Academic Program: UG

Academic Year 2024-25

Syllabus

VII & VIII Semester B.E.

Electronics & Communication Engineering

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,

DHARWAD – 580 002

(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)

Accredited by NBA under Tier-1 2023-2026

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SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for VII & VIII semester of UG program in Electronics and Communication Engineering is recommended by Board of Studies of Electronics and Communication Engineering Department and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2024-25 till further revision.

Chairman BOS & HOD Principal

SDM College of Engineering & Technology, Dharwad-02

Department of Electronics & Communication Engineering

College – Vision and Mission

VISION:

To develop competent professionals with human values

MISSION:

1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy

- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values

- Competency
- Commitment
- Equity
- Team work and
- Trust

Department- Vision and Mission

Vision

Fostering excellence in the field of Electronics & Communication Engineering, showcasing innovation, research and performance with continuous Industry – Institute Interaction with the blend of Human values.

Mission

M1: To provide quality education in the domain of Electronics & Communication Engineering through state of the art curriculum, effective teaching learning process and the best of laboratory facilities.

M2: To encourage innovation, research culture and team work among students.

M3: Interact and work closely with industries and research organizations to accomplish knowledge at par.

M4: To train the students for attaining leadership with ethical values in developing and applying technology for the betterment of society and sustaining the global environment.

Program Educational Objectives (PEOs)

The Graduates, after a few years of Graduation will be able to:

I. **Apply** the latest in-depth knowledge in the field of Electronics and Communication Engineering with Mathematical applications to address real life challenges.
II. **Exhibit** the confidence for independent working and / or spirit to work cohesively with group.
III. **Readily** be accepted by the Industry globally.
IV. **Develop** design skills, fault diagnosis skills, communication skills and create research orientation.
V. **Inculcate** professional, social ethics and to possess awareness regarding societal responsibility, moral and safety related issues

Programme Outcomes (POs):

Engineering Graduates will be able to:

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 teamwork: 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

13. Design economically and technically sound analog and / or digital systems based on the principles of signal processing, VLSI and communication Engineering (PO-13)

14. Integrate hardware – software and apply programming practices to realize the solutions in electronics domain. (PO-14)

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD
Department of Electronics and Communication Engineering
VII Semester
Scheme of Teaching and Examinations 2024 – 25

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UECC700	PC	Wireless Communication	2 - 2 - 0	3	50	100	3	-	-
21UECE7XX	PE	Program Elective-4	3 - 0 - 0	3	50	100	3	-	-
21UECE7XX	PE	Program Elective-5	3 - 0 - 0	3	50	100	3	-	-
21UECE7XX	PE	Program Elective-6	3 - 0 - 0	3	50	100	3	-	-
21UECO7XX	OE	Open Elective-2	3 - 0 - 0	3	50	100	3	-	-
21UHUC700	HU	Research Methodology	2- 0 - 0	2	50	50	2	-	-
21UECL701	PC	Communication Networks Laboratory	0 - 0 - 2	1	50	-	-	50	3
21UECL702	PC	Major Project Phase-1	0 - 0 - 4	2	50	-	-	50	3
	Total		**16 - 2 -6**	**20**	**400**	**550**		**100**	

* BS- Basic science ES- Engineering Science HU- Humanities, languages and Management AE-Ability enhancement course PC- Program core

** Semester End Examination conducted for 100 marks will be reduced to 50 marks

21UECE7XX	PE	**Program Elective-4**
21UECE730		Computer Architecture
21UECE731		Wireless Senor Networks

21UECE7XX	PE	**Program Elective-5**
21UECE740		ASIC Design
21UECE741		Artificial Neural Network and Computer Vision

21UECE7XX	PE	**Program Elective-6**
21UECE750		Optical Fiber Communication
21UECE751		Low Power VLSI Design

21UECO7XX	OE	**Open Elective-2**
21UECO760		MEMS
21UECO761		Operations Research

PC- Program Core, PE-Program Elective, OE- Open Elective

SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD
Department of Electronics and Communication Engineering
VIII Semester
Scheme of Teaching and Examinations 2024 – 25

Course Code	Course Category	Course Title	Teaching		Examination				
			L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
					Max. Marks	*Max. Marks	Duration in Hrs.	Max. Marks	Duration In Hrs.
21UECL800	PC	Technical Seminar	0 - 0 - 2	1	50	-	-	-	-
21UECL801	PC	Major Project Phase-2 (In Industry/ college/ Through internship)	0-0 -18	9	50	-	-	50	3
21UECL802	PC	Internship-2	4 - 6 weeks	3	50	-	-	50	3
	Total		**0- 0 - 20**	**13**	**150**	**-**	**-**	**100**	**-**

