KAMARAJ
COLLEGE OF ENGINEERING & TECHNOLOGY
(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)
S.P.G.Chidambara Nadar - C.Nagammal Campus
S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS – 2021

AUTONOMOUS SYLLABUS

CHOICE BASED CREDIT SYSTEM

VII TO VIII SEMESTER CURRICULUM AND SYLLABI

VISION:

To make the Department of Electronics and Communication Engineering of this Institution the unique of its kind in the field of Research and Development activities in this part of world.

MISSION:

To impart highly innovative and technical knowledge in the field of Electronics and Communication Engineering to the urban and unreachable rural student folks through Total Quality Education.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: To establish a strong foundation in Electronics and Communication Engineering necessary to formulate, model, analyze and solve real time problems.

PEO 2: To inculcate professional skills and life skills for placement or to pursue higher studies in the relevant fields.

PEO 3: To promote research and development activities and solve industrial problems with creative ideas.

PROGRAM OUTCOMES:

After going through the four years of study, the Electronics and Communication Engineering graduates will have the ability to

POs	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem analysis	Identify,formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/Development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1 : Ability to make use of attained technical knowledge in the field of Electronics and Communication Engineering for successful career and qualifying in competitive examinations at the national level.

PSO2 : Ability to develop workable solutions for real time challenges in Electronics and Communication Engineering.

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CHOICE BASED CREDIT SYSTEM

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND SYLLABI FOR SEMESTER VII TO VIII

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	EC2401	Microprocessor and Embedded Systems	PC	3	3	0	0	3
2	GE2401	Universal Human Values and Ethics	HS	2	2	0	0	2
3		Management – Elective	HS	3	3	0	0	3
4		Open Elective – II*	OE	3	3	0	0	3
5		Open Elective – III*	OE	3	3	0	0	3
6		Open Elective – IV*	OE	3	3	0	0	3
PRACTICAL								
7	EC2402	Microprocessor and Embedded Systems laboratory	PC	4	0	0	4	2
			TOTAL	**21**	**17**	**0**	**4**	**19**

***Open Elective Courses shall be chosen from the list of open electives offered by other Programmes**

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1	EC2451	Project Work	EE	20	0	0	20	10
			TOTAL	**20**	**0**	**0**	**20**	**10**

MANAGEMENT ELECTIVES

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	GE2491	Principles of Management	HS	3	3	0	0	3
2	GE2492	Total Quality Management	HS	3	3	0	0	3

OPEN ELECTIVES III (Offered to CSE, IT, ADS, EEE, Mechanical, Civil, Mechatronics and Bio-Technology)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	OEC701	Fundamentals of Electronic Devices and Circuits	OE	3	3	0	0	3
2	OEC702	Sensors and Wireless Technologies	OE	3	3	0	0	3

OPEN ELECTIVES IV (Offered to CSE, IT, ADS, EEE, MECH, CIVIL, MTR, BT)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	OEC703	Industry 4.0	OE	3	3	0	0	3
2	OEC704	Introduction to Signal Processing	OE	3	3	0	0	3
3	OEC705	Medical Electronics	OE	3	3	0	0	3
4	OEC706	MEMS and VLSI Design	OE	3	3	0	0	3

Course Code	Course Name	L	T	P	C
EC2401	MICROPROCESSOR AND EMBEDDED SYSTEMS	3	0	0	3

Category: Professional Core

a. Preamble

An embedded system is a combination of computer hardware and software designed for a specific function. Embedded systems can be programmable or have a fixed functionality. Microprocessors and Microcontrollers are programmable devices used for designing any embedded system.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Make use of 8086 processor architecture, addressing mode and instruction set to develop Assembly Language Programming.	K3
CO2	Apply the knowledge of 8051 architecture, addressing modes and instruction set to develop Assembly Language Programming.	K3
CO3	Explain interfacing of I/O devices with 8086 processor and 8051 microcontroller.	K2
CO4	Describe the Architecture and programming of ARM processor.	K2
CO5	Outline the concepts of embedded systems and quality assurance techniques.	K2

c. Course Syllabus **Total : 45 Periods**

8086 MICROPROCESSOR **9**

Introduction to 8086 - Microprocessor architecture - Addressing modes - Instruction set and assembler directives - Assembly language programming - Interrupts and interrupt service routines-8086 signals - Basic configurations.

8051 MICROCONTROLLER **9**

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes -programming 8051 Timers - Serial Port Programming - Interrupts Programming.

