

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 - 22)

V Semester

Digital Communication			
Course Code	21EC51	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
Course objectives: <ul style="list-style-type: none"> Understand the concept of signal processing of digital data and signal conversion to symbols at the transmitter and receiver. Compute performance metrics and parameters for symbol processing and recovery in ideal and corrupted channel conditions. Understand the principles of spread spectrum communications. Understand the basic principles of information theory and various source coding techniques. Build a comprehensive knowledge about various Source and Channel Coding techniques. Discuss the different types of errors and error detection and controlling codes used in the communication channel. Understand the concepts of convolution codes and analyze the code words using time domain and transform domain approach. 			
Teaching-Learning Process (General Instructions) The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following: <ol style="list-style-type: none"> Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes. Arrange visits to nearby PSUs such as BHEL, BEL, ISRO, etc., and small-scale communication industries. Show Video/animation films to explain the functioning of various modulation techniques, Channel, and source coding. Encourage collaborative (Group) Learning in the class Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize & analyze information rather than simply recall it. Topics will be introduced in multiple representations. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding. 			
Module-1			
Digital Modulation Techniques: Phase shift Keying techniques using coherent detection: generation, detection and error probabilities of BPSK and QPSK, M-ary PSK, M-ary QAM. Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability. Non coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams treatment of Transmitter and Receiver, Probability of error (without derivation of probability of error equation).			
Teaching-Learning Process	Chalk and talk method, Simulation of modulation techniques, Power Point Presentation, YouTube videos Animation of BPSK, QPSK, BFSK and DPSK. Problems on Generation and detection of DPSK, QPSK. Self-study topic: Minimum shift keying and Non-coherent BFSK RBT Level: L1, L2, L3		

Module-2	
Signalling Communication through Band Limited AWGN Channels: Signalling over AWGN Channels- Introduction, Geometric representation of signals, Gram- Schmidt Orthogonalization procedure, Conversion of the continuous AWGN channel into a vector channel (without statistical characterization), Optimum receivers using coherent detection: ML Decoding, Correlation receiver, matched filter receiver. Signal design for Band limited Channels: Design of band limited signals for zero ISI-The Nyquist Criterion (statement only), Design of band limited signals with controlled ISI-Partial Response signals, Probability of error for detection of Digital PAM: Symbol-by-Symbol detection of data with controlled ISI.	
Teaching-Learning Process	Chalk & talk method, PowerPoint Presentation, YouTube videos Self-study topics: Maximum Likelihood detection, Channel equalization RBT Level: L1, L2, L3
Module-3	
Principles of Spread Spectrum: Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems, Effect of De-spreading on a narrowband Interference, Probability of error (statement only), Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum, CDMA based on IS-95.	
Teaching-Learning Process	Chalk & talk method, Seminar about security issues in communication systems RBT Level: L1, L2, L3
Module-4	
Introduction to Information Theory: Measure of information, Average information content of symbols in long independent sequences. Source Coding: Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Huffman coding. Error Control Coding: Introduction, Examples of Error control coding, methods of Controlling Errors, Types of Errors, types of Codes.	
Teaching-Learning Process	Chalk and talk method, Problems on source coding, error control codes RBT Level: L1, L2, L3
Module-5	
Linear Block Codes: Matrix description of Linear Block Codes, Error Detection & Correction capabilities of Linear Block Codes, Single error correction Hamming code, Table lookup Decoding using Standard Array. Convolution codes: Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram.	
Teaching-Learning Process	Chalk and talk method, Animation of convolution encoders RBT Level: L1, L2, L3
Course outcomes (Course Skill Set) At the end of the course the student will be able to: <ol style="list-style-type: none"> 1. Analyze different digital modulation techniques and choose the appropriate modulation technique for the given specifications. 2. Test and validate symbol processing and performance parameters at the receiver under ideal and corrupted bandlimited channels. 3. Differentiate various spread spectrum schemes and compute the performance parameters of communication system. 4. Apply the fundamentals of information theory and perform source coding for given message 5. Apply different encoding and decoding techniques with error Detection and Correction. 	
Assessment Details (both CIE and SEE)	

10.10.2022

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
2. John G Proakis and Masoud Salehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
3. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
4. Hari Bhat, Ganesh Rao, "Information Theory and Coding", Cengage, 2017.
5. Todd K Moon, "Error Correction Coding", Wiley Std. Edition, 2006.

Reference Books:

1. Bernard Sklar, "Digital Communications - Fundamentals and Applications", Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.