VII Semester

21UECC700	Wireless Communication	(2-2-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on evolution of wired Telecommunication, comparison of wireless1G, 2G, 3G, LTE,4G and 5G Networks, its advantages/ applications. It covers cellular structure, capacity expansion methods, modulation techniques with mathematical description for their parameters and its Hardware and IEEE standards with respect to 4G technology.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Discuss** the evolution and history of wireless technology and compare different mobile Networks along with their common System components.	-	3,4,5,13	1,2,10,12
CO-2	**Apply** the cellular concepts such as frequency reuse, handoff to evaluate the signal reception and Performance of cellular systems.	13	4,5,14	1,2,3,10,12
CO-3	**Explain** the GSM techniques and its architecture with time slot structures and study different traffic case operations and protocol stack in GSM.	-	4,5	1,2,3,10,12
CO-4	**Analyze** CDMA techniques with their channel structures and scrutinize future mobile communication networks.	-	5,6,7	1,2,3,4,10, 12
CO-5	**Describe** modulation techniques in wireless networks and Explain IEEE standards and protocols of Wireless	-	5,6,7	1,2,3,4,10,

	networks			12

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1	1	1.21	1.61	2	2	2	-	-	1	-	1	2.5	2

Pre-requisites: Analog Communication, Digital Communication
Contents:

Unit-I

Introduction to Wireless Communication: Introduction to wireless communication systems and networks, history and evolution, different generations of wireless cellular networks, 1G, 2G, 3G and 4G networks.

Cellular System: Common cellular system components, common cellular network components, hardware and software, views of cellular networks, 3G cellular systems components, and cellular component identification call establishment.

08 Hrs

Unit-II

Cellular structure and fundamentals: Wireless network architecture and operation, cellular concept, cell fundamentals, capacity expansion techniques, mobility management, radio sources and power management, wireless network security, SS7.

08 Hrs

Unit-III

Second Generation mobile system: GSM and TDMA techniques, GSM system, overview, GSM network and system architecture, GSM channel classifications & concepts, GSM identifiers.

GSM system operation: System Operation traffic cases, call handoff, roaming, GSM protocol architecture, TDMA systems. **08 Hrs**

Unit-IV

Third, Fourth and Fifth Generation mobile system: CDMA technology CDMA overview, CDMA channel concept, CDMA operations. LTE and 4G architectures

and their comparisons, Introduction to 5G and its features.

08 Hrs

Unit-V

Modulation Techniques: Wireless modulation techniques and hardware, characteristics of air interface, path loss models, wireless coding techniques, digital modulation techniques, OFDM, UWB radio techniques, diversity techniques, demonstration of typical GSM, CDMA hardware.

IEEE standards: Introduction to wireless LAN, 802.11X technologies, introduction to 802.15X, technologies in PAN applications, Introduction to Bluetooth model, introduction to broadband wireless MAN, 802.16X technologies, Black Berry Handsets

07 Hrs

Reference Books:

1) Mullet, "Wireless Telecommunication Systems and networks", Thomson Learning 2006.
2) Lee W.C.Y," Mobile Cellular Telecommunication",MGH,2002.
3) D.P. Agrawal," Wireless communication",2/e, Thomson Learning,2007.
4) T.S. Rappaport," Wireless Communications", principles &practice, 3/e, Pearson Education,2008.

21UHUC700	Research Methodology	(2-0-0) 2

Contact Hours: 26

Course Learning Objectives (CLOs):

The students are expected to learn about the need and types of research, problem formulation, literature review, measurement, scaling, data collection, testing of hypothesis, result interpretation and report writing. Further, the students shall know about the intellectual property rights, copy rights, trademarks, patents, patents filing procedure, infringement &remedies and information technology act etc.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	**Mapping to POs(1-12)/ PSOs (13,14)**		
	Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**

CO-1	**Formulate** the research problem, carryout literature survey and decide the methodology.	-	2	-
CO-2	**Importance** of Literature survey and need to identify gaps	5	2	
CO-3	**Describe** measurement and scaling and data collection &report writing		3	2
CO-4	**Test** the hypothesis, interpret &analyze the results and write the report.		4	
CO-5	**Explain** the need for interpretation and report writing	-	5	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	-	1.66	2	2	2.5	-	-	-	-	-	-	-	-	2

Pre-requisites: Branch specific course on problem analysis (Preferred)

Contents:

Unit-I

Research Methodology: Introduction, meaning of research, objectives of research, motivation in research, types of research, research approaches, significance of research, research methods versus methodology.

Defining the Research Problem: Research problem, selecting the problem, necessity of defining the problem, technique involved in defining a problem, an illustration. **06 Hrs.**

Unit-II

Reviewing the literature: Importance of the literature review in research, How to review the literature, searching the existing literature, reviewing the selected literature and writing about the literature reviewed.

Research Design: Meaning of research design, need for research design, features of a good design, important concepts relating to research design.

05 Hrs

Unit-III

Measurement and Scaling: Measurement in research, measurement scales, sources of error in measurement, scaling, meaning of scaling and important scaling techniques.

Data Collection: Collection of primary data, observation method, interview method, collection of data through questionnaires. **05 Hrs**

Unit-IV

Testing of Hypotheses: What is a Hypothesis? Basic concepts concerning testing of hypotheses, procedure for hypothesis testing, flow diagram for hypothesis testing, measuring the power of a hypothesis test, tests of hypotheses **05 Hrs**

Unit-V

Interpretation and Report Writing: Meaning of interpretation, technique of interpretation, precaution in interpretation, significance of report writing, different steps in writing report, layout of the research report, types of reports, oral presentation and mechanics of writing a research report, precautions for writing research reports, plagiarism and its significance. **05 Hrs**

Reference Books:

1) C.R. Kothari, Gaurav Garg, "Research Methodology: Methods and Techniques", New Age International, 4th Edition, 2018.
2) Ranjit Kumar, "Research Methodology a step-by-step guide for beginners, SAGE Publications", 3rd Edition, 2011.
3) Fink A, "Conducting Research Literature Reviews: From the Internet to Paper", Sage Publications, 2009.