INTERFACING MICROPROCESSORS AND MICROCONTROLLER 9

Using 8086 Microprocessor: Memory Interfacing - Parallel communication interface - Serial communication interface - Timer - Keyboard /display controller.

Using 8051 Microcontroller: ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation .

EMBEDDED ARM PROCESSOR 9

ARM Embedded system - ARM processor fundamentals- Introduction to ARM instruction set- Efficient C programming.

EMBEDDED SYSTEM DESIGN TECHNIQUES 9

Complex systems and microprocessors - Embedded system design process - Design example: Model train controller - Design methodologies- Design flows - Requirement Analysis - Specifications - System analysis and architecture design - Quality Assurance techniques - Design Example - Software Modem, Data compressor.

d. Activities

Students shall be exposed to 8086, 8051 and ARM programming to perform basic arithmetic and logical instructions.

e. Learning Resources

Text Books

1. Liu, Y.C. and Gibson, G.A., 2000. *Microcomputer systems: The 8086/8088 family: Architecture, programming, and design*. Prentice-Hall, Inc..
2. Ali, M.M., 2007. *The 8051 Microcontroller and Embedded Systems: Using Assembly and C*. Pearson Education India.
3. Wolf, M., 2012. *Computers as components: principles of embedded computing system design*. Elsevier.
4. Sloss, A., Symes, D. and Wright, C., 2004. *ARM system developer's guide: designing and optimizing system software*. Elsevier.

References

1. Kumar, N.S., Saravanan, M. and Jeevananthan, S., 2011. *Microprocessors and microcontrollers*. Oxford University Press, Inc..
2. Furber, S.B., 2000. *ARM system-on-chip architecture*. pearson Education.

Course Code	Course Name	L	T	P	C
GE2401	UNIVERSAL HUMAN VALUES AND ETHICS	2	0	0	2

Category: Science and Humanities

a. Preamble

This course is intended to provide a much-needed orientational input in value education to the young enquiring minds.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Describe the essential complementarily between 'VALUES' and 'SKILLS' for ensuring happiness and prosperity.	K2
CO2	Explore Human being as the Co-existence of the Self and the Body.	K3
CO3	Develop holistic perspective towards value-based living in a natural way.	K3
CO4	Discuss the interconnectedness of the four orders of Nature and existence.	K2
CO5	Comprehend the ethics of human values, Humanistic education and constitution, strategies of value-based life and profession.	K2

c. Course Syllabus **Total : 30 Periods**

INTRODUCTION TO VALUE EDUCATION **6**

Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity - the Basic Human Aspirations, Happiness and Prosperity - Current Scenario, Method to Fulfil the Basic Human Aspirations.

HARMONY IN THE HUMAN BEING **6**

Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

HARMONY IN THE FAMILY AND SOCIETY **6**

Harmony in the Family - the Basic Unit of Human Interaction, 'Trust' - the Foundational Value in Relationship, 'Respect' - as the Right Evaluation, Other Feelings, Justice in Humanto-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order.

HARMONY IN THE NATURE/EXISTENCE **6**

Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence.

IMPLICATIONS OF THE HOLISTIC UNDERSTANDING – A LOOK AT PROFESSIONAL ETHICS **6**

Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

d. Activities

Practice Sessions - Introduction to Value Education

1 Sharing about Oneself
2 Exploring Human Consciousness
3 Exploring Natural Acceptance

Practice Sessions– Harmony in the Human Being

4 Exploring the difference of Needs of Self and Body
5 Exploring Sources of Imagination in the Self
6 Exploring Harmony of Self with the Body

Practice Sessions– Harmony in the Family and Society

7 Exploring the Feeling of Trust
8 Exploring the Feeling of Respect
9 Exploring Systems to fulfil Human Goal

Practice Sessions– Harmony in the Nature (Existence)

10 Exploring the Four Orders of Nature
11 Exploring Co-existence in Existence

Practice Sessions– Implications of the Holistic Understanding – a Look at Professional Ethics

12 Exploring Ethical Human Conduct
13 Exploring Humanistic Models in Education
14 Exploring Steps of Transition towards Universal Human Order

e. Learning Resources

https://fdp-si.aicte-india.org/UHV-II_Lectures_PPTs.php

https://fdp-si.aicte-india.org/UHV-II%20Practice%20Sessions.php

Text Books

1. Gaur, R.R., Sangal, R. and Bagaria, G.P., 2010. *A Foundation Course in Human Values and Professionals Ethics*. Excel Books India.

