DEPARTMENT

OF

ELECTRONICS & COMMUNICATION ENGINEERING

ECE

SCHEME & SYLLABUS

of

UG B.E. COURSE

(Autonomous)

Batch: 2020-24 & 2019 Scheme

VI Semester

Jan to Jun' 2023

Dayananda Sagar College of Engineering

Shavige Malleshwara Hills, Kumaraswamy Layout,
Banashankari, Bangalore-560078, Karnataka
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Web - http://www.dayanandasagar.eduEmail :hod-ece@dayanandasagar.edu
(An Autonomous Institute Affiliated to VTU, Approved by AICTE & ISO 9001:2008 Certified)
(Accredited by NBA, National Assessment & Accreditation Council (NAAC) with 'A' grade)

SCHEME
VI SEMESTER ECE (AUTONOMOUS COURSE)
2019 SCHEME 2020-24 BATCH 175 CREDITS

Sl. No	Course Code	Course Title	Teaching Dept.	Teaching Hours / Week			Examination			Total Credits
				L	T	P	CIE	SEE	Total	
1	19HS6ICEEM	Engineering Economics	ECE	3	1*	0	50	50	100	3
2	19EC6DCEAI	Embedded System & IOT Applications	ECE	4	0	0	50	50	100	4
3	19EC6DCFOV	Fundamentals of VLSI Design	ECE	3	1*	0	50	50	100	3
4	19EC6DCCCN	Computer Communication Networks	ECE	3	0	0	50	50	100	3
5	19EC6DEXXX	Dept. Elective – C	ECE	3	0	0	50	50	100	3
6	19EC6IEXXX	Institutional Elective – I	ECE	3	0	0	50	50	100	3
7	19EC6DLCCN	CCN &Embedded Lab	ECE	0	1	2	50	50	100	**2**
8	19EC6DLVLS	VLSI Lab	ECE	0	1	2	50	50	100	**2**
9	19EC6DCMPR	Mini Project	ECE	0	1	2	50	50	100	**3**
				19	05	06	450	450	900	26

ELECTIVE-C		INSTITUTION ELECTIVE-1	
19CE6IEPYP	Python Programming	19EC6IEFCV	Fundamentals of Computer Vision
19EC6DEACT	Automotive Communication Technology		
19EC6DEDIP	Digital Image Processing		
19EC6DEECC	Error Control Coding		

Mini-project	Internship
To be completed before VI semester. The examination for the same will be conducted during VI semester and accordingly credit is added. The mini-project is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the mini-project will be declared as failed and have to complete during subsequent examination after satisfying the internship requirements. Also, mini-project is considered for eligibility to VII semester.	All the students admitted to III year of BE have to undergo mandatory internship of 4 weeks during the vacations of VI and VII semesters and /or VII and VIII semesters. Examination will be conducted during VIII semester and prescribed credits are added to VIII semester. Internship is considered as a head of passing and is considered for the award of degree. Those, who do not take-up/complete the internship will be declared as failed and have to complete during subsequent examination after satisfying the internship requirements.

AICTE Activity Points : Students should complete the mandatory AICTE activity points of 50 (regular) & 25 (diploma) students and should submit the report at the end of the 8th semester.

Institution Elective: Students can select any one of the Institution electives offered by any Department. Candidate will be offered with an Institution elective,

If the candidate has not studied the same course during the earlier courses of the program.

The syllabus content of Institution elective is not similar to that of Departmental core courses or professional electives.

A similar course, under any category, is not prescribed in the higher semesters of the programme. Registration to electives shall be documented under the guidance of Programme Coordinator/ Adviser/Mentor.

* tough mathematical subjects introduced tutorial classes to solve additional problems

About the college & the department

Dayananda Sagar College of Engineering (DSCE), started in the year 1979, was founded by the Late Sri.R. Dayananda Sagar under the aegis of Mahatma Gandhi Vidya Peeta Trust (MGVP, Estd. 1960). DSCE has got widest choice of engineering branches having 15 Under Graduate courses & 13 Post Graduate courses. The Trust manages 28 educational institutions in the name of "Dayananda Sagar Institutions" (DSI) and multi – specialty hospitals in the name of Sagar Hospitals – Bangalore along with an medical college. Dayananda Sagar College of Engineering (DSCE) is approved by All India Council for Technical Education (AICTE), Govt. of India and is affiliated to Visvesvaraya Technological University (VTU), Belagavi, Karnataka. DSCE is accredited by NAAC, NBA and has ISO certification, also ranked by NIRF. In addition to the different institutions, it has got 20 Research Centres in different branches of Engineering catering to research scholars for obtaining Ph.D. under VTU.

One of the vibrant & oldest department is the ECE dept. & is the biggest in the DSI group with 50+ staffs & 1000+ students (UG/PG/PhD) with 20 Ph.D.'s & more than 25+ staffs pursuing their research in various universities across the country. At present, the department runs a UG programme (BE - ECE) with an intake of 240 with 2 PG programmes (M.Tech.), viz., VLSI Design Embedded Systems & Digital Electronics & Communications with an intake of 18 students each. The department has got an excellent infrastructure of 11 sophisticated labs catering to different ECE subjects, Texas Instruments Centre of Excellence, Antenna Architects Laboratory, 13 class rooms,a Full-fledged VTU R & D centre, a board room, a departmental library, etc… The Department of ECE was started in the year 1979 with an intake of 60 and has achieved a very good academic and research track record till date in all round aspects at the national & international levels. Currently, DSCE is an autonomous institution affiliated to the VTU, Belagavi. Funded projects of more than Rs. 1 Crore from DST, DRDO, ISRO, KSCST, etc... are completed & some of them are currently under progress. The department has highly qualified, trained & dedicated faculty having rich Industry and research experience belonging to varied specializations in the field of Electronics & Communication Engineering from reputed institutes like IITs, NITs, IISc., VTU, JNTU, Anna Univ., Gulbarga, Bangalore, Osmania Universities, etc.

Vision & Mission of the Institute (Engineering College)

Vision:

- To impart quality technical education with a focus on Research and Innovation emphasizing on Development of Sustainable and Inclusive Technology for the benefit of society.

Mission:

- To provide an environment that enhances creativity and Innovation in pursuit of Excellence.
- To nurture teamwork in order to transform individuals as responsible leaders and entrepreneurs.
- To train the students to the changing technical scenario and make them to understand the importance of sustainable and inclusive technologies.

Vision & Mission of the ECE Department

Vision :

- To achieve continuous improvement in quality technical education for global competence with focus on industry, societal needs, research and professional success.

Mission:

- Offering quality education in Electronics and Communication Engineering with effective teaching learning process in multidisciplinary environment.
- Training the students to take-up projects in emerging technologies and work with team spirit.
- To imbibe professional ethics, development of skills and research culture for better placement opportunities.

Program Education Objectives (PEO)

After four years, the students will be

PEO1 : ready to apply the state-of-art technology in industry and meeting the societal needs with knowledge of Electronics and Communication Engineering due to strong academic culture.

PEO2 : competent in technical and soft skills to be employed with capability of working in multidisciplinary domains.

PEO3 : professionals, capable of pursuing higher studies in technical, research or management programs.

Program Specific Outcomes (PSO)

PSO1 : Design, develop and integrate electronic circuits and systems using current practices and standards.

PSO2 : Apply knowledge of hardware and software in designing Embedded and Communication systems.

PROGRAM 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 conditions.
4. Conduct investigations on complex problems: Use research based knowledge and research methods including design of Experiments, analysis and interpretation of data, and synthesis of Information to provide valid conclusions.
5. Modern tool usage: Create, select, and apply appropriate technique, 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 society, 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 work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Lifelong 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.

ENGINEERING ECONOMICS

Course Code:19HS6ICEEM **Credits:** 03
L: P: T: S: 3: 0:1: 0 **CIE Marks:** 50
Exam Hours:03 **SEE Marks:** 50
Total Hours:40 **Total Marks :** 100

COURSE OBJECTIVES:

1. Expose the students to role and importance of engineering economics in decision making.
2. Equip the students with methods of evaluating investment decisions.
3. Establish decision making capabilities in investments alternatives.

COURSE OUTCOMES:

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

CO1	Identify the importance and role of engineering economy in investment decisions.
CO2	Understand the techniques of cash flows and interest calculations
CO3	Use present, annual & future worth comparisons for evaluation of investment decisions
CO4	Analyze and determine the various rates of reruns for different investments.
CO5	Plan a depreciation schedule for an asset and make break even decisions
CO6	Recommend decisions on replacement of equipment and assess the cost of product by considering the various elements of cost.