21UECL701	Communication Networks Laboratory	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs):

The course focuses on the process of data communication in computer network and other communication networks through the layered architecture. It also deals with the IEEE standards and various protocols at different layers of operation of Networks. It also focuses on compiling programs for various protocols and usage of Simulation Tools for Simulating various networks protocols.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13,14)		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Illustrate** the importance of High-Level Data Link Control.	-	1	4
CO-2	**Demonstrate** various functionalities Of Network Layer and usage of algorithms for routing strategies, packet management.	1,4	-	-
CO-3	**Demonstrate** the performance of various protocols and algorithms for Framing, Flow control, Error control and media access control	1,2	3,14	11
CO-4	**Apply** high-level programming language and techniques to **realize** various protocols of Networking	-	3,14	1,2
CO-5	**Apply** network simulation tools to **analyse** and **understand** various modern communication networks	2,3	14	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.25	2.23	2.23	2.0		-	-	-	-	-	1	-	-	2

Pre-requisites: Computer Communication Networks, C/C++ Programming and Compilation, Usage of Simulation Tools

List of Experiments:

1. Realization of process of Error Detection using Cyclic Redundancy Check using C Programming.
2. Realization of process of Character Stuffing and Framing using C Programming.
3. Realization of process of Bit Stuffing and Framing using C Programming.
4. Realization of Stop and Wait Protocol using C Programming.

5. Realization of Go Back N Protocol using C Programming.
6. Realization of Shortest Path Algorithm using C Programming.
7. Realization of process of Encryption/Decryption using Block Transposition method through C Programming.
8. Connecting a Wired and Wireless using CISCO Packet Tracer/ NetSim.
9. Simulation of HTTP, SMTP, DHCP using CISCO Packet Tracer/ NetSim.
10. Simulate and demonstrate Network Address Translation (NAT) using CISCO Packet tracer / NetSim.

Reference Books:

1. Behrouz A. Forouzan, **"**Data Communication and Networking**"**, 5th Edition, McGraw Hill, 2012..
2. James F. Kurose, KeithW. Ross, "Computer Networks", Pearson education,2ndEdition, 2003.
3. Wayne Tomasi, "Introduction to Data communication and Networking", Pearson Education,2007.

21UECL702	**Major Project Phase - I**	**(0-0-4) 2**

Contact Hours: 52

Course Learning Objectives (CLOs):

The objectives of final year project during phase-I are to:

- Allow the students to demonstrate the skills learnt during their course of study by asking them to deliver a product that has passed through design, analysis, testing and evaluation stages.
- Encourage multidisciplinary research through the integration of material learnt in number of courses.
- Allow students to develop problem solving, analysis, synthesis and evaluation skills.
- Encourage teamwork and improve students' communication skills through project reports and presentations of their work.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** societal problems and analyze from engineering view point.	1,2	-	6,7

CO-2	**Perform** extensive literature survey on the identified problem and **explore** possible technical solutions.	1,2,3,4	5	13,14
CO-3	**Implement** and provide feasible solution for the identified problem.	1,2,3,4	5	13
CO-4	**Develop** presentation skills of summarizing technical contents and **organize** the study material in the form of a report.	10	11	-
CO-5	**Inculcate** professional ethics, moral responsibilities and develop the spirit of team work.	8,9	12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	3	3	2	1	1	3	3	3	2	2	1	1

Major Project phase-I is a substantial piece of work that requires creative activity and original thinking. The project phase-I has to start with the problem formulation that will lead to feasible solutions. The material collection, survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The project shall consist of a team of students not more than 4. Each batch shall be assigned with a guide. The guide will continuously monitor and evaluate the student project. Further, a review team will also evaluate the project progress.

21UECE730 Computer Architecture (3-0-0) 3

Contact Hours: 39 Hrs

Course Learning Objectives (CLOs):

The course deals with understanding quantitative principles guiding the computer system design. It focuses on enhancing the performance by addressing parallelism at different levels such as Instruction, thread, task, job. Evaluates memory hierarchy, speculations, ISA, ALU architectures.

Course Outcomes:

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs(1-12)/ PSOs (13,14)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Understand the fundamental concepts of parallel computing models, including multiprocessors, multicomputers, multivector, and SIMD computers.	1	2	4
CO-2	Apply scalable performance principles, demonstrate proficiency in performance metrics and parallel processing applications, explain advanced technologies like superscalar processors, vector processors, memory hierarchy, and virtual memory.	1	3	14
CO-3	Describe bus, cache, and shared memory, and evaluate their impact on data access in parallel systems.	4	2	14
CO-4	Apply pipeline and superscalar techniques, showcasing expertise in linear and nonlinear pipeline processors, instruction pipeline design, and arithmetic pipeline design.	4	1,3	6
CO-5	Explain large-scale multiprocessors, covering system interconnects, cache coherence, synchronization mechanisms, and message-passing mechanisms across three generations of multicomputers.	6	1,2	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	2	2.33	-	2	-	-	-	-	-	-	-	1

Course Contents:

Unit-I

Parallel Computer Models: The State of Computing, Multiprocessors and Multicomputer, Multivector and SIMD Computers, PRAM and VLSI Models.