References

1. Values, H. and Tripathi, A.N., 2004. New Age Intl. *Publishers, New Delhi, 3*.
2. Gandhi, M., 2023. *My experiments with Truth*. Strelbytskyy Multimedia Publishing.
3. Kumarappa, J.C., 1946. The economy of permanence.
4. AZAD, M.A.K., *WINS FREEDOM*.

Course Code	Course Name	L	T	P	C
EC2402	MICROPROCESSOR AND EMBEDDED SYSTEMS LABORATORY	0	0	4	2

Category: Professional Core

a. Preamble

This course promotes students to understand the concepts of programming embedded processors. An embedded system is a combination of computer hardware and software designed for a specific function. Embedded systems can be programmable or have a fixed functionality. Microprocessors and Microcontrollers are programmable devices used for designing embedded system.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Implement assembly language programs in 8086 MASM.	K3
CO2	Implement assembly language programs in 8051 kits.	K3
CO3	Implement different I/Os with 8086 and 8051 kits.	K3
CO4	Build ARM based embedded 'C' program in MicroKeil Environment.	K3
CO5	Develop IO Programming in ARM system to interface DAC and Stepper Motor interface.	K3

c. Course Syllabus **Total : 60 Periods**

I. Microprocessor based Experiments

1. Basic Arithmetic and Logical Manipulation –MASM
2. Array Processing and Sorting Operation – 8086 kit
3. Interfacing Traffic Light Controller – 8086 kit
4. Interfacing Keyboard and Display Interface with 8086 kit.
5. Basic Arithmetic and Logical Manipulation with 8051 kit

II. ARM based Experiments

1. Study of ARM evaluation system
2. Flashing of LEDs
3. LED & switch interface

4. DAC interface
5. Stepper motor interface

d. Activities

Students shall be given exposure to learn the programming of 8086 MASM Assembler, 8051 Microcontroller and ARM Keil programming. Based on the gained knowledge, they can be insisted to do mini projects.

e. Learning Resources

Text Books

1. Liu, Y.C. and Gibson, G.A., 2000. *Microcomputer systems: The 8086/8088 family: Architecture, programming, and design*. Prentice-Hall, Inc..
2. Ali, M.M., 2007. *The 8051 Microcontroller and Embedded Systems: Using Assembly and C*. Pearson Education India.
3. Furber, S.B., 2000. *ARM system-on-chip architecture*. pearson Education.

References

1. https://www.nxp.com/documents/user_manual/UM10562.pdf.
2. Sloss, A., Symes, D. and Wright, C., 2004. *ARM system developer's guide: designing and optimizing system software*. Elsevier.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl. No	Description of Equipment	Quantity Required
1	8086- Microporcessor trainer kits	10 Nos
2	8051- Microcontroller kits	10 Nos
3	Traffic Light Controller Interface	5 Nos
4	Keyboard and display Interface	5 Nos
5	Embedded trainer kits with ARM board	10 Nos
6	Adequate Quantities of Hardware, software and consumables	-

Course Code	Course Name	L	T	P	C
GE2491	PRINCIPLES OF MANAGEMENT	3	0	0	3

Category: Science and Humanities

a. Preamble

This course introduces fundamental principles of management, emphasizing their universal applicability in diverse organizations. It covers core managerial functions, explores organizational structures, and provides insights into effective global leadership qualities and skills.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Explain the trends and challenges of management in global scenario, the different types of organization and its effectiveness.	K2
CO2	Utilize the strategies and policies which are involved in planning, Steps involved in the process of planning and use it for decision.	K2
CO3	Explain the structure, purpose, selection and recruitment process in organizations.	K2
CO4	Explain the various motivational theories and processes of management including its functions.	K2
CO5	Compare and contrast the various control techniques.	K2

c. Course Syllabus **Total : 45 Periods**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **9**

Definition of Management – Nature, Scope and Functions of Management – Evolution of Management – Contributions of FW Taylor (14 principles of Management), Henri Fayol, Elton Mayo, Roethilisberger, H.A.Simon and P.F Drucker- Management theories - Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations ,system and contingency approaches – Current trends and issues in Management.

9

PLANNING

Nature and purpose of planning - Planning process - Types of planning - Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

ORGANISING **9**

Nature and purpose - Formal and informal organization - Organization chart - Organization structure - Types - Line and staff authority - Departmentalization - delegation of authority - Centralization and decentralization - Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

DIRECTING **9**

Directing meaning - importance - principles of directing - Motivation - Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership - 14 types and theories of leadership - Communication - Process of communication, types of communication and its uses - Barrier in communication - Effective Communication - Communication and IT.