Mapping of Course outcomes to Program outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	-	2	-	1	-	1	3	2
CO2	2	3	2	2	2	2	-	1	-	1	3	3
CO3	2	3	3	2	2	2	-	1	-	1	3	2
CO4	3	3	3	2	2	2	-	1	-	1	3	2
CO5	3	3	3	2	2	2	2	1	-	1	3	2
CO6	3	3	2	2	2	3	3	1	-	1	3	2

Module	Course Content	Hours	COs
1	**Introduction to Engineering economics** - Engineering Decision makers, Engineering and Economics, Problem solving and Decision making, Intuition and Analysis, Tactics & Strategy. **Time value of Money** – Interest, Interest rate, simple interest & Compound interest, Nominal and Effective interest rate, Cash- flow diagrams for different situations, Numerical Exercises.	8	CO1 CO2
2	**Present Worth Comparison** - Conditions for present worth comparisons, Present worth by the 72 rule, Basic Present worth comparisons, Present worth equivalence, Net Present worth, Assets with equal and unequal lives, Future worth comparison, Pay back comparison, Numerical Exercises.	8	CO3
3	**Equivalent Annual Worth Comparisons**–Structure of a capital recovery annuity, Equivalent Annual Worth, Comparison methods, Situations for Equivalent Annual Worth Comparison, Consideration of asset life, comparison of assets with equal and unequal lives, Use of sinking fund method,Annual average cost method, Equivalent annual cost method, , Numerical Exercises. **Rate of Return Calculations:** Rate of return, Minimum acceptable rate of return, IRR, ERR, Numerical Exercises on Rate of return calculations.	8	CO3 CO4
4	**Depreciation:** Meaning of depreciation, Causes of Depreciation, methods of computing depreciation, Straight line method of depreciation, Declining balance method, Sum of year's digits method and Sinking fund method. **Breakeven analysis**: Introduction to breakeven analysis, calculation of BEQ, BEP, Numerical Exercises.	8	CO5
5	**Replacement Analysis**: Deterioration, obsolescence, inadequacy, Economic life for cycle replacements, individual replacement, Numerical Exercises. **Costing**: Elements of cost, Components of cost, preparation of cost sheet, Numerical Exercises.	8	CO6

SELF-STUDY COMPONENT/ASSIGNMENT:

Unit-1: Law of demand and supply, Law of returns.
Unit-2: Comparison of assets with infinite lives.
Unit-3: Rate of return calculations by using ERR method.
Unit-4: Depreciation computations by using double declining balance method
Unit-5: Group replacement analysis.

TEXT BOOKS:

1. RIGGS J.L., Engineering economy, *McGraw Hill*, 2002.
2. R PANEERSELVAM, Engineering Economics, PHI, *Eastern Economy Edition*, 2013.
3. NAIDU, BABU & RAJENDRA, Engineering Economy, *New Age international Publishers*, 2006.
4. M N Arora, Priyanka Katyal, Cost Accounting, *Vikas Publishing house*, 2nd Revised Edition, 2016.

REFERENCE BOOKS:

1. TARACHAND, *Engineering Economy*, 2000.
2. TUESENG., Engineering Economy, *Prentice Hall Inc.*, 9thedition, 2009.

Assessment Pattern:

CIE –Continuous Internal Evaluation Theory (50 Marks)
SEE – Semester End Examination Theory (50 Marks)

Bloom's Category	**Tests**	**Assignment**	**Quiz**
Marks (Out of 50)	**30**	**10**	**10**
Remember	05	04	04
Understand	05	02	02
Apply	10	02	02
Analyze	05	01	01
Evaluate	05	01	01
Create	-	-	-

EMBEDDED SYSTEM & IOT APPLICATIONS

Course Code :19EC6DCEAI **Credits :** 04
L : P : T : S : 4 : 0 : 0 : 0 **CIE Marks :** 50
Exam Hours :03 **SEE Marks :** 50
Total Hours :50 **CIE + SEE :** 100

COURSE OBJECTIVES:

1. To familiarize the basic design concepts of Embedded System Design and to introduce different processor architecture and working principles
2. To understand the memory concepts in detail and understand various embedded peripherals, communication protocols employed
3. Dealing with High level operating systems
4. To introduce emerging technological options, platforms and functions of Internet of Things (IoT).
5. To understand the technical aspects of IoT and machine-to-machine and to learn the platform designing methodology.
6. To have the various platform design for IoT.

COURSE OUTCOMES:

After completion of the course, the graduates will be able to

CO1	Understand the basic architecture of embedded system design and analyse different processor architecture..
CO2	Illustrate the working principles of different peripherals, memory subsystems and communication protocols.
CO3	Describe memory constraints and compatibility between peripherals and processors. To illustrate RTOS application
CO4	Illustrate the concepts of IoT, Architecture and different Reference Models , various Applications of IoT and Management Challenges in the Internet of Things
CO5	Understand IoT Hardware Development Platforms Past, Present, and Future.
CO6	Develop IoT applications to solve social problems.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	-	-	-	-	-	-	-
CO2	3	2	2	2	-	-	-	-	-	-	-	-
CO3	3	2	3	3	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-
CO6	3	2	2	2	-	-	-	-	-	-	-	-

Module	Contents of the Module	Hours	CO's
1	**Introduction:** Embedded System Overview, Design Challenges – Optimizing design metrics, Embedded Processor Technology: (Text Book-1). **Processors Architecture:** Advanced Processor Technology, Super Scalar and Vector Processors (Text Book 2).	10	CO1
2	**Memory Hierarchy, Bus and Cache:** Memory Hierarchy Technology, Virtual Memory Technology, Cache Memory Organizations (Text Book 3). **Interfacing, Peripherals and Interfacing**: General Purpose Microprocessors, Timers, Watchdog Timers, PWM, LCD, UART, Keypad Controller, Stepper Motor Controller, ADC	10	CO2 CO3
3	**Communication Protocols:** Serial Protocols: I2C, CAN and USB Parallel Protocols: PCI bus, (Text Book 1, 2). **Real Time Operating Systems:** Real Time and Embedded Operating Systems, Schedule Management for Multiple Tasks by an RTOS, Interrupt Routines in RTOS Environment, RTOS Task Scheduling models (Text Book 2, 3).	10	CO2 CO3 CO4
4	**Introduction to the Internet of Things:** Introduction, Definition of IoT, Proposed Architectures and Reference Models, Enabling Technologies, Application Areas: An Overview, Challenges. (Text Book 4). **Organizational Implementation and Management Challenges in the Internet of Things:**Introduction, IoT in Organizations, Managing IoT Systems. (Text Book 4).	10	CO5 CO1
5	**IoT Hardware Development Platforms Past, Present, and Future:**Introduction, IoT Hardware Development Platforms, IoT Hardware Development Platforms in the Past 9 Years, Current IoT Hardware Development Platforms, IoT Hardware Development Platforms in the Next 5 Years, Timeline of Evolution of the IoT Hardware Development Platforms. (Text Book 4).	10	CO5 CO6

NOTE:

1. Questions for CIE and SEE not to be set from self-study component.
2. Assignment Questions should be from self-study component only.

PRE-REQUISITES:

Micro-Processors and Micro-Controllers, Control Systems, Logic Design.

SELF-STUDY COMPONENT:

Module-1 : Understanding general Purpose and ASIC design, Data path, RT Level Sequential components, optimizing FSMD.
Module-2 : VLIW architecture, Scalable Architectures, 32 bit processors.
Module-3 : Problem solving capability in Cache Memory Implementation, understanding PCI – XPRESS.
Module-4 : Building the Blocks into the IoT.

TEXT BOOKS:

1. Frank Vahid, Tony Givargis, "Embedded System Design: A Unified Hardware / Software Approach", *John Wiley and Sons*.
2. Kai Hwang, "Advanced Computer Architecture", *Tata McGraw Hill*, India.
3. Raj Kamal, "Embedded Systems – Architecture, Programming and Design", *Tata McGraw Hil*l.
4. Hassan, Q.F., Atta ur, R.K., &Madani, S.A. (2017). "Internet of Things: Challenges, Advances, and Applications" (1st ed.),*CRC Press*, https://doi.org/10.1201/9781315155005

REFERENCE BOOKS:

1. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", *John Wiley India Pvt. Ltd*., 2008.
2. Shibu K.V., "Introduction to Embedded Systems", *Tata McGraw Hill Education*, India.
3. Tammy Noergaard, "Embedded Systems Architecture – A Comprehensive Guide for Engineers and Programmers," *Elsevier Publication*, 2005
4. Dreamtech Software Team, "Programming for Embedded Systems", *John Wiley India* Pvt. Ltd, 2008.
5. OvidiuVermesan and Peter Friess, "The River Publisher Series in Communications, Internet of Things – Converging Technologies for Smart Environments and Integrated Ecosystems", *Edition* - 2013.
6. Massimo Banzi, "Getting Started with Arduino (Make: Projects)", *O'Reilly Media*, 2008.
7. Mike Kuniavsky, "Smart Things: Ubiquitous Computing User Experience Design", *Morgan Kaufmann Publishers*, 2010.
8. Sara Cordoba, WimerHazenberg, Menno Huisman, "Meta Products: Building the Internet of Things", *BIS Publishers*, 2011.
9. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A Hands on Approach", 1st Edition, 2015.