Program and Network Properties: Conditions of Parallelism, Program Partitioning and Scheduling, Program Flow Mechanisms.

08 Hrs

Unit-II

Principles of Scalable Performance: Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws.

Processors and Memory Hierarchy: Advanced Processor Technology, Superscalar and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology.

08Hrs

Unit-III

Hardware and Software Technology: Bus, Cache and Shared Memory, Bus systems, Cache Memory Organizations, Shared-Memory Organizations, Sequential and Weak Consistency Models.

08 Hrs

Unit-IV

Pipelining and Superscalar Techniques: Linear Pipeline Processors, Nonlinear Pipeline Processors, Instruction Pipeline Design, Arithmetic Pipeline Design.

08 Hrs

Unit-V

Large Scale Multiprocessors: Multiprocessors and Multicomputers, Multiprocessor system Interconnects, Cache Coherence and Synchronization Mechanisms, Three Generations of Multicomputers, Message-Passing Mechanisms.

07 Hrs

Reference Books

1. Kai Hwang, "Advanced Computer Architecture: Parallelism, Scalability, Programmability",1993,McGraw-Hill.
2. John L. Hennessy and David A. Patterson "Computer Architecture A Quantitative Approach",6th edition, 2019, Morgan Kaufmann
3. William Stallings "Computer Organization and Architecture Designing for Performance",11th edition, 2022, Pearson.
4. Hesham El-Rewini and Mostafa Abd-El-Barr "Advanced Computer Architecture And Parallel Processing", 2005, Wiley.

21UECE731	Wireless Sensor Networks	(3-0-0)3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on architecture of Wireless sensor nodes, Operating systems used in WSN, Medium Access Control Protocols, Networks Protocols, Power Management, Time Synchronization, Localization and security issues in WSN.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Identify** various parts of WSN and **explain** their construction and operation	1	6	7
CO-2	**Select** and **apply** suitable medium access control technique for a given application of WSN.	-	1	2
CO-3	**Select** and **apply** suitable data dissemination and routing protocol for a given application of WSN.	1	2	-

CO-4	**Apply** various techniques and **solve** the problems related to power efficiency and synchronization in WSN.	2	1	-
CO-5	**Apply** the techniques and **determine** solutions various issues related to localization and security issues in WSN	-	3	1

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.2	2.0	2.0	-	-	2.0	1.0	-	-	-	-	-	-	-

Pre-requisites: Sensors and Actuators, Wireless Communication, Microcontrollers, Communication Network protocols.

Contents:

Unit - I

Wireless Sensor Network Basics: Motivation, Definitions and Background, Challenges and Constraints, Areas of Applications, Node Architecture, Sensing Subsystem, Processor Subsystem, Communication Interfaces, Operating Systems, Functional and Non functional aspects of OS. **08 Hrs**

Unit - II

Medium Access Control: Medium Access Control, Overview, Wireless MAC Protocols, Characteristics of MAC Protocols in Sensor Networks, Contention-Free MAC protocols, Contention based MAC protocols, Hybrid MAC protocols.

08 Hrs

Unit-III

Network Layer: Overview, Routing Metrics, Flooding and Gossiping, Data-centric Routing, Proactive Routing, On-Demand Routing, Hierarchical Routing, Location based Routing, QoS based routing protocols. **08 Hrs**

Unit-IV

Power Management and Time Synchronization: Local Power Management Aspects, Dynamic Power Management, Conceptual Architecture, Clocks and

synchronization problem, Time synchronization in WSN, Basics of Time synchronization, Time synchronization protocols. **08 Hrs**

Unit-V

Localization and Security: Overview, Ranging Techniques, Range based Localization, Range-Free Localization, Event Driven Localization, Fundamentals of Network Security, Challenges of Security in WSN, Security Attacks in Sensor Networks, Protocols and Mechanisms for Security. **07 Hrs**

Reference Books:

1) Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks”, Wiley Publications, 2014.
2) Kazem Sohraby, Daniel Minoli, Taieb Znati “Wireless Sensor Networks”, Wiley Publications, 2015.
3) Jun Zeng, Abbas Jamalipour "Wireless Sensor Networks", Wiley Publications, 2014.
4) S. Swapnakumar, " A Guide to Wireless Sensor Networks”, Laxmi Publications , 2013.

21UECE740 ASIC Design (3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on ASIC design flow, challenges in the design, verification phase, and various circuit examples and widely used ASIC tools.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Interpret** the types of ASIC design flow and its concepts.	-	1	-
CO-2	**Analyze** the challenges in designing complicated digital circuits and its CMOS Implementations.	-	1,2	3
CO-3	**Apply** the Partitioning & Floor-planning Techniques	3	4	-

CO-4	**Evaluate** placement and routing techniques for ASIC.	5	-	1,2
CO-5	**Design** of SOC based Architectures and its applications.	13,14	12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1.66	1.5	2	2	3	-	-	-	-	-	-	2	3	3

Pre-requisites: FPGA and microcontroller architecture.