CONTROLLING **9**

System and process of controlling - Budgetary and non - Budgetary control techniques - Use of computers and IT in Management control - Productivity problems and management - Inventory Management - PERT, CPM - Application - Control and performance - Direct and preventive control.

d. Activities

Students shall be given exposure to various concepts of delegation of authority, centralization, and decentralization within the college premises.

e. Learning Resources

Text Books

1. Koontz, H., O'Donnell, C. and Weihrich, H., 1986. *Essentials of management* (Vol. 18). New York: McGraw-Hill.
2. Robbins, S.P., Bergman, R., Stagg, I. and Coulter, M., 2014. *Management*. Pearson Australia.

Reference Books

1. Robert Kreitner and Mamata Mohapatra, *Management*, Biztantra, 2008.
2. Robbins, S.P., Coulter, M. and DeCenzo, D.A., 2017. *Fundamentals of management: Management myths debunked*. Pearson.
3. Tripathi, P.C. and Reddy, P.N., 2000. Principle of Management –TATA Mc Graw.

Course Code	Course Name	L	T	P	C
GE2492	TOTAL QUALITY MANAGEMENT	3	0	0	3

Category: Science and Humanities

a. Preamble

Quality is the mantra for success or even for the survival of any organization in this competitive global market. Total Quality Management (TQM) is an enhancement to the traditional way of doing business. It is a proven technique to guarantee survival in worldclass competition. It integrates fundamental management techniques, existing improvement efforts, and technical tools under a disciplined approach. At the end of the course the students are expected to recognize the quality issues in an organization and analyze the ways to solve those using TQM techniques, and demonstrate skills in using modern TQM tools.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Describe TQM concepts of selected enterprise.	K2
CO2	Comprehend the TQM principles and how it is implemented in a selected enterprises.	K2
CO3	Discuss the various traditional and new TQM tools.	K2
CO4	Explain the fundamentals of QFD and TPM.	K2
CO5	Apply QMS and EMS in business organization.	K2

c. Course Syllabus **Total : 45 Periods**

INTRODUCTION **9**

Concept of Quality and Quality Management - Determinants of quality of a product & Service - Reliability - Definition of TQM - Basic concepts of TQM - TQM Framework - Barriers to TQM - Benefits of TQM - Gurus of TQM (Brief Introduction) - Quality statements - vision, mission, and policy.

TQM PRINCIPLES **9**

Continuous Improvement Process - Deming Philosophy - Juran Trilogy - PDSA cycle - Kaizen - Concepts of Quality circle - Japanese 5S principles and 8D methodology.

TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six-sigma Process Capability - Bench marking: Reasons for benchmarking, Benchmarking process, Understanding Current Performance, Planning, Pitfalls and Criticisms of Benchmarking - FMEA: Intent, Documentation, Stages: Design FMEA and Process FMEA.

TQM TOOLS & TECHNIQUES II **9**

Quality circles - Quality Function Deployment: QFD Team - Benefits of QFD - Voice of the customers - Organization of Information - House of Quality - QFD Process - Taguchi quality loss function - TPM: Concepts, improvement needs - Performance measures - Cost of Quality.

QUALITY AND ENVIRONMENTAL MANAGEMENT SYSTEM **9**

Introduction - Benefits of ISO Registration - ISO 9000 Series of Standards - Sector Specific Standards: AS 9100, TS16949 and TL 9000 - ISO 9001 Requirements - Implementation - Documentation - Internal Audits - Registration - ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction - ISO 14000 Series Standards - Concepts of ISO 14001 - Requirements of ISO 14001 - Benefits of EMS.

d. Activities

Students shall be exposed to learn the knowledge and skills necessary to drive organizational excellence through the implementation of effective quality management strategies.

e. Learning Resources

Text Books

1. Besterfield, D.H., Besterfield-Michna, C., Besterfield, G.H., Besterfield-Sacre, M., Urdhwareshe, H. and Urdhwareshe, R., 1995. *Total Quality Management Revised Edition: For Anna University, 3/e*. Pearson Education India.
2. Suganthi, L. and Samuel, A.A., 2004. *Total quality management*. PHI Learning Pvt. Ltd..

Reference Books

1. Kiran, D.R., 2016. *Total quality management: Key concepts and case studies*. Butterworth-Heinemann.
2. Bhat, K.S., 2010. *Total quality management*. Himalaya Publishing House.