MOOCS :

https://onlinecourses.nptel.ac.in/noc19_cs46/preview
https://www.coursera.org/learn/iot

Scheme of Evaluation of the CIE & Assessment Pattern :

Assignment : Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro' the semester or in between 2nd& 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class, the questions have to be set according to easy, medium, tough & severe and evaluation to be done as per the assignment evaluation rubrics.

Quiz : There will be 1 quiz of 10 marks consisting of 10 questions of multiple choice of 1 marks each, which may be conducted along with the 2nd CIE test and written in the answer booklet at the end.

CIE : There will be 3 CIE tests in a semester conducted for 50 marks each with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems) & finally each CIE will be reduced to 10 Marks and totalled up for 30 Marks and then rounded off to the nearest integer. There has to be choices in the descriptive questions & the questions has to be set module/unit-wise only. The total CIE marks is for 50 and is the total of averaged CIE + Assignment of 10 marks & Quiz of 10 marks.

CIE – Continuous Internal Evaluation Theory (50 Marks)

Bloom's Category	**Tests - 3 CIEs**	**Assignments - 1 No.**	**QUIZ - 1 No.**
Marks (out of 50)	**30**	**10**	**10**
Remember	10		
Understand	05	05	
Apply	05		
Analyze	05	05	
Evaluate	05		
Create			

SEE – Semester End Examination Theory (50 Marks)

Bloom's Category	**Marks Theory (50)**
Remember	10
Understand	10
Apply	05
Analyze	05
Evaluate	05
Create	05

FUNDAMENTALS OF VLSI DESIGN

Course Code: 19EC6DCFOV **Credits :**03
L : P : T : S : 3 : 0 : 1 : 0 **CIE Marks :** 50
Exam Hours :03 **SEE Marks :** 50
Total Hours :40 **CIE + SEE :** 100

COURSE OBJECTIVES:

1. To understand the basic concepts of MOSFET and study of MOSFET based circuits.
2. To understand the basic fabrication process and lambda-based design rules.
3. To acquire the knowledge of combinational circuits used in data path subsystems and additional CMOS logic structures.
4. To analyse CMOS logic gates design.
5. To apply MOSFET properties for memory cell design.
6. To understand the concept of MOSFET based single stage amplifiers.

COURSE OUTCOMES:

After completion of the course, the graduates will be able to

CO1	Illustrate and analyse the working and fabrication of MOS technologies.
CO2	To analyse the Switching Characteristics of MOSFET, Sketch the schematic and stick diagram CMOS circuits by Apply Lambda based rules.
CO3	Design complex logic functions using CMOS and advanced CMOS logic
CO4	Analyse CMOS subsystem design and Construct memory arrays subsystem.
CO5	Design and analyse amplifiers, current mirrors circuits
CO6	Design and simulate MOSFET based circuits using CADENCE/Micro wind tool.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	1		-	-	-	-	-	-	-
CO2	3	2	2	2	1	-	-	-	-	-	-	-
CO3	3	3	3	2	1	-	-	-	-	-	-	-
CO4	3	3	1	1		-	-	-	-	-	-	-
CO5	3	2	2	2		-	-	-	-	-	-	-
CO6	3	3	2	2	2	-	-	-	1	1	-	-

Module	Contents of the Module	Hours	CO's
1	**An overview of VLSI :** Complexity and design, basic concepts **Basic MOS Technology:** Introduction to MOS transistors, nMOS fabrication, CMOS fabrication, Bi-CMOS technology. (Text book-1) **Logic Design with MOSFETs:** Ideal switches and Boolean operations, MOSFETs as switches, Basic logic gates in CMOS, Complex logic gates in CMOS,Transmission gates (Text book-2)	8	CO1 CO2
2	**Circuit Design Processes:** MOS layers, Stick diagrams, Design rules and layout – lambda-based design and other rules. Examples. (Text book-1) **CMOS Sub System Design:** Introduction, Addition/Subtraction, Single bit addition, Full adder design, Comparators, LFSR,XOR/XNOR circuits (Text book-3)	8	CO2 CO4
3	Electronic Analysis of CMOS Logic gates: DC Characteristics of CMOS Inverter, Inverter switching characteristics, Power dissipation, DC Characteristics of NAND and NOR gates. NAND and NOR transient response, Analysis of Complex logic gates, Gate design and transient response.(Text book-3) Clocked Latch and Flip Flop circuits (D-Latch, D-FF, MS JK Flip Flop) (Text book -6)	8	CO2 CO3
4	**Advanced CMOS Logic Structures:** Mirror circuits, Pseudo-nMOS Logic, Tristate circuits, Clocked CMOS Logic, Dynamic CMOS Logic circuits (Text book-2) **Array Subsystems:** Introduction, Static Random-Access Memory (SRAM), Dynamic Random-Access Memory (DRAM), Read only Memory, Serial Access Memories, Content addressable memory. (Text 3)	8	CO3 CO4
5	**The MOS Amplifiers:** Single-Stage MOS Amplifiers : The basic structure, Characterizing amplifiers Common-Source (CS) Amplifier, The Common-Source Amplifier resistive load , The Common-Gate (CG) Amplifier ,The Common-Drain or Source-Follower Amplifier (Text book -4), Differential amplifier (4.1-4.4), **Differential Amplifiers & Current Mirrors:**Basic difference pair, common mode/differential mode responses, Differential pair with MOS loads, basic current mirrors (Text book-B. Razavi:-section 4.1 to 4.4 full). (Text book -6)	8	CO1 CO5

NOTE:

1. Questions for CIE and SEE not to be set from self-study component.

2. Assignment Questions should be from self-study component only.

PRE-REQUISITES:

Digital Electronic Circuits and Analog Electronic Circuits.

TEXT BOOKS:

1. Douglas A. Pucknell, Kamran E., "Basic VLSI Design", 3rd Edition, *PHI Publication*, India.
2. John P.Uyemura, "Introduction to VLSI Circuits and Systems", *Wiley India Edition*, 3rd print, 2007.
3. Neil H.E. Weste, Harris, Banerjee, "CMOS VLSI design", *Pearson*, Third Edition, 2007.
4. Adel A. Sedra and K.C. Smith, "Microelectronics Circuits", 7th edition, *Oxford University Press*, *International Version*, 2009.
5. Sung Mo Kang &YosufLeblebici, "CMOS Digital Integrated Circuits: Analysis and Design", *Tata McGraw-Hill*, Third Edition.
6. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", *TMH*, India, 2007.

REFERENCE BOOKS:

1. Behzad Razavi, "Fundamentals of Microelectronics", *John Wiley India*Pvt. Ltd, 2008.
2. Neil Weste and K. Eshragian, "Principles of CMOS VLSI Design: A System Perspective", Second Edition, *Pearson Education* (*Asia*) *Pvt. Ltd*. 2000.
3. Jhon P Uyemura, "Introduction to VLSI Circuits and Systems", *Wiley India* (*P*) *Ltd*., New Delhi, 2002.
4. Sung Mo Kang & Yusuf Leblebici, "CMOS Digital Integrated Circuits: *Analysis and Design*", 3rdEdition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
5. D.A. Hodges, H.G. Jackson and R.A. Saleh, "Analysis and Design of Digital Integrated Circuits", 3rd Edition, *Tata McGraw-Hill Publishing Co. Limited*, New Delhi, 2007.

Scheme of Evaluation of the CIE & Assessment Pattern :

Assignment : Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro' the semester or in between 2nd& 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class, the questions has to be set according to easy, medium, tough & severe and evaluation to be done as per the assignment evaluation rubrics.

Quiz : There will be 1 quiz of 10 marks consisting of 10 questions of multiple choice of 1 marks each, which may be conducted along with the 2nd CIE test and written in the answer booklet at the end.

CIE : There will be 3 CIE tests in a semester conducted for 50 marks each with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems) & finally each CIE will be reduced to 10 Marks and totalled up for 30 Marks and then rounded off to the nearest integer. There has to be choices in the descriptive questions & the questions has to be set module/unit-wise only. The total CIE marks is for 50 and is the total of averaged CIE + Assignment of 10 marks & Quiz of 10 marks.