Contents:

Unit-I

Introduction To ASICs: Types of ASICs, Full-Custom ASICs, Standard cell based ASICs, Gate array based ASICs, Channelled gate array, channel-less gate array, structured gate array, Programmable logic devices (PLD), Field–programmable gate arrays (FPGA), ASIC Design flow, Economics of ASICs with Example. **06 Hrs**

Unit-II

Logic Design: CMOS Implementations, Transistor Sizing, Logical Effort: Predicting delays, logical areas and logical efficiency, logical paths, Multi stage cells, Optimum delay, Optimum number of stages, RTL design, Concept of RTL Linting, Clock domain Crossing.

08 Hrs

Unit-III

Partitioning & Floor-planning: Partitioning Methods, Measuring Connectivity, Constructive and Iterative Partitioning, The Kernighan–Lin Algorithm, The Ratio-Cut Algorithm**.** Floor-planning goals and objectives, floor planning tools, I/O and power planning, clock system planning.

08 Hrs

Unit-IV

Placement & Routing: placement goals and objectives, placement algorithms, iterative placement, Time Driven Placement Algorithm, Global routing and types, Detailed routing: Left edge Algorithm, Special routing**.** **08 Hrs**

Unit- V

System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, On-Chip Communication Architecture Standards, Low-Power SoC Design**.** **09 Hrs**

Activity beyond Syllabus: Seminar on Fabrication Techniques

Reference Books:

1) M.J.S. Smith, "Application Specific Integrated Circuits", Pearson Education,1/e 2002.
2) Jose E. France, YannisTsividis, "Design of Analog–Digital VLSI Circuits for Telecommunication and Signal Processing, Prentice Hall, 2/e 1993.
3) Malcolm R Haskard, Lan C, May, "Analog VLSI Design – NMOS and CMOS", Prentice Hall, 1998.
4) Hoi-Jun Yoo, KangminLeeand JunKyong Kim, "Low-Power NoC for High-Performance SoC Design", CRC Press, 2008

21UECE741	**Artificial Neural Network & Computer Vision**	**(3-0-0) 3**

Contact Hours: 39Hrs

Course Learning Objectives (CLOs):

This course introduces the traditional computer vision topics & Artificial Neural Network (ANN). The course delves into selected topics of ANN, discussing recent models from both supervised and unsupervised learning. Special emphasis will be on convolutional architectures, invariance learning, back propagation and non-convex optimization. Also, course covers models for various vision applications.

Course Outcomes:

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1 to 12) & PSOs(13-14)**		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Understand** basic concepts, terminology, theories related to image formation and camera models.		1,2	12
CO-2	**Implement** fundamental image processing techniques required for		1	12

	computer vision.			
CO-3	**Develop** perception learning algorithm and delta learning rule for Multilayer feed forward neural network.	2	1,3	
CO-4	**Calculate** weight gradients in a feed forward neural network using back propagation algorithm and various optimization techniques	2	1, 3	
CO-5	**Identify** the deep learning algorithms which are more appropriate for various types of learning tasks in computer vision.	2	1,13	

PO's/PSO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	2.0	2.75	2	--	--	--	--	--	--	--	--	1	2	--

Pre-requisites: Image processing, Mathematics

Course Contents:

Unit-I

Image Formation: Geometric image formation, Photometric image formation - **Camera Models and Calibration**: Camera Projection Models – Orthographic, Affine, Perspective, Projective models. Projective Geometry, Transformation of 2D and 3D, Internal Parameters. **08 Hrs**

Unit-II

Local Feature Detectors and Descriptors: Edge, Blobs, Hessian corner detector, Harris Corner Detector, LOG detector, DOG detector, SIFT, PCA-SIFT, GLOH, SURF, HOG, **Calibration Methods**: Linear, Direct, Indirect and Multiplane methods –Pose estimation. **08 Hrs**

Unit-III

Single layer Perception: Introduction, Pattern Recognition, Linear classifier, Simple perception, Perception learning algorithm.

Multi-Layer Perceptron Networks: Introduction, MLP with 2 hidden layers, Delta

learning rule of the output layer, Multilayer feed forward neural network with continuous perceptions. **07 Hrs**

Unit-IV

Improving Neural Networks: Sigmoid, ReLU, Softmax, Gradient descent, Stochastic gradient descent, back propagation.
Optimization & Regularization: Over fitting and Capacity, Cross validation, Feature selection, Regularization & Hyper parameters. **08 Hrs**

Unit-V

Introduction to Convolutional & Recurrent Neural Network: Introduction to CNNs, Kernel filter, Principles behind CNNs, Multiple filters, CNN applications in Vision, Introduction to RNNs, unfolded RNNs, Seq2seq RNNs, LSTM, RRN applications in Vision. **08 Hrs**

Reference Books

1. Forsyth and Ponce, “Computer Vision – A Modern Approach”, Second Edition, Prentice Hall, 2011.
2. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.
3. Goodfellow, I., Bengio, Y, and Courville A., “Deep learning”, MIT press, 2016
4. Michael Nielsen, Neural Networks and Deep Learning, 2016

21UECE750	Optical Fiber Communication	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):
The course focuses on principles of Optical Fiber Communication, devices involved in communication system and challenges in Optical Fiber Communication networks.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:	**Mapping to POs(1-12)/ PSOs (13,14)**		
	Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**