Course Code	Course Name	L	T	P	C
OEC701	FUNDAMENTALS OF ELECTRONIC DEVICES AND CIRCUITS	3	0	0	3

Category: Elective Courses

a. Preamble

This course promotes students to understand basic concepts of various devices, their characteristics, and applications to impart knowledge on usage of devices in circuits. It also enables the students to have knowledge in wave shaping circuits.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the working principle of various semiconductor diodes and its characteristics.	K2
CO2	Illustrate the function of BJT & FET and derive its basic parameters.	K2
CO3	Infer about the positive and negative feedback circuits with its working principles.	K2
CO4	Interpret the basic concepts and applications of operational amplifiers.	K2
CO5	Summarize the logic design of combinational and sequential circuits.	K2

c. Course Syllabus **Total: 45 Periods**

SEMICONDUCTOR DIODES **9**

PN junction Diode - Zener Diode - Varactor diode - Tunnel diode - Schottky diode - LED and Photodiode - working principle, VI characteristics.

BIPOLAR AND UNIPOLAR TRANSISTORS **9**

Bipolar Junction Transistor - Principle and Operation of PNP, NPN transistors, BJT as a switch and Amplifier - Field Effect Transistors - Principle and Operation of JFET and MOSFET.

FEEDBACK CIRCUITS **9**

Feedback Concepts - gain with feedback, Effect of feedback on gain stability, Distortion, bandwidth - Topologies of feedback amplifiers - Oscillators - Barkhausen criterion for oscillation - LC and RC oscillators.

BASICS OF LINEAR INTEGRATED CIRCUITS **9**

Basic information of op-amps - Ideal Operational Amplifier - General operational amplifier stages - Applications - Adder, Subtractor, Integrator, Differentiator, Comparators, Clipper and Clamper.

BASICS OF DIGITAL CIRCUITS **9**

Basic Gates - Boolean Theorems & Minimization of Boolean expressions - Karnaugh Map - NAND and NOR implementation - Combinational Circuits - Adder, Subtractor, code converters, Sequential Circuits - Latches & Flip-flops.

d. Activities

Students shall be given exposure to understand the devices characteristics and to solve the electric circuits by framing the circuit equations.

e. Learning Resources

Text Books

1. Floyd, T.L., 2005. *Electronic devices*. Pearson Education India.
2. Neamen, D.A. and Biswas, D., 2011. *Semiconductor physics and devices* (pp. 106-169). New York: McGraw-Hill higher education.

References

1. Sedra, A.S. and Smith, K.C., 2013. *Microelectronic circuits: theory and applications*. Oxford University Press.
2. Roy, D.C., 2003. *Linear integrated circuits*. New Age International.
3 Floyd, T.L., 2011. *Digital fundamentals, 10/e*. Pearson Education India.

Course Code	Course Name	L	T	P	C
OEC702	SENSORS AND WIRELESS TECHNOLOGIES	3	0	0	3

Category: Open Elective

a. Preamble

The course promotes students to learn Sensors and wireless technologies, which are the two of the most important technological advances of our time. Sensors are devices that can detect and measure physical or environmental conditions, such as temperature, pressure, humidity, light, motion, and sound. Wireless technologies allow devices to communicate with each other without the need for wires or cables.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Interpret various calibration techniques and signal types of Sensors.	K2
CO2	Explain the types of Sensors and Actuators.	K2
CO3	Describe the concepts of analog and digital modulation.	K2
CO4	Identify suitable wireless technologies for wireless communication.	K2
CO5	Elucidate the different types of network topologies and protocols.	K2

c. Course Syllabus **Total : 45 Periods**

SENSOR FUNDAMENTALS **9**

Basics of Measurement - Classification of errors - Error analysis - Static and dynamic characteristics of transducers - Performance measures of sensors - Classification of sensors - Sensor calibration techniques - Sensor Output Signal Types.

TYPES OF SENSORS **9**

Motion sensor - Temperature Sensor with Thermistor & LM35 - Proximity Sensor - Humidity Sensor - Motion detection sensors- Gas & Smoke Sensor - Accelerometer Sensor - Gyroscopic Sensor - Distance measurement with Ultrasound sensor.

BASICS OF MODULATION **9**

Need for Modulation - Types of Modulation - Analog Modulation - Amplitude modulation (AM) - Frequency modulation (FM) - Digital Modulation - Amplitude-shift keying (ASK) - Frequency-shift keying (FSK) - Phase-shift keying (PSK) - Quadrature amplitude modulation (QAM).