CIE – Continuous Internal Evaluation Theory (50 Marks)

Bloom's Category	Tests - 3 CIEs	Assignments - 1 No.	QUIZ - 1 No.
Marks (out of 50)	**30**	**10**	**10**
Remember	10		
Understand	05	05	
Apply	05		
Analyze	05	05	
Evaluate	05		
Create			

SEE – Semester End Examination Theory (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	10
Understand	10
Apply	05
Analyze	05
Evaluate	05
Create	05

COMPUTER COMMUNICATION NETWORKS

Course Code :19EC6DCCCN **Credits :** 03
L : P : T : S : 3 : 0 : 0 : 0 **CIE Marks :** 50
Exam Hours : 03 **SEE marks :** 50
Total Hours: 40 **CIE + SEE :**100

COURSE OBJECTIVES:

1. To teach and make the students learn the need and role of networking in embedded applications
2. To make the students familiarize different models of networking like OSI and TCP/IP
3. To make the students understand the functionality and responsibilities of each layer in Networking
4. To impart programming skill sets while working on different layers of data structures concepts.

COURSE OUTCOMES:

At the end of the course, student will be able to

CO 1	Apply the basic knowledge on the diverse networks, its topologies, components, protocols and the different layers of the OSI and TCP/IP model to ensure the error free transmission of data
CO 2	Analyse the several access techniques, protocols and standards of Data Link Layer
CO 3	Design subnet masks and addresses to accomplish networking requirements
CO 4	Apply various routing algorithms over a network to provide an optimal path from source to destination
CO 5	Analyse the features and operations of various Transport and congestion in networks
CO 6	To understand the concepts of various network applications.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	-	-	-	-	-	-	-	-	-
CO2	3	1	2	-	-	-	-	-	-	-	-	-
CO3	3	3	3	2	3	-	-	-	2	-	-	-
CO4	3	3	3	~~2~~	3	-	-	-	2	-	-	-
CO5	3	3	2	2	-	-	-	-	1	-	-	-
CO6	3	-	-	-	-	-	-	-	-	-	-	-

Module	COURSE CONTENT	Hours	CO's
1	DATA COMMUNICATIONS: Components – Direction of Data Flow – Networks- – Topologies- Modes of data Transmission – Protocols and Standards- – Components and Categories – Types of Connections– ISO / OSI model –TCP/IP, Digital Multiplexing , Packet Switching.	7	CO1
2	DATA LINK LAYER: Flow Control and Error control – Stop and Wait – Go Back N ARQ – Selective Repeat ARQ – Sliding Window Techniques – HDLC – LAN – Ethernet IEEE 802.3 (Only Description) IEEE 802.4 and IEEE 802.5 – IEEE 802.11–FDDI – Bridges	8	CO2 CO6
3	NETWORK LAYER: Internet works –– IPv4 and IPv6, Transition from IPv4 to IPv6, Subnetting, Routing – Distance Vector Routing – Link State Routing – Routers.	8	CO1 CO2 CO3 CO5
4	TRANSPORT LAYER: Duties of Transport Layer – Multiplexing – Demultiplexing – Sockets – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Congestion Control – Quality of Services (QOS).	9	CO1 CO4 CO5 CO6
5	APPLICATION LAYER: Principles of Network Application – Domain Name Space (DNS)- DNS in the Internet, Resolution, E-mail- Architecture, User agent, Message transfer Agent, FTP- FTP and Anonymous FTP, The WEB- WEB documents, HTTP, Network Management: SNMP, Structure of management information, Management information base	8	CO1 CO5 CO6

NOTE :1. Questions for CIE and SEE not to be set from self-study component.
2. Assignment Questions should be from self-study component only.

Self-Study component:

Module 1: Telephone networks, Dial up modems, Digital subscriber line, Cable TV networks, Cable TV for data transfer.
Module 2: Point to Point protocols, Bluetooth, Cellular telephony, Satellite networks
Module 3: Address mapping, ICMP, IGMP, ICMPv6
Module 4: SCTP, Network management system, SNMP
Module 5: Security services, Message confidentiality, Integrity, authentication, management.

TEXT BOOKS:

1. Behrouz A. Foruzan, "Data communication and Networking", *Tata McGraw-Hill*, Fourth edition, 2013.
2. James F. Kurouse& Keith W. Ross, "Computer Networking: A Topdown Approach Featuring", *Pearson Education*, Third edition.

REFERENCE BOOKS:

1. Andrew S. Tannenbaum, "Computer Networks", *PHI*, Fourth Edition, 2003.
2. William Stallings, "Data and Computer Communication", Sixth Edition, *Pearson Education*, 2000.
3. Larry L.Peterson & Peter S. Davie, "Computer Networks", *Harcourt Asia Pvt. Ltd.*, Second Edition.

Scheme of Evaluation of the CIE & Assessment Pattern :

Assignment : Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro' the semester or in between 2nd& 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class, the questions has to be set according to easy, medium, tough & severe and evaluation to be done as per the assignment evaluation rubrics.

Quiz : There will be 1 quiz of 10 marks consisting of 10 questions of multiple choice of 1 marks each, which may be conducted along with the 2nd CIE test and written in the answer booklet at the end.

CIE : There will be 3 CIE tests in a semester conducted for 50 marks each with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems) & finally each CIE will be reduced to 10 Marks and totalled up for 30 Marks and then rounded off to the nearest integer. There has to be choices in the descriptive questions & the questions has to be set module/unit-wise only. The total CIE marks is for 50 and is the total of averaged CIE + Assignment of 10 marks & Quiz of 10 marks.

CIE – Continuous Internal Evaluation Theory (50 Marks)

Bloom's Category	**Tests - 3 CIEs**	**Assignments - 1 No.**	**QUIZ - 1 No.**
Marks (out of 50)	**30**	**10**	**10**
Remember	10		
Understand	05	05	
Apply	05		
Analyze	05	05	
Evaluate	05		
Create			

SEE – Semester End Examination Theory (50 Marks)

Bloom's Category	**Marks Theory (50)**
Remember	10
Understand	10
Apply	05
Analyze	05
Evaluate	05
Create	05

Python Programming
(Elective Subject)

Course Code: 19CE6IEPYP | **Credits:** 03
L : P : T : S : 3 : 0 : 0 : 0 | **CIE Marks :** 50
Exam Hours:03 | **SEE Marks :** 50
Total Hours:40 | **CIE + SEE Marks :** 100

COURSEOBJECTIVES:

1. Understand the core syntax and semantics of Python programming language& to define the need for working with the strings and functions.
2. Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
3. Indicate the use of regular expressions and built-in functions to navigate the file system.
4. Infer the object-oriented Programming concepts in Python.

COURSE OUTCOMES: At the end of the course, student will be able to

CO1	Apply the fundamental Python syntax and semantics to solve simple computational problems and interpret the concepts of strings and functions in Python.
CO2	Develop programs using Object oriented methodologies to solve variety of problem statements and compare them with Procedural oriented methodologies.
CO3	Construct programs using data structures and regular expressions, to solve given problem statement.
CO4	Design and Develop solutions by implementing appropriate algorithm and Programming techniques.
CO5	Build applications in math science, business, and games using Python and Debug the logical and syntax errors.
CO6	Adapt good software engineering practices and demonstrate programming skills to develop an application.

Mapping of Course outcomes to Program outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	-	-	-	-	-	-	-
CO2	3	2	2	1	1	-	-	-	-	-	-	-
CO3	3	2	2	1	1	-	-	-	-	-	-	-
CO4	3	2	2	1	2	-	-	-	-	-	-	-
CO5	3	2	2	1	2	-	-	2	2	-	-	-

Module	Course Content	Hours	COs
1	**Introduction to Python Programming:** History, Application of Python, Identifiers, Keywords, Statements and Expressions, Variables, Operators, Data Types, Type Conversions. **Control Flow Statements:** The if, if…else, if…elif…else, Decision Control Flow Statement, Nested if Statement, The while, for Loop, The continue and break Statements, **Functions**: Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function,ThereturnStatementandvoidFunction, **Strings:**Basic String Operations, Accessing Characters in String byIndex Number, String Slicing and Joining, String Methods.	08	CO1, CO2, CO3, CO4
2	**Object-Oriented Programming:** Classes and Objects, Creating Classes in Python, Creating Objects in Python, The Constructor Method, Encapsulation, Inheritance, Polymorphism.	08	CO1, CO2, CO5, CO6
3	**Arrays and Linked Structures**: The Array Data Structure, Operations on Arrays, Two-Dimensional Arrays (Grids), Linked Structures, Operations on Singly Linked Structures, Variations on a Link **Searching Algorithms:** Search for the Minimum, Sequential Search of a List, Binary Search of a Sorted List **Sorting Algorithms:** Selection Sort, Bubble Sort, Insertion Sort	08	CO1, CO3, CO4, CO5
4	**Lists:** Basic List Operations, Indexing and Slicing in Lists, Built- In Functions used on Lists, List Methods. **Dictionaries:**CreatingDictionary,AccessingandModifyingkey: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries,DictionaryMethods. **Tuplesand Sets:** Basic Tuple Operations, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, TupleMethods. Sets, Set Methods, Traversing of Sets.	08	CO1, CO3, CO5
5	**Files**: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, The Pickle Module, Reading and Writing CSV Files, **Regular Expression Operations:** Using Special Characters, Regular Expression Methods, Named Groups in Python Regular Expressions, Regular Expression with glob Module.	08	CO5, CO6