CO-1	**Classify** the structures of Optical fiber and types and Calculate their different parameters in single mode and Multimode operation.	13	-	1
CO-2	**Illustrate** the optical fiber channel impairments and analyze various types of optical fiber coupling losses.	4, 13	2,3	1
CO-3	**Discuss** different Optical sources and detector with their principles and **analyze** link power and rise time budget schemes for optical fiber links.	4, 13	2	5
CO-4	**Describe** the working principles of WDM with different active and passive devices of optical fiber link.	3,13	1,2	-
CO-5	**Explain** concepts, working principles of different types of optical networks and their structures.	-	3, 13	1,2,12

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	1.5	1.75	2.33	1.5	-	-	-	-	-	-	-	1	2.8	-

Pre-requisites: Optical physics, Analog Communication, Digital Communication

Contents:

Unit-I

Optical fiber Communications: Historical development, The general system, Advantages of optical fiber communication, Optical fiber wave guides: Ray theory transmission, Modes in planar guide, Phase and group velocity, And Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index. Fiber Materials, Photonic crystal fibers (PCF)

09 Hrs

Unit-II

Transmission characteristics of optical fiber: Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index

fiber. Optical Fiber Connectors: Fiber alignment and joint loss, Fiber splices, Fiber connectors, Fiber couplers **09 Hrs**

Unit-III

Optical sources: Energy Bands, Direct and Indirect Band gaps, Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant frequencies, Laser Diode structures and their principles.

Photo detectors: Physical principles of Photodiodes, Photo detector noise, Detector response time. **07 Hrs**

Unit-IV

Optical Receiver: Optical Receiver Operation: Error sources, Receiver sensitivity, Quantum Limit, Introduction, point–to–point links, System considerations, link power budget, rise-time budget calculations. Short wavelength band and transmission distance for single mode fibers, Power penalties, nodal noise and chirping.

Analog Links: Analog links – Introduction, overview of analog links, CNR, multichannel transmission techniques, key link parameters, Radio over fiber links, microwave photonics. **07 Hrs**

Unit-V

WDM Concepts and Components : Overview of WDM, Operational Principles of WDM, WDM standards, Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings, Active Optical Components, Tunable light sources.

Optical Networks: Optical Networks concepts, Network Topologies, Introduction to SONET/SDH networks, Optical Add/Drop Multiplexing, Wavelength Division Multiplexing (WDM) Concepts. Revolution of optical networks in India. **07 Hrs**

Reference Books:

1) Gerd Keiser, “Optical Fiber Communication”, 5th Edition, McGraw Hill Education (India) Private Limited, 2015.
2) John M Senior, “Optical Fiber Communications, Principles and Practice”,3rd Edition, Pearson Education, 2010.
3) Rama Swamy & Sivarajan, “Optical Networks”, 2nd edition, Elsevier publishers, 2010.

4) Govind P. Agarwal, “Fiber Optic Communication Systems”, 3rd edition, John Wiley India, 2001.

21UECE751	Low Power VLSI Design	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course focuses on factors which may lead to the techniques of power saving in design of VLSI circuits. Knowledge of CMOS digital circuits and analog Mixed Mode VLSI Design are required as prerequisites.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**List** the factors effecting the power requirement in design of VLSI circuits.	-	-	2,3,13
CO-2	**Explain** various methods of achieving the power minimization	2,13	-	-
CO-3	**Compare** various methods of achieving the power minimization	1,2,12	-	-
CO-4	**Estimate** the features of synthesis tools for Low Power VLSI Design	-	5	-
CO-5	**Analyze** and **investigate** switched capacitance, leakage power minimization techniques	1,2	4	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	2.5	1	2	2	-	-	-	-	-	-	3	2	-

Prerequisites: Basics of CMOS digital circuits and Analog Mixed Mode Design.

Contents:

Unit-I

MOS Transistor structure and device modeling, MOS Inverters, MOS Combinational Circuits - Different Logic Families. **08 Hrs**

Unit-II

Sources of Power dissipation: Dynamic Power Dissipation, Short Circuit Power, Switching Power, Glitching Power, Static Power Dissipation, Degrees of Freedom

Supply Voltage Scaling Approaches: Device feature size scaling, Multi-Vdd Circuits, Architectural level approaches: Parallelism, Pipelining, Voltage scaling using high-level transformations, Dynamic voltage scaling, Power Management. **08 Hrs**

Unit-III

Switched Capacitance Minimization Approaches: Hardware Software Tradeoff, Bus Encoding, Two's complement Vs Sign Magnitude, Architectural optimization, Clock Gating, Logic styles. **08 Hrs**

Unit-IV

Leakage Power minimization Approaches: Variable-threshold-voltage CMOS (VTCMOS) approach, Multi-threshold-voltage CMOS (MTCMOS) approach, Power gating, Transistor stacking, Dual-Vt assignment approach (DTCMOS). **08 Hrs**

Unit-V

Special Topics: Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design, CAD tools for low power synthesis. **07 Hrs**

Reference Books:

1) Gary K Yeap, "Practical low power digital VLSI Design" ,Kluwer Academic, 1998.

2) Jan M. Rabaey, MassoudPedram, " Low power design methodologies", Kluwer Academic, 2010.

3) Kaushik Roy, Sharat Prasad, "Low power CMOS VLSI circuit design", Wiley 2000.