WIRELESS TECHNOLOGIES **9**

Wireless LAN – IEEE 802.11 - WiMAX - GSM - RFID - GPRS - Bluetooth - WiFi - ZigBee.

NETWORK TOPOLOGIES AND PROTOCOLS **9**

OSI Model - Types of topologies: Bus - Star - Ring - Mesh - Tree - Hybrid - Network protocols - TCP/IP protocol suite - Ethernet protocol - Wi-Fi protocol - Bluetooth protocol - ZigBee protocol.

d. Activities

Students shall be exposed to do mini Project in real time smart IoT Applications using sensors.

e. Learning Resources

Text Books

1. Patranabi, D., 2003. *Sensors and Tranducers*. PHI Learning Pvt. Ltd..
2. Dargie, W. and Poellabauer, C., 2010. *Fundamentals of wireless sensor networks: theory and practice*. John Wiley & Sons.

References

1. Ida, N., 2013. *Sensors, actuators, and their interfaces: A multidisciplinary introduction* (No. 11040). SciTech Publishing Inc.
2. Zheng, J. and Jamalipour, A., 2009. *Wireless sensor networks: a networking perspective*. John Wiley & Sons.
3. Haykin, S. and Moher, M., 1989. Analog & Digital Communications. *Canada: John Wiley & Sons Inc*.

Course Code	Course Name	L	T	P	C
OEC703	INDUSTRY 4.0	3	0	0	3

Category: Professional Elective

a. Preamble

The Industry 4.0 is transforming the way we live and work, revolutionizing industries ranging from manufacturing to healthcare. This course provides an in-depth exploration of the principles of IoT technologies and prepares students to design and implement industrial IoT systems in a variety of industrial settings.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Outline the implementation systems for the Industry 4.0.	K2
CO2	Explain the devices and components of IoT.	K2
CO3	Illustrate the Security and smartness in Smart Factories.	K2
CO4	Interpret the data collected from IoT devices using Data Analytics.	K2
CO5	Utilize the different applications enabling the Industrial 4.0.	K3

c. Course Syllabus **Total : 45 Periods**

INTRODUCTION TO INDUSTRY 4.0 **9**

Introduction - The Various Industrial Revolutions -Defining Industry 4.0 -Main Characteristics of Industry 4.0 - The Value Chain - Industry 4.0 Design Principles - Building Blocks of Industry 4.0 - Smart Manufacturing -Digitalization and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0- The Journey so far: Developments in USA, Europe, China and other countries.

IOT COMPONENTS **9**

Sensors and Actuators for Industrial Processes, Sensor networks, Process automation and Data Acquisitions on IoT Platform, Microcontrollers and Embedded PC roles in Industrial IoT, Wireless Sensor nodes with Bluetooth, Wi-Fi, and LoRa Protocols and IoT Hub systems.

SECURITY SYSTEMS **9**

Cybersecurity in Industry 4.0 - Secure Manufacturing Information Architecture - Robotic Automation and Collaborative Robots - Support System for Industry 4.0- Smart Manufacturing - Advantages of smart manufacturing companies- Smart Factories- Real-World Smart Factories: GE's Brilliant Factory - Siemens' Amberg Electronics Plant (EWA).

DATA ANALYTICS AND COMPUTING **9**

IoT Analytics - Types - Machine Learning and Data Science - Cloud Computing In Industrial IoT - Cloud Platform for Device Management - Mobile Computing - Edge Computing - Fog Computing - Data Management with Hadoop – Data Center Network/

INDUSTRY 4.0 APPLICATIONS **9**

Smart Factory and Assembly Line - Food Industry - IIoT in Healthcare - Plant Security and Safety (Including AR and VR safety applications) - Facility Management - Oil, Chemical and Pharmaceutical Industry - UAVS in Industries - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics.

d. Activities

Students shall develop strategies for competing in an Industry 4.0 world - Industry 4.0 laboratories.

e. Learning Resources

Text Books

1. Gilchrist, A., 2016. *Industry 4.0: the industrial internet of things*. Apress.

2. Ustundag, A. and Cevikcan, E., 2017. *Industry 4.0: managing the digital transformation*. Springer.

References

1. Vermesan, O. and Friess, P. eds., 2013. *Internet of things: converging technologies for smart environments and integrated ecosystems*. River publishers.
2. Thames, L. and Schaefer, D., 2017. *Cybersecurity for industry 4.0* (pp. 1-33). Heidelberg: Springer.
3. Kagermann, H., Wahlster, W. and Helbig, J., 2013. Acatech "Recommendations for implementing the strategic initiative INDUSTRIE 4.0. *Final report of the Industrie, 4*.
4. Evans, P.C. and Annunziata, M., 2012. Industrial internet: Pushing the boundaries. *General Electric Reports*, pp.488-508.

