROCESS TECHNOLOGY

Contact Hours/ Week:	3+0+0 (L-T-P)	Credits:	3
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	N7EIPE34
Course Type:	Theory (PEC)	Exam Hours:	3

Course objectives:
This course will enable students to:

1.	Learn the environment for IC fabrication technology, preparation of silicon wafer and oxidation process.
2.	Understand deposition of thin film using CVD and PVD techniques.
3.	Learn incorporation of impurity in the thin film and etching process.
4.	Understand lithography techniques and various characterization tools for analyzing the properties of thin films
5.	Learn VLSI Process Integration and packaging types

UNIT I

Introduction: Electronic-Grade Silicon, Czochralski Crystal Growing, Silicon Shaping, Process Considerations. Environment for VLSI technology: clean room and safety requirements, Wafer cleaning process.
Epitaxy: Introduction, Vapour-Phase Epitaxy, Molecular Beam Epitaxy.
Oxidation: Wet and dry oxidation process.

09 Hours

UNIT II

Chemical Vapour deposition techniques: CVD techniques for deposition of materials: Plasma enhanced CVD, Atmospheric pressure CVD andLow power CVD.
Metallization: Metallization Applications, Metallization Choices, Physical Vapor Deposition (evaporation and sputtering techniques).

09 Hours

UNIT III
Impurity incorporation: Models of Diffusion in Solids, Fick's laws for Diffusion, Measurement Techniques, Ion implantation: Introduction, Implantation Equipment, Annealing, Reactive Plasma Etching: Introduction, Plasma Anisotropic Etch Mechanisms, Other Properties of Etch Processes, Reactive Plasma-Etching Techniques and Equipment.
08 Hours

UNIT IV
Lithography: Introduction, Optical Lithography, Electron Lithography, X-ray Lithography, Ion Lithography. **Thin film Characterization**: Overview of thin film characterization, Structural properties: Scanning electron microscopy (SEM), AFM, X-ray diffraction (XRD), Electrical properties: Resistance/resistivity – four point probe, Vander Pauw.
08 Hours

UNIT V
VLSI Process Integration: Introduction, Fundamental Considerations for IC Processing, NMOS IC technology, MOS Memory IC Technology. Packaging of VLSI Devices: Introduction, Package Types, Packaging Design Considerations.
08 Hours

TEXT BOOKS		
1	S. M. Sze	VLSI Technology, McGraw-Hill, 2nd Edition, 2017.
2	S.K. Ghandhi	VLSI Fabrication Principles, John Wiley Inc., New York, 2nd Edition, 2008.

REFERENCE BOOKS		
1	John A. Venables	Introduction to Surface and Thin Films Processes, Cambridge University Press, 2000.
2	Leon I. Maissel and Reinhard Glang.	Handbook of Thin Film Technology, McGraw-Hill Publishing Company, New Delhi (1970)

Course Outcomes: Upon completion of this course the student will be able to:	
CO1	Analyze the crystal growth process and select appropriate epitaxial growth techniques for IC's fabrication.
CO2	Analyze and Select appropriate deposition method to deposit various material in the thin film for IC's fabrication.
CO3	Identify and select appropriate impurity incorporation, and etching methods used in IC's fabrication
CO4	Describe the various lithography techniques used in IC's fabrication. Analyze the material properties of thin films using the various characterization techniques.
CO5	Apply various process sequence and special considerations for IC's fabrication. Select an appropriate package type and explain design considerations of VLSI devices.

RESEARCH METHODOLOGY AND IPR

Contact Hours/Week:	2+0+0 (L+T+P)	Credits:	2
Total Lecture Hours:	28	CIE Marks:	50
Total Tutorial Hours:	0	SEE Marks:	50
Total Practical Hours:	0	Course Code:	NSH09
Course Type:	Theory (AEC)	Exam Hours:	3

UNIT-I

Introduction: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

6-Hours

UNIT-II

Research Problem: Effective literature studies approaches, analysis Plagiarism, and Research ethics.

6-Hours

UNIT-III

Technical Writing: Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

6-Hours

UNIT-IV

Intellectual Property Rights: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

5-Hours

UNIT-V

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems,

Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.
5-Hours

Text Books:		
Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	Wayne Goddard and Stuart Melville	Research methodology: an introduction, 2nd Edition, 2014, Juta Academic Lt.D. ISBN 9780702156601.
2.	Stuart Melville and Wayne Goddard	Research methodology: an introduction for science & engineering students, 2nd Edition, Juta Academic,
3.	Ranjit Kumar	Research Methodology: A Step-by-Step Guide for beginners, SAGE Publications India Pvt Ltd, 4th Edition, 2023, ISBN: 9789351501336

Reference Book:		
Sl. No.	**Author/s**	**Title, Publisher, Edition, Year, ISBN**
1.	T. Ramapp	Intellectual Property Rights Under WTO", S. Chand, 2008
2.	Robert P. Merges, Peter S. Menell, Mark A. Lemley	Intellectual Property in New Technological Age", 2016.

CO1	Identify based on the knowledge the basics of research and its types.
CO2	Apply knowledge to write Literature Review, Technical Reading, Attributions and Citations.
CO3	Practice the knowledge of Ethics in Engineering Research
CO4	Apply the concepts of Intellectual Property Rights in engineering
CO5	Apply IPR knowledge for the granting patents and its procedure for new innovative product for grants.

8th Semester

TECHNICAL SEMINAR

Contact Hours/ Week:	One contact hour/Week for interaction between the faculty and students.	Credits:	1
Total Lecture Hours:		CIE Marks:	100
Total Tutorial Hours:		SEE Marks:	0
Total Practical Hours:		Course Code:	N8EITS
Course Type:	Seminar		

Guidelines for Seminar:	
1	Seminar must be based on thrust area in Instrumentation Engineering.
2	Students should undergo literature survey and identify the topic of seminar and finalize in consultation with the Guide/Supervisor. Students should use multiple literatures and understand the topic and compile the report in standard format and present it in front of the Panel of Examiners appointed by the Head of the Department/Institute of respective Program.
3	Seminar assessment should be based on following points: • Quality of Literature survey and Novelty in the topic. • Relevance to the specialization • Understanding of the topic • Quality of Written and Oral Presentation