4) A.P. Chandrasekaran and R. W. Broadersen, "Low power digital CMOS design", Kluwer Academic, 1995.

21UECO760	MEMS	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

The course focuses on the study of various micro-electromechanical systems. The course discusses different fabrication techniques, modeling aspects and transduction principles of various electromechanical sensors, actuators at micro and nanoscale.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Appreciate the significance of MEMS, as an emerging area in the field of electronics.	1	-	2
CO-2	Identify various micro sensors and actuators used for electromechanical applications.	2	-	4
CO-3	Discuss the processes involved in the fabrication of different micro sensors and micro actuators.	-	2	5
CO-4	Design simple micro sensors and actuators using CAD Tools and perform simulation.	5	2,3	13
CO-5	Classify various micro system packaging technologies related to MEMS.	2	3	-

POs/PSOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
Mapping Level	3	2	2	1	2	-	-	-	-	-	-	-	1	-

Pre-requisites: Physics, Electronics, Engineering Mathematics, Material Science

Contents:

Unit-I

Overview of MEMS & Microsystems: MEMS & Microsystems, typical MEMS and micro system products — features of MEMS, multidisciplinary nature of Microsystems, design and manufacture, applications of microsystems.

Scaling Laws in Miniaturization: Introduction to scaling, scaling in geometry, scaling in rigid body dynamics, scaling in electrostatic forces, electromagnetic forces, electricity. **08 Hrs**

Unit-II

Transduction Principles in MEMS & Microsystems: Introduction, micro sensors, electromechanical transducers, micro actuation principles, MEMS with micro actuators, Micro accelerometers, MEMS switches, micro relays, MEMS inductors and capacitors. **08 Hrs**

Unit-III

Microsystems Fabrication Process: Introduction, photolithography, ion-implantation, diffusion, oxidation, CVD, PVD, etching and materials used for MEMS, MEMS fabrication processes: Surface micro-machining, Bulk micromachining, LIGA process. **08 Hrs**

Unit-IV

Micro System Design and Modeling: Introduction, Design considerations: Process design, Mechanical design, Modeling using CAD tools: Multiphysics/ Intellisuite/MEMS CAD, Features and Design considerations of RF MEMS, Design considerations of Optical MEMS.

Design and Modeling: Case studies- i) Cantilever beam ii) Micro switches **08 Hrs**

Unit-V

Micro system packaging: Overview of mechanical packaging of micro electronics, micro system packaging, interfaces in microsystem packaging, packaging technologies in MEMS. **07 Hrs**

Reference Books:

1) Tai Ran Hsu, “MEMS and Micro Systems: Design and Manufacture”, Tata McGraw Hill, 2002.
2) Boca Raton, “MEMS and NEMS: Systems, Devices and Structures”, CRC Press, 2002.
3) J. W. Gardner and V. K. Varadan, “Micro Sensors MEMS and SMART Devices”, John Wiley, 2002 N. Maluf, “Introduction to Micro Mechanical Systems Engineering, Artech House”, Norwood, MA, 2000.
4) V.K.Varadan, K.J.Vinoy and K.A.Jose, “RF MEMS and their Applications”, Wiley India Pvt Ltd, Reprint 2011.

21UECO761	Operations Research	(3-0-0) 3

Contact Hours: 39

Course Learning Objectives (CLOs):

This course aims to introduce students to use quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Recognize** the need for operation research.	-	2,4	1
CO-2	**Design** the alternative solutions for transportation problem.	-	2,3	4
CO-3	**Sequence** various operations in an establishment.	-	2	-
CO-4	**To comprehend** the characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.	-	-	5
CO-5	**Evaluate** various inventory control techniques and device the CPM and PERT methods for project management.	12	5	13

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	1	2	2	1.5	1.5	-	-	-	-	-	-	3	1	-

Pre-requisites: Management & Entrepreneurship, Basics of Statistics

Contents:

Unit-I

Introduction to OR: Basics definition, scope, objectives, phases, models and limitations of Operations Research.

Linear Programming Problem: Formulation of LPP, Graphical solution of LPP, Simplex Method, Artificial variables, big-M method. **08 Hrs**

Unit-II

Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method.

Assignment Model: Formulation, Hungarian method for optimal solution Solving unbalanced problem, Traveling salesman problem and assignment problem.

08 Hrs

Unit-III

Sequencing models Solution of Sequencing Problem – Processing n Jobs through 2 Machines – Processing n Jobs through 3 Machines – Processing 2 Jobs through m machines – Processing n Jobs through m Machines.

Decision theory Decision under uncertainty, Decision under certainty, Decision under risk, Decision trees, Game Theory, Two-person zero sum game, Competitive games. **08 Hrs**

Unit-IV

Game Theory Two-person zero sum game, Competitive games, rectangular game, saddle point, mini-max (maximin) method of optimal strategies, value of the game.

Replacement Models Replacement of Items that Deteriorate whose maintenance costs increase with time without change in the money value, Replacement of items that fail suddenly: individual replacement policy, group replacement policy. **08 Hrs**

Unit-V

Inventory Models Inventory costs, Models with deterministic demand – model (a) demand rate uniform and production rate infinite, model (b) demand rate non-uniform and production rate infinite, model (c) demand rate uniform and production rate finite.