SELF-STUDY COMPONENTS:

Module 1 : Precedence and Associativity, Indentation, Comments, Reading Input, Print Output, The type() Function and Is Operator, Dynamic and Strongly Typed Language, Catching Exceptions Using try and except Statement, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments. Formatting Strings, Programming using tool, Simulation of programs

Module 2 : Classes with Multiple Objects, Class Attributes versus Data Attributes

Module 3 : Complexity analysis of searching and sorting algorithms, simulation of algorithms

Module 4 : The Del Statement of List and Dictionary, zip () Function

Module 5 : Python os and os.path Modules. Programming using tool

TEXT BOOKS :

1. Kenneth Lambert – "Fundamentals of Python_ Data Structures", *Cengage Learning PTR* (2013).
2. Gowrishankar S, Veena A, "Introduction to Python Programming", 1st Edition, *CRC Press/Taylor & Francis*, 2018. ISBN-13: 978-0815394372.
4. Mark Lutz, "Programming Python", 4th Edition, *O'Reilly Media*, 2011.ISBN-13: 978-9350232873.
5. Zed A. Shaw, "Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code", *Addison-Wesley Professional*,Year: 2017, ISBN: 0134692888, 9780134692883.

REFERENCES BOOKS:

1. Cody Jackson ,"Learning to Program using Python", Second Edition, 2014.
2. Michael DAWSON, "Python Programming",3rd Edition, Course technology PTR, 2010
3. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India
4. Kent D. Lee, Steve Hubbard, "Data Structures and Algorithms with Python, Springer, 2015
6. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition,CreateSpace Independent Publishing Platform, 2016.http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf
7. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition,Green Tea Press, 2015.(http://greenteapress.com/thinkpython2/thinkpython2.pdf)

On-Line Materials & Resources (NPTEL courses / Video lectures / You-tube Videos / Power points / On-line notes / web-links :

1. https://nptel.ac.in/courses/106/106/106106182/
2. https://nptel.ac.in/courses/115/104/115104095/
3. https://www.edx.org/learn/python
4. https://www.coursera.org/courses?query=python
5. https://www.udemy.com/topic/python/
6. https://online-learning.harvard.edu/subject/python
7. https://www.codecademy.com/learn/learn-python
8. https://www.geeksforgeeks.org/python-programming-language/
9. https://www.lynda.com/Python-training-tutorials/415-0.html
10. https://www.python.org/

Scheme of Evaluation of the CIE & Assessment Pattern :

Assignment : Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro' the semester or in between 2nd& 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class, the questions has to be set according to easy, medium, tough & severe and evaluation to be done as per the assignment evaluation rubrics.

Quiz : There will be 1 quiz of 10 marks consisting of 10 questions of multiple choice of 1 marks each, which may be conducted along with the 2nd CIE test and written in the answer booklet at the end.

CIE : There will be 3 CIE tests in a semester conducted for 50 marks each with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems) & finally each CIE will be reduced to 10 Marks and totalled up for 30 Marks and then rounded off to the nearest integer. There has to be choices in the descriptive questions & the question has to be set module/unit-wise only. The total CIE mark is for 50 and is the total of averaged CIE + Assignment of 10 marks & Quiz of 10 marks.

CIE – Continuous Internal Evaluation Theory (50 Marks)

Bloom's Category	Tests - 3 CIEs	Assignments - 1 No.	QUIZ - 1 No.
Marks (out of 50)	**30**	**10**	**10**
Remember	10		
Understand	05	05	
Apply	05		
Analyze	05	05	
Evaluate	05		
Create			

SEE – Semester End Examination Theory (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	10
Understand	10
Apply	05
Analyze	05
Evaluate	05
Create	05

Automotive Communication Technology
(Elective Subject)

Course Code:19EC6DEACT **Credits:** 03
L : P : T : S : 3 : 0 : 0 : 0 **CIE Marks :** 50
Exam Hours:03 **SEE Marks :** 50
Total Hours:40 **CIE + SEE Marks :** 100

COURSE OBJECTIVES:

1. To understand the basic concepts of communication in automotive electronics
2. To gain knowledge on standard protocols used in road vehicles
3. To acquire insights of the various Diagnostic services used in automotive technology
4. To summarize the operation of Ethernet Protocol
5. To describe the relevance of RTOS in automotive electronics

COURSE OUTCOMES:

After completion of the course, the graduates will be able to

CO1	Understand Communication fundamentals and principles in a vehicle based on OSI model
CO2	Analyze the different data communication protocols in a vehicle based on CAN, LIN and Flex ray
CO3	Understand basics of Diagnostics, Unified Diagnostic services handling in a vehicle; Insights into UDS implementation based on CAN protocol
CO4	Comprehend data communication process in a vehicle based on Ethernet protocol; Illustrate different protocols involved in Ethernet in network Layer
CO5	Apply the principles of Real Time Operating Systems, the different system characteristics of RTOS and its relevance in designing Electronic Control Units inside a vehicle
CO6	Usage of modern tools to interpret the standard protocols in vehicles

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	-	2	-	-	-	-	-	-	1
CO2	3	1	1	-	-	-	-	-	-	-	-	-
CO3	3	1	1	-	-	-	-	-	-	-	-	-
CO4	3	1	1	-	-	-	-	-	-	-	-	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-
CO6	3	1	1	-	-	-	-	-	-	-	-	-

Module	Contents of the Unit	Hours	COs
1	**Introduction** History of Automotive Electronics, Data communication: Communication principles, Introduction to data communication, introduction to OSI model, CAN Protocol: Introduction, Characteristics of CAN (CAN frame format and arbitration), CAN controller, CAN Physical Layer, CAN datalink Layer, Error detection.	08	CO1 CO6
2	**Local Interconnect Network (LIN) protocol:** History and overview, physical layer, Protocol specification Flexray protocol: History and overview, Flexray network topology, physical layer, Data link layer, Clock synchronization	08	CO2 CO6
3	**Diagnostic Protocols:** Introduction, Diagnostics on CAN, Structure of Diagnostic services, Addressing schemes, Data segmentation, Diagnostic message flows Unified Diagnostic services: Introduction, Standardized services, structure of UDS messages, UDS communication message flows, Diagnostic sessions	08	CO3
4	**Wired LANs-Ethernet:** IEEE standard, standard Ethernet, Bridged, switched, full-duplex Ethernet. Fast Ethernet, GIGABit Ethernet, Wireless LANs: IEEE 802.11. Bluetooth Network Layer; Address mapping, ICMP, ARP, NDP, IGMP, ICMPV6 Different types of media independent interface like RJ45	08	CO4
5	**Real Time Operating Systems:** Operating System Basics , Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task Communication, Task Synchronisation, Device Drivers	08	CO5

TEXT BOOKS:

1. ChristophMarscholik, Peter Subke, "Road vehicles-Diagnostic communication", *University science press.*
2. Behourz A. Forouzan, "Data Communications and Networking",*McGraw Hill companies* 4th edition
3. ShibuKizhakkeVallathai, " Introduction to embedded systems".

REFERENCE MATERIALS:

1. John Catsoulis, "Designing Embedded hardware".
2. Embedded systems by "Rajkamal", McGraw Hill companies,second edition.

Scheme of Evaluation of the CIE & Assessment Pattern :

Assignment : Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro' the semester or in between 2nd& 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class, the questions has to be set according to easy, medium, tough & severe and evaluation to be done as per the assignment evaluation rubrics.

Quiz : There will be 1 quiz of 10 marks consisting of 10 questions of multiple choice of 1 marks each, which may be conducted along with the 2nd CIE test and written in the answer booklet at the end.

CIE : There will be 3 CIE tests in a semester conducted for 50 marks each with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems) & finally each CIE will be reduced to 10 Marks and totalled up for 30 Marks and then rounded off to the nearest integer. There has to be choices in the descriptive questions & the questions has to be set module/unit-wise only. The total CIE marks is for 50 and is the total of averaged CIE + Assignment of 10 marks & Quiz of 10 marks.

CIE – Continuous Internal Evaluation Theory (50 Marks)

Bloom's Category	**Tests - 3 CIEs**	**Assignments - 1 No.**	**QUIZ - 1 No.**
Marks (out of 50)	**30**	**10**	**10**
Remember	10		
Understand	05	05	
Apply	05		
Analyze	05	05	
Evaluate	05		
Create			

SEE – Semester End Examination Theory (50 Marks)

Bloom's Category	**Marks Theory (50)**
Remember	10
Understand	10
Apply	05
Analyze	05
Evaluate	05
Create	05

DIGITAL IMAGE PROCESSING
(Elective Subject)

Course Code :19EC6DEDIP **Credits :** 03
L : P : T : S : 3 : 0 : 1 : 0 **CIE Marks :** 50
Exam Hours :03 **SEE Marks :** 50
Total Hours :40 **CIE + SEE :** 100

COURSE OBJECTIVES:

1. Review the basics of Digital Image Processing.
2. Study different spatial and frequency domain image enhancement algorithms.
3. Appraise 2-D filtering and image restoration techniques.
4. Study on Line and Edge detection.
5. Study thresholding and different segmentation techniques.