Course Code	Course Name	L	T	P	C
OEC704	INTRODUCTION TO SIGNAL PROCESSING	3	0	0	3

Category: Open Elective Course

a. Preamble

This course promotes the students to learn classification of discrete time signals & systems, analog and digital filter design and applications of Digital Signal Processing.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Identify the different types of discrete time signals and discrete time systems.	K3
CO2	Solve Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) of any discrete time sequences.	K3
CO3	Construct digital IIR filters from analog Butterworth filter using bilinear transformation and impulse invariant methods.	K3
CO4	Design digital linear phase FIR filters using windowing and frequency sampling methods.	K3
CO5	Explain multirate signal processing and its applications.	K2

c. Course Syllabus **Total : 45 Periods**

CLASSIFICATION OF DISCRETE TIME (DT) SIGNALS AND SYSTEMS 9

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids - Classification of DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of DT systems - Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Z-Transform, Inverse Z-Transform.

DISCRETE FOURIER TRANSFORM 9

Discrete Fourier Transform (DFT), properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT – Problem using Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT).

INFINITE IMPULSE RESPONSE FILTERS **9**

Design of analog filters - Butterworth filters, Design of IIR filters from analog LPF filters - Impulse invariance method, Bilinear transformation.

FINITE IMPULSE RESPONSE FILTERS **9**

Design of linear phase FIR filters using Fourier series method - FIR filter design using windows -Rectangular, Hamming and Hanning window, Frequency Sampling method.

MULTIRATE SIGNAL PROCESSING **9**

Introduction to multirate signal Processing - Decimation, Interpolation - Applications of multirate Signal Processing - Subband coding, Quadrature Mirror Filter, Adaptive Equalization, Noise Cancellation.

d. Activities

Students shall be given exposure on signal processing in MATLAB.

e. Learning Resources

Text Books

1. Proakis, J.G., 2007. *Digital signal processing: principles, algorithms, and applications, 4/E*. Pearson Education India.
2. Babu, P.R., 1989. *Digital signal processing*. Scitech publications.

References

1. Ifeachor, E.C. and Jervis, B.W., 2002. *Digital signal processing: a practical approach*. Pearson Education.
2. Orfanidis, S.J., 1995. *Introduction to signal processing*. Prentice-Hall, Inc..
3. Oppenheim, A.V., 1999. *Discrete-time signal processing*. Pearson Education India.
4. Mitra, S.K. and Kuo, Y., 2006. *Digital signal processing: a computer-based approach* (Vol. 2). New York: McGraw-Hill Higher Education.
5. Antoniou, A., 2016. *Digital signal processing*. McGraw-Hill.

Course Code	Course Name	L	T	P	C
OEC705	MEDICAL ELECTRONICS	3	0	0	3

Category: Professional Elective

a. Preamble

Basics of Electronics Circuits, Analog and Digital Communication Concepts and Medical Instrumentation terms. This course aims to developing the ability to get the knowledge about the various physiological parameters both electrical and nonelectrical, Assist devices and Real time Applications.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Know the human body electro- physiological parameters and recording of bio-potentials.	K3
CO2	Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.	K3
CO3	Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators.	K3
CO4	Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies, and bio-telemetry principles and methods.	K3
CO5	Know about recent trends in medical instrumentation.	K3

c. Course Syllabus **Total : 45 Periods**

BIO SIGNALS AND VITAL SIGNS **9**

Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, Typical waveforms and signal characteristics - ECG, EEG, EMG, PCG. Clinical parameters: PH, PO_2, PCO_2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

MEDICAL IMAGING MODALITIES **9**

X-ray, Computer Tomography Systems, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems ,PET Imaging systems.

ASSIST DEVICES **9**

Cardiac pacemakers, DC Defibrillator, Dialyzer, Ventilators, Heart Lung Machine .

PHYSICAL MEDICINE AND BIOTELEMETRY **9**

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry and applications.