Project Management Phases of project management, guide lines for network construction, CPM and PERT, Resource analysis in network scheduling, updating a project. **07 Hrs**

Reference Books:

1) A M Natarajan, P. Balasubramani, "Operation Research", 2nd Edition, Pearson Publications, 2014.
2) J.K. Sharma, "Operation Research : Theory and applications", 5th Edition, Macin Publishers, 2012.

3) Wayne L Winston, “Operations Research : Applications and Algorithms”, Duxbuty Press, 2003.
4) Hamdy H Taha, “Operations Research : An Introduction”, 9th Edition, Pearson Education, 2010.

VIII Semester

21UECL800	Technical Seminar	(0-0-2) 1

Contact Hours: 26

Course Learning Objectives (CLOs):

The objective of seminar is to prepare the students for independent study of the state-of-the-art topics in the broad areas of interest. The students are exposed to various aspects of seminar such as literature survey, organization of the material, technical writing and presentation skills.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Read and understand** technical topics from technical journals/ magazines.	-	1,2	6,7,12
CO-2	**Analyze** technical content and extract necessary information.	1,2	-	-
CO-3	**Organize** the topic in a systematic manner and **prepare** the report in a specific format	-	5	-
CO-4	**Present** the topic in a convincing manner	9,10	-	13
CO-5	**Inculcate** professional ethics and moral responsibilities	8	-	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	2.5	2.5	-	-	-	1	1	3	3	3	-	1	1	-

Technical Seminar: The students are expected to learn how to carry out literature survey to locate the state of the art technology in engineering domain of their interest. They are required to carry out selection of an emerging topic beyond the syllabus relevant to the branch of study, understand the concept, analyze and present effectively for 15-20 minutes followed by 5 minutes of questions and answers before their classmates and faculty. They can also present the technical innovative/novel work carried out in the laboratory. Students are also required to learn the effective communication and modalities of technical interactions. Further, they have to submit the seminar material in the form of a paper in IEEE format. All the students are required to attend all the sessions throughout the semester.

21UECL801	Major Project Phase - 2	(0-0-18) 9

Contact Hours: 234

Course Learning Objectives (CLOs):

The objectives of final year project are to:

- Allow students to demonstrate wide range of skills learned during their course of study by asking them to deliver a product that has passed through the design, analysis, testing and evaluation stages.
- Encourage multidisciplinary research through the integration of material learned in a number of courses.
- Allow students to develop problem solving, analysis, synthesis and evaluation skills.
- Encourage teamwork.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs(1-12)/ PSOs (13,14)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	**Arrive** at an optimal solution towards the problem identified	1,2,3,9	4	5,12
CO-2	**Implement** proposed solution in the form of development of software and/ or hardware prototype.	3,4,9,13, 14	5,6,7	12

CO-3	**Organize** the topics in a systematic manner and **prepare** report in a specific format	9,10,11	-	12
CO-4	**Present** the work in a systematic way	-	1,6,10	-
CO-5	**Adopt** professional ethics and responsibilities	8	11,12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	3	2.5	1	2	2	3	3	2.5	2.5	1.3	3	3

Major Project phase-II is the continuation from phase – I in which the students are expected to go for material collection, survey, visits, data collection, optimized design, analysis, model development, code writing, field work etc. The same project team formed for phase –I will continue the work under the guidance of the same faculty member. For all the projects, problems may be domain specific or interdisciplinary in nature. The guide will continuously monitor and evaluate the student project. Further, a review team will rigorously evaluate the project progress and completion.

21UECL802 Internship - 2 (4-6 weeks) 3

Contact Hours:4-6 weeks

Course Learning Objectives (CLOs):

By the end of this internship, students will be able to effectively apply the knowledge and skills acquired during their academic studies to real-world workplace scenarios. They will demonstrate the ability to work collaboratively within an interdisciplinary team, utilizing strong communication skills to contribute to team objectives and solve complex problems. Additionally, students will develop professional competencies that will enhance their future career prospects and workplace performance.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able	**Mapping to POs(1-12)/ PSOs (13,14)**

to:		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	**Acquire** practical experience in an organizational setting	1,2	-	-
CO-2	**Apply** the knowledge and skill set in engineering design processes appropriate to the internship program.	1,2,3,4	5	-
CO-3	**Apply** modern tools and processes to solve the live problems.	5	3,4	-
CO-4	**Get** an opportunity to learn new skills	10	11	-
CO-5	**Learn** strategies like time management, multi-tasking, communication and team work skills in an industrial setup.	8,9	12	-

POs/PSOs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Mapping Level	3	3	2.5	2.5	2.5	-	-	3	3	3	2	2	-	-

The students are to undergo internship in Private industries/R&D organizations/ Centre of Excellence/Laboratories of Reputed Institutions/Govt. & Semi Govt. organizations, PSUs, construction companies, entrepreneurial organizations, inter departments within the college etc. to get an exposure to the external world for a period of 4 weeks in the summer vacation after VI semester and before start of VII semester. The students are to prepare a report on the internship work carried out. The internal faculty shall monitor the student and award CIE marks. There is a SEE in which the student shall present the work before a panel of examiners consisting of HoD, Guide and one faculty member during VII semester. The performance shall be communicated to the CoE office and the same shall reflect in the VIII semester grade card.