COURSE OUTCOMES:

After completion of the course, the graduates will be able to

CO1	Relate human visual system with the fundamentals of IP techniques and discuss the fundamental components and steps in IP and also various frequency domain filtering techniques
CO2	Illustrate the process of image acquisition using image sensors, image sampling and quantization.
CO3	Demonstrate and analyze the different relationships between the pixels.
CO4	Employ various transforms like DCT, DFT, Hadamard on image
CO5	Categorize and apply various point processing techniques for image enhancement and categorize restoration techniques
CO6	Analyse various segmentation techniques and also various spatial filtering techniques

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	2	-	-	1	2	1	1	1
CO2	3	3	1	-	-	-	-	1	2	1	1	1
CO3	3	3	2	1	2	-	-	1	2	1	1	1
CO4	3	3	1	1	2	-	-	1	2	1	1	1
CO5	3	3	2	1	2	-	-	1	-	1	1	1
CO6	3	3	2	1	2	-	-	1	2	1	1	1

Module	Contents of the Module	Hours	COs
1	**Introduction to image processing**: Fundamental Steps, Components, Elements of visual perception: Image formation in the eye, Brightness adaptation and Discrimination, Image Sensing and acquisition: Image acquisition using sensor Arrays, Image sampling and quantization, Basic relationship between pixels (Text book 1 & 2).	8	CO1
2	**Image Enhancement in the Spatial Domain**: Some Basic gray level transformations, Histogram processing, Spatial filtering-Introduction to smoothing spatial filters and Sharpening spatial filters(Text book 1).	8	CO2
3	**Image Transforms**: Two dimensional Orthogonal and unitary Transforms, Properties of Unitary Transforms, 1D-DFT, 2D-DFT, DCT, Hadamard transform (Text book 1 & 3).	8	CO3
4	**Image Enhancement in frequency Domain**: Basics of filtering in the frequency domain, Image Smoothing and Image Sharpening using Frequency domain filters. **Image Restoration**: Model of image degradation/restoration process, noise models, Spatial filtering (Textbook 1).	8	CO4
5	**Image Segmentation**: Fundamentals, Edge detection, Edge linking via Hough Transform, Threshold based segmentation, Region Based Segmentation, Segmentation using Morphological Watersheds (Textbook 1 & 3).	8	CO5 CO6

PRE-REQUISITES: Signal & systems, Digital Signal Processing, Engineering Mathematics

SELF-STUDY COMPONENT:

Unit 1 : Linear and Nonlinear Operations, Image resizing, Spatial resolution reduction using MATLAB.

Unit 2 : Arithmetic / Logic Operations, Brightness and contrast modification using MATLAB, Histogram of an image using MATLAB.

Unit 3 : Sine transforms, 2D DFT for a given input matrix using MATLAB, 2D forward and inverse DCT in MATLAB.

Unit 4 : Homomorphic filtering, Ideal LPF in frequency domain uses MATLAB.

Unit 5 : Basic global thresholding, Basic Adaptive thresholding.

TEXTBOOKS:

1. R.C. Gonzalez, R.E. Woods, "Digital Image Processing", 3rd edition, *Pearson Education*, 2009.
2. S. Jayaraman, S. Esakkirajan, T. Veerakumar, "Digital Image Processing", 2009, *Mc Graw Hill Education*, India.
3. Dr. Vipula Singh," Digital Image Processing with MATLAB & LabVIEW", *Reed Elsevier India Pvt. Ltd.*
4. Dr. Pavithra G., *et.al*., "Image Processing & Machine Vision", 200 pages, *Notion Press Publications*, India.

REFERENCE BOOKS:

1. R.C. Gonzalez, R.E. Woods, S.L. Eddins, "Digital Image Processing using MATLAB", 2nd Edition, *Addison* Wesley, 2009.
2. Anil. K. Jain, "Fundamentals of Digital Image Processing", *Pearson Education*, 2002.
3. B. Chanda and D. Dutta Majumdar, "Digital image processing and analysis", *PHI*, New Delhi, India, 2003.
4. Dr. Pavithra G. *et.al*., "Computer Vision & Techniques", 195 pages, ISBN 978-1-68509-224-5, *Notion Press Publi*cations, India.

WEB LINKS :http://nptel.ac.in/courses/117105079/

Scheme of Evaluation of the CIE & Assessment Pattern :

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CIE – Continuous Internal Evaluation Theory (50 Marks)

Bloom's Category	Tests - 3 CIEs	Assignments - 1 No.	QUIZ - 1 No.
Marks (out of 50)	**30**	**10**	**10**
Remember	10		
Understand	05	05	
Apply	05		
Analyze	05	05	
Evaluate	05		
Create			

SEE – Semester End Examination Theory (50 Marks)

Bloom's Category	Marks Theory (50)
Remember	10
Understand	10
Apply	05
Analyze	05
Evaluate	05
Create	05

ERROR CONTROL CODING
(Elective Subject)

Course Code :19EC6DEECC **Credits :** 03
L : P : T : S : 3 : 0 : 1 : 0 **CIE Marks :** 50
Exam Hours :03 **SEE Marks :** 50
Total Hours :40 **CIE + SEE Marks :** 100

COURSE OBJECTIVES:

1. To learn linear algebra as a prerequisite to error control coding concepts
2. Understand different types of error control coding and decoding techniques
3. To get clear understanding in formulation and computation of Linear Block Codes, Cyclic Codes and BCH Codes.
4. To understanding Convolutional Codes
5. Implement different error detection and correcting circuits
6. To provide knowledge about detection and correction of errors using various coding techniques.

COURSE OUTCOMES: At the end of the course, the student will be able to

CO1	Apply the concept of linear algebra for the error control coding technique
CO2	Construct and Implement LBC, Cyclic codes, convolutional encoder and decoders
CO3	Apply the Viterbi algorithm to decode a convolutional code
CO4	Design error detection and correction codes using Linear Block code, Cyclic codes and Convolutional codes.
CO5	Illustrate the concepts of concatenated and turbo codes
CO6	Work in a team to simulate various coding techniques

Mapping of Course outcomes to Program outcomes:

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**
CO1	3	2	2	-	-	-	-	-	-	-	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-
CO6	2	2	1	-	2	-	-	-	1	1	-	-

Module	Course Content	Hours	COs
1	Introduction to algebra: Groups, Fields, binary field arithmetic, Construction of Galois field GF (2m) and its properties, Computation using Galois filed GF (2m) arithmetic, Vector spaces and Matrices.	08	CO1
2	Linear block codes: Introduction, Generator and parity check matrices, Encoding circuits, Syndrome and error detection, Minimum distance considerations, Error detecting and error correcting capabilities, decoding circuits, Hamming codes, Reed-Muller codes. Golay codes, Product codes and interleaved codes	08	CO2 CO4
3	Cyclic codes: Introduction, Generator and parity check Polynomials, Encoding of Cyclic Codes, generator matrix for cyclic code, Syndrome computation and Error Detection, Meggit Decoder, Cyclic hamming codes, The (23,12) Golay code	08	CO2 CO4
4	BCH codes: Binary primitive BCH codes, Decoding Codes, Implementation of Galois field arithmetic, Implementation of error correction. Convolution codes: Encoding of Convolutional codes, , Different types of CC encoders, conversion from one form to other, Viterbi decoding algorithm for decoding, soft output Viterbi algorithm	08	CO2 CO3 CO4
5	Concatenated codes and Turbo codes: Single level concatenated codes, Multilevel concatenated codes, Soft decision multistage decoding, Concatenated coding schemes with convolutional inner codes, Introduction to Turbo coding- Transmitter and Receiver	08	CO5

PRE-REQUISITES :

Knowledge of subjects like: Communication systems

NOTE :

1. Questions for CIE and SEE not to be set from self-study component.
2. Assignment Questions may or may not be from self-study component only.

SELF-STUDY COMPONENTS:

Module 1 : Simulate the Linear Algebra concepts
Module 2 : Simulate Linear Block Codes
Module 3 : Simulate Cyclic codes

Module 4 : Non Binary BCH Codes, RS Codes, Simulations of convolutional codes

Module 5 : Design of Turbo codes, Simulations

TEXT BOOKS:

1. Shu Lin, Daniel J Costello Jr., "Error Control Coding", *Pearson Education Asia*, Second Edition, 2004.
2. Simon Haykin, "Digital communication", ISBN-9971-51-205-X, *John Wiley & Sons* (Asia), Pvt. Ltd, 2008.
3. Bernard Sklar, "Digital Communication", *Pearson Education*, 2007
4. K. Sam Shanmugam, "Digital and analog communication systems", *John Wiley India Pvt. Ltd*, 1996.