RECENT TRENDS IN MEDICAL INSTRUMENTATION **9**

Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.

d. Activities

Students shall be Design and Implement to Mini project in medical field using various programming language and Embedded Systems.

e. Learning Resources

Text Books

1. Leislie Cromwell, 2007. *Biomedical instrumentation and measurement*, Prentice Hall of India, New Delhi.
2. Khandpur, R.S., 1987. *Handbook of biomedical instrumentation*. Tata McGraw-Hill Education.

References

1. Joseph J.Carr and John M.Brown, 2004. *Introduction to Biomedical Equipment Technology*, John Wiley and Sons, New York.
2. Rangayyan, R.M. and Krishnan, S., 2024. *Biomedical signal analysis*. John Wiley & Sons.

Course Code	Course Name	L	T	P	C
OEC706	MEMS AND VLSI DESIGN	3	0	0	3

Category: Open Elective

a. Preamble

This course aims to design a circuit using MOS transistors by different circuit families and analyzing the parameters like area, speed and power.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Formulate the design techniques and analyze the characteristics of VLSI circuits.	K2
CO2	Design the combinational and sequential logic circuits using CMOS.	K3
CO3	Summarize the Concept of miniaturization and need for MEMS in various applications.	K2
CO4	Design and analyze various Micro Sensors	K3
CO5	Implement combinational and sequential logic circuits using Verilog HDL.	K2

c. Course Syllabus **Total : 45 Periods**

INTRODUCTION TO VLSI DESIGN **9**

VLSI design Flow -MOS transistor, Ideal I–V characteristics, C–V characteristics, Non ideal I–V effects - CMOS Inverter and Pass transistor - DC transfer characteristics - Power dissipation.

COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS **9**

Circuit Families: Static CMOS, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Power: Dynamic Power, Static Power, Low Power Architecture. RC Delay Model, Static latches and Registers, Dynamic latches and Registers, Pipelining.

INTRODUCTION TO MEMS **9**

Introduction to Design of MEMS, Overview of Microelectromechanical Systems, Applications of Micro Electro Mechanical Systems, Materials for MEMS: Silicon, silicon

compounds, polymers, metals.

MICRO SENSORS **9**

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester.

VERILOG HDL **9**

VLSI Circuit Design Flow-Hierarchical modeling concepts - Basic concepts: Lexical conventions - Data types - Modules and ports. Gate level modeling - Dataflow modeling - Behavioural modeling - Design examples of Combinational and Sequential circuits - Tasks and Functions.

d. Activities

Students shall be exposed to Verilog programming and layout generation using backend tools.

e. Learning Resources

Text Books

1. Weste, N.H. and Harris, D., 2015. *CMOS VLSI design: a circuits and systems perspective*. Pearson Education India.
2. Varadan, V.K., Vinoy, K.J. and Jose, K.A., 2003. *RF MEMS and their applications*. John Wiley & Sons.
3. Palnitkar, S., 2003. *Verilog HDL: a guide to digital design and synthesis* (Vol. 1). Prentice Hall Professional.

References

1. Michael J Flynn and Wayne Luk, 2011. *Computer system Design: System-on-Chip*, Wiley-India.
2. Rabaey, J.M., Chandrakasan, A. and Nikolic, B., 2002. *Digital integrated circuits* (Vol. 2). Englewood Cliffs: Prentice hall.
3. Liu, C., 2012. *Foundations of MEMS*. Pearson Education India.
4. Lyshevski, S.E., 2018. *MEMS and NEMS: systems, devices, and structures*. CRC press.

Course Code	Course Name	L	T	P	C
EC2451	PROJECT WORK	0	0	20	10

Category: Employablity and Enhancement courses

a. Objectives

- To impart required knowledge related to the project.
- To analyze the realtime problem with an indepth study from available literature in the selected domain.
- To understand the methodology used to solve the problem.
- To apply the engineering knowledge in the project domain.
- To discuss results with experimental outputs of hardware/ software implementation.

b. Course Outcome

After successful completion of the course, the students will be able to

CO. No.	Course Outcome	Knowledge Level
CO1	Identify a potential problem based on literature Survey/impending industrial/real time needs.	K3
CO2	Categorize various solution methodologies to solve Problem taken for study.	K4
CO3	Design and develop proposed solution relevant to the Problem.	K4
CO4	Analyze design/experimental results based on hardware & software implementation.	K4
CO5	Analyze and recommend solution to potential engineering problems based on results and conclusion.	K4

Total : 300 Periods

The Students in a group of 3 or 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The review progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.