REFERENCES BOOKS:

1. K. Deergha Rao, "Channel Coding Techniques for Wireless Communications", ISBN 978-81-322-2291-0, ISBN 978-81-322-2292-7 (eBook) DOI 10.1007/978-81-322-2292-7 *Springer publication* 2015
2. T L Singal, "Analog and digital Communications", *Mc Graw Hill Education* (India) Pvt. Ltd., 2012.
3. Peter Sweeney"Error Control Coding from theory to practice" *John Wiley & Sons*, Ltd.,, 2002
4. Yuan Jiang,"A Practical Guide to Error-Control Coding Using MATLAB", ISBN: 9781608070886

On-Line Materials & Resources (NPTEL courses / Video lectures / You-tube Videos / Power points / On-line notes / web-links :

1. https://nptel.ac.in/courses/117/104/117104120/
2. https://nptel.ac.in/courses/117/104/117104121/
3. https://nptel.ac.in/courses/117/108/117108044/
4. https://in.mathworks.com/help/comm/ug/error-detection-and-correction.html
5. https://youtu.be/_oxnYV6y51w

Scheme of Evaluation of the CIE & Assessment Pattern :

Assignment : Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro' the semester or in between 2nd& 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class, the questions has to be set according to easy, medium, tough & severe and evaluation to be done as per the assignment evaluation rubrics.

Quiz : There will be 1 quiz of 10 marks consisting of 10 questions of multiple choice of 1 marks each, which may be conducted along with the 2nd CIE test and written in the answer booklet at the end.

CIE : There will be 3 CIE tests in a semester conducted for 50 marks each with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems) & finally each CIE will be reduced to 10 Marks and totalled up for 30 Marks and then rounded off to the nearest integer. There has to be choices in the descriptive questions & the questions has to be set module/unit-wise only. The total CIE marks is for 50 and is the total of averaged CIE + Assignment of 10 marks & Quiz of 10 marks.

CIE – Continuous Internal Evaluation Theory (50 Marks)

Bloom's Category	**Tests - 3 CIEs**	**Assignments - 1 No.**	**QUIZ - 1 No.**
Marks (out of 50)	**30**	**10**	**10**
Remember	10		
Understand	05	05	
Apply	05		
Analyze	05	05	
Evaluate	05		
Create			

SEE – Semester End Examination Theory (50 Marks)

Bloom's Category	**Marks Theory (50)**
Remember	10
Understand	10
Apply	05
Analyze	05
Evaluate	05
Create	05

CCN & EMBEDDED LAB

Course code: 19EC6DLCCN **Credits :** 2
L : P : T : S : 0 : 2 : 1 : 0 (3 periods lab) **CIE Marks :** 50
Exam Hours : 03 **SEE Marks :** 50
Total Hours :26 **CIE + SEE Marks** : 100

COURSE OBJECTIVES:

1. To build the knowledge of networking protocols and interconnections.
2. To impart the programming skill sets to implement the functionalities and responsibilities of Data link and networking layer
3. To build the knowledge of interface between sensors and MSP430
4. To develop a establish communication between Server and client IoT Nodes
5. To design and Implementation of IoT communication Protocols

COURSE OUTCOMES:

CO 1	Apply the difference between wired and wireless network
CO 2	Evaluate the performance parameters of wired and wireless networks
CO 3	Create different wired and wireless networks for data communication
CO 4	GPIO and ADC Configurations of Sensors using TI Launchpad
CO 5	Establish one/two way communication between client and server using 2 IoT Nodes
CO 6	Design and Implementation of HTTP based IoT Web Server module

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1												
CO2												
CO3												
CO4	3	2	1	1	2	-	-	-	2	-	-	-
CO5	3	2	2	1	2	-	-	-	2	-	-	1
CO6	3	3	3	1	2	-	-	-	2	-	-	1

Sl. No.	COURSE CONTENTS	COs
	PART-A **SIMULATION EXPERIMENTS USING NS2/ NS3 / NCTUNS**	
1	Implement a point to point network with four nodes and duplex links between them. Analyze the network performance by setting the queue size and varying the bandwidth.	CO1 CO2 CO3
2	Implement a four node point to point network with links n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP.	CO1 CO2 CO3
3	Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.	CO1 CO2 CO3
4	Implement Ethernet LAN using n nodes and assign multiple traffic to the nodes and obtain congestion window for different sources/ destinations.	CO1 CO2 CO3
5	Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.	CO1 CO2 CO3
6	Implementation of any routing algorithm	CO1 CO2 CO3
	PART-B	
7	A simple GPIO configuration: LED and Switch interface	CO4
8	Using the 12-bit ADC configuration of LM35/DHT11 Sensor	CO4
9	a) Configuration of IoT Node as an Access Point b) Establish connection between IoT Node and Access Point and display of Local IP and Gateway IP	CO5
10	a) Network Communication- Establish one way communication between client and server using 2 IoT Nodes b) Network Communication- Establish two way communications between client and server using 2 IoT Nodes.	CO5
11	a) Design and Implementation of HTTP based IoT Web Server to control the status of LED. b) Design and Implementation of HTTP based IoT Web Server to display sensor values.	CO6

EXTRA PROGRAMS:

1. Implementation of spanning tree algorithm
2. Implementation of Stop and wait protocol
3. Implement a program to communicate between mobile nodes and suspicious nodes using NS2.
4. Implement UDP wireless communication using NS2
5. Implement TCP communication using NS2

HARDWARE AND SOFTWARE REQUIREMENTS:

Hardware Requirements:

- Processor : Pentium 3 or higher
- RAM : 512MB or more
- Hard Disk : 16GB or more (there should be enough space to hold both Linux and Windows)
- MSP430F5529 Launchpad + CC3100Booster Pack

SOFTWARE REQUIREMENTS:

- Operating System : Windows, Linux
- Simulation Software: NS2/ NCTUns/Energia 1.8.7E21 or higher(latest)

TEXT BOOKS:

1. **Introduction to Network Simulator NS2,** **Issariyakul**, Teerawat, **Hossain**, Ekram,, Springer US, 2012.

ASSESSMENT PATTERN:

CIE – Continuous Internal Evaluation Lab (50 Marks)
SEE – Semester End Examination Lab (50 Marks)

Note : For conduction, record book writing, viva, marks is kept, totalling to 25 marks & there will be 1 CIE test in a semester conducted for 50 marks at the end of the semester & reduced to 25 marks, i.e., 25 + 25 = 50 marks.

Bloom's Category	Performance (Day To Day)	Internal Test
Marks (Out of 50)	**25**	**25**
Remember		
Understand		
Apply	05	05
Analyze	10	10
Evaluate	05	05
Create	05	05

Bloom's Category	MarksTheory(50)
Remember	
Understand	
Apply	15
Analyze	15
Evaluate	10
Create	10

VLSI LAB

Course Code:19EC6DLVLS **Credits:** 03
L : P : T : S : 0 : 2 : 1 : 0 (3 periods lab) **CIE Marks :** 50
Exam Hours : 03 **SEE Marks :** 50
Total Hours :26 **CIE + SEE Marks** : 100

Course Objectives:

1. To get a practical experience in analysis of the MOSFETcircuits.
2. To get a practical experience in design of the MOSFETcircuits.
3. To know the art of debugging the digital circuits using theV-codes.
4. To know the use of tools in the design of CMOScircuits.
5. To get acquainted with the VLSI verificationtechniques.
6. To investigate the layoutdesign.

Course Outcomes:

At the end of the course, student will be able to

CO1	Understand digital design flow using NCSIM and debug digital circuit design using Verilog Code.
CO2	Analyze and verification by writing Test Benches using NCSIM and further model subsystem blocks using Verilog code.
CO3	Perform the initial timing verification of Verilog code.
CO4	Design front-end digital/ analog circuit using industry standard cadence tool.
CO5	Apply the knowledge of amplifier design and analyze DC, AC and transient characteristics
CO6	Designandanalyzelayoutforthecircuitsusingback-endtoolandverifytheDRCandERC and check for LVS, ExtractRC.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	2	3	-	-	1	2	-	1	2
CO2	3	3	2	2	3	-	-	1	2	-	1	2
CO3	3	3	2	2	3	-	-	1	2	-	1	2
CO4	3	3	2	2	3	-	-	1	2	-	1	2
CO5	3	3	2	2	3	-	-	1	2	-	1	2
CO6	3	3	2	2	3	-	-	1	2	-	1	2

Module	Expt. No.	Content of the Lab Module with Expt. Nos.	Hours	COs
Digital Design				
Part A	1	Inverter and Buffer design and verification.	03	CO1 CO3
	2	Transmission Gate and basic/universal gates design and verification	03	CO1 CO2 CO3
	3	Design and verification of Serial& Parallel adder.	03	CO1 CO3 CO4
	4	Design and verification of 4-bit counter 1. Synchronous 2. Asynchronouscounter	03	CO1 CO3 CO4
Analog Design				
Part B	5	Design an Inverter with given specifications	03	CO4 CO5 CO6
	6	Design of CMOS AND/NAND,CMOS OR/NOR	03	CO4 CO5 CO6
	7	Design of Common source amplifier	03	CO4 CO5 CO6
	8	Design of Common Drain amplifier	03	CO4 CO5 CO6
	9	Design of Single Stage differential amplifier	03	CO4 CO5 CO6
	10	Design of an op-amp with given specification	03	CO4 CO5 CO6

ASSESSMENT PATTERN:

CIE – Continuous Internal Evaluation Lab (50 Marks)
SEE – Semester End Examination Lab (50 Marks)

Note : For conduction, record book writing, viva, marks is kept, totalling to 25 marks & there will be 1 CIE test in a semester conducted for 50 marks at the end of the semester & reduced to 25 marks, i.e., 25 + 25 = 50 marks.

Bloom's Category	**Performance (Day To Day)**	**Internal Test**
Marks (Out of 50)	**25**	**25**
Remember		
Understand		
Apply	05	05
Analyze	10	10
Evaluate	05	05
Create	05	05

Bloom's Category	**MarksTheory(50)**
Remember	
Understand	
Apply	15
Analyze	15
Evaluate	10
Create	10

FUNDAMENTALS OF COMPUTER VISION - FCV
Global / Institutional / Open Elective
Semester - 6

Course Code : 19EC6IEFCV | **Credits :**3
L : P : T : S :3 : 0 : 0 : 0 | **CIE Marks :**50
Exam Hours :3 | **SEE Marks :**50
Total Hours :40 | **CIE + SEE :**100

COURSE OBJECTIVES:

1. To understand the concepts of image processing techniques for computer vision.
2. To gain knowledge about types of image acquisition techniques.
3. To study spatial domain image enhancement and image analysis.
4. To expose the students to various applications of image processing.

COURSE OUTCOMES:

At the end of the course, student will be able to

CO1	Relate human visual system with the fundamentals of IP techniques and discuss the fundamental components and steps in IP.
CO2	Illustrate the process of image acquisition using image sensors and CCD's.
CO3	Demonstrate and analyze the different relationships between the pixels.
CO4	Apply and analyze spatial filtering techniques on images for enhancement.
CO5	Categorize various point processing techniques, image data types and image file formats.
CO6	Analyze the various applications of Computer Vision.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	2	-	-	-	2	1	-	-
CO2	3	2	-	-	2	-	-	-	2	1	-	-
CO3	3	2	-	-	2	-	-	-	2	1	-	-
CO4	3	2	-	-	2	-	-	-	2	1	-	-
CO5	3	2	-	-	2	-	-	-	2	1	-	-
CO6	3	1	-	-	-	-	-	-	-	-	-	-

Module	Content of the module	Hours	COs
1	**Fundamentals of vision**: Light and electromagnetic spectrum, Elements of visual perception: Image formation in the eye, Brightness adaptation and Discrimination, image display, Fundamental Steps, Components.	8	CO1
2	**Image Sensing and acquisition**: CCD sensor, Four- phase CCD, CCD formats, Architecture of CCD, scanning mechanisms, photo conductive cameras, camcorder, Image acquisition using single sensor, sensor strips, sensor Arrays, Image formation model, Representation of digital images, Spatial and Grey level resolution.	8	CO1 CO3 CO5
3	**Image fundamentals**: Basic relationship between pixels, Different Image data types, Types of images, Image file formats.	7	CO1 CO3 CO4
4	**Image Enhancement**: Background, Image negative, contrast stretching, gray level slicing, bit plane slicing, smoothing spatial filters: averaging filters, order statistic filters, sharpening spatial filters.	8	CO2 CO4 CO5
5	**Applications:** Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces. Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis & Vehicular detection in tolls.	9	CO6

PRE-REQUISITES:

Knowledge of subjects like: Image Processing, Computer Vision, Mobiles, Cameras& its types, Images, Videos, Capturing of images, Google imaging.

NOTE:

1. Questions for CIE and SEE not to be set from self-study components.
2. Assignment questions should be from self-study component only.

SELF STUDY COMPONENTS:

Module 1 : Image storage mechanisms.
Module 2 : Image sampling and quantization, Aliasing effects, Analog color TV camera.
Module 3 : Intensity and range images, Satellite images.
Module 4 : Image enhancement in frequency domain.
Module 5 : Application in-vehicle vision system.

TEXT BOOKS:

1. R.C. Gonzalez, R.E. Woods, "Digital Image Processing", 3rd edition, *Pearson Education*, 2009.
2. S. Nagabhushushana, "Computer Vision and Image Processing", *1st Edition*, 2006.
3. S Jayaraman, S. Esakkirajan, T., Veerakumar, "Digital Image Processing", 1st Edn. *McGraw Hill Education* 2009.
4. Dr. Pavithra G. *et.al.*, "Computer Vision & Techniques", 195 pages, ISBN 978-1-68509-224-5, *Notion Press Publications*, India.
5. E.R. Davies, "Computer Vision Principles, Algorithms, Applications, Learning", *Elsevier Publications*, 5th Edition, eBook ISBN: 9780128095751, ISBN: 9780128092842, 2017

REFERENCE BOOKS:

1. R.Szeliski, "Computer Vision: Algorithms and application", *Springer*, 2011.
2. Dhananjay Theckadath, "Image Processing", *Nandu Publishers*, 2015.
3. Vipula Singh, "Digital Image Processing with MATLAB and LABVIEW", *Sapna Publications*, Publications, 2013.
4. Dr. Pavithra G.,*et.al.*, "Image Processing & Machine Vision", 200 pages, *Notion Press Publications*, India.
5. Dr. Anil K. Jain, "Fundamental of Digital Image Processing", *Prentice Hall, Englewood Cliffs, USA*, ISBN-0-13-33676-5-9.

Scheme of Evaluation of the CIE & Assessment Pattern:

Assignment: Only one assignment (open book test normally) will be of 10 marks & conducted in the class during the course of the semester (normally midway thro' the semester or in between 2nd& 3rd test). Generally, 2- 4 questions can be given which has to be solved in 1 hour duration, the assignment question has to be from the self-study component or it can be a coding demo done in the laptop & shown on the spot to the teacher in the class, the questions has to be set according to easy, medium, tough & severe, the evaluation has to be done as per the assignment evaluation rubrics.

Quiz : There will be 1 quiz of 10questions of 1 mark each, which may be conducted along with the 2ndCIE test or at the appropriate time during the course of the semester and written in the answer booklet at the end (may be conducted on-line also) or which may be conducted along with the 2nd CIE test or at the appropriate time during the course of the semester.

CIE : There will be 3 CIE tests in a semester conducted for 50 marks with 10 Marks MCQs, remaining 40 Marks descriptive (with theory & problems). Finally, each CIE will be reduced to 10 Marks and totalled up for 30 Marks. There will be choices in the descriptive questions and evaluation has to be done as per the scheme of evaluation rubrics given. There has to be choices in the descriptive questions & the questions have to be set module/unit-wise. Total CIE marks

for 50 will be finally rounded off to the nearest integer if the sum turns out to be a fraction, the total CIE marks being – 3 CIEs of 30 Mks + 1 Assignment of 10 Mks + 1 Quiz of 10 Mks.

CIE – Continuous Internal Evaluation Theory (50 Marks) :

Bloom's Category	**Tests -3 CIEs**	**Assignment - 1 No.**	**Quiz - 1 No.**
Marks (Out of 50)	**30**	**10**	**10**
Remember	05	--	--
Understand	10	05	--
Apply	10	05	--
Analyze	05	--	--
Evaluate	--	--	--
Create	--	--	--

SEE –Semester End Examination Theory (50 Marks) :

Bloom's Category	**Theory Marks (50)**
Remember	10
Understand	10
Apply	10
Analyze	20
Evaluate	
Create	

Highlights of Computer Vision:

1. Computer vision is a discipline that covers various sensors, cameras and different operations that can be performed on an image for various image processing applications.
2. This field includes methods for acquiring, processing and understanding images from the computers point of view.
3. The ultimate goal is to emulate perceptual capability of human eye and assist the human in different ways in the 2D environments.
4. Applications of computer vision in processing of a scene or an object for automatic machine perception.
5. Application of computer vision in the Improvement of pictorial information for human interpretation using software packages.