Web links and Video Lectures (e-Resources)

- <https://nptel.ac.in/courses/108102096>

Devi
H. O. D.
Dept. of Electronics & Communication
JSS Institute of Engg. & Technology
Mysore, MOODBIDRI - 574 220

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V Semester

V Semester

Computer Organization & ARM Microcontrollers			
Course Code	21EC52	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:2:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 13 Lab slots	Total Marks	100
Credits	04	Exam Hours	03
Course objectives: This course will enable students to:			
<ol style="list-style-type: none">1. Explain the basic organization of a computer system.2. Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.3. Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3.4. Apply the knowledge gained for Programming ARM Cortex M3 for different applications.5. Understand the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.			
Teaching-Learning Process (General Instructions)			
These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes,			
<ul style="list-style-type: none">• Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.• Encourage collaborative (Group) Learning in the class.• Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.• Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.• Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.• Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.• Give Programming Assignments.			
Module-1			
Basic Structure of Computers: Basic Operational Concepts, Bus Structures, Performance - Processor Clock, Basic Performance Equation, Clock Rate, Performance Measurement. Text Book 1: Chapter 1 - 1.3, 1.4, 1.6 (1.6.1-1.6.4, 1.6.7), Chapter 2 - 2.2 to 2.10			
Input/Output Organization: Accessing I/O Devices, Interrupts - Interrupt Hardware, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces - PCI Bus, SCSI Bus, USB. Text Book 1: Chapter 4 - 4.1, 4.2, 4.4, 4.5, 4.6, 4.7			
Teaching-Learning Process	Chalk and Talk, YouTube videos RBT Level: L1, L2, L3		
Module-2			
Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost, Cache Memories - Mapping Functions, Replacement Algorithms, Performance Considerations. Text book 1: Chapter 5 - 5.1 to 5.4, 5.5 (5.5.1, 5.5.2), 5.6			
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hard-wired Control, Micro programmed Control. Basic concepts of pipelining. Text book 1: Chapter 7, Chapter 8 - 8.1			

Teaching-Learning Process	Chalk and Talk, YouTube videos RBT Level: L1, L2, L3
Module-3	
ARM Embedded Systems: Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware – AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications. ARM Processor Fundamentals, ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions. Text book 2: Chapter 1, 2	
Teaching-Learning Process	Chalk and Talk, YouTube videos RBT Level: L1, L2, L3
Module-4	
Introduction to the ARM instruction set: Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution. Text book 2: Chapter 3	
Teaching-Learning Process	Chalk and Talk, Power point presentations, Programming assignments RBT Level: L1, L2, L3
Module-5	
Introduction to the THUMB instruction set: Introduction, THUMB register usage, ARM – THUMB interworking, Other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions. Efficient C Programming: Overview of C Compilers and optimization, Basic C Data types, C looping structures. Text book 2: Chapter 4, 5	
Teaching-Learning Process	Chalk and Talk, Power point presentations, Programming assignments RBT Level: L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Cortex M3 Registers using an evaluation board/simulator and the required software tool.

Sl.No	Experiments
1	Write an ALP to i) multiply two 16-bit binary numbers. ii) add two 64-bit numbers.
2	Write an ALP to find the sum of first 10 integer numbers.
3	Write an ALP to find factorial of a number.
4	Write an ALP to add an array of 16-bit numbers and store the 32-bit result in internal RAM.
5	Write an ALP to find the square of a number (1 to 10) using look-up table.
6	Write an ALP to find the largest/smallest number in an array of 32 numbers.
7	Write an ALP to arrange a series of 32-bit numbers in ascending/descending order.
8	i) Write an ALP to count the number of ones and zeros in two consecutive memory locations. ii) Write an ALP to Scan a series of 32-bit numbers to find how many are negative.

Demonstration Experiments (For CIE only not for SEE)

Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' & Keil μ vision-4 tool/compiler.

9	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
10	Interface a DAC and generate Triangular and Square waveforms.
11	Display the Hex digits 0 to F on a 7-segment LED interface, with a suitable delay in between.
12	Interface a simple Switch and display its status through Relay, Buzzer and LED.

Course Outcomes

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

1. Explain the basic organization of a computer system.
2. Demonstrate functioning of different sub systems, such as processor, Input/output, and memory.
3. Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3.
4. Apply the knowledge gained for Programming ARM Cortex M3 for different applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks (duration 01 hour)**

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Scaled-down marks of two tests and two assignments added will be CIE marks for the theory component of IPCC for **30 marks**.

CIE for the practical component of IPCC

- On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The **15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.
- The laboratory test (**duration 03 hours**) at the end of the 15th week of the semester /after completion of all the experiments (whichever is early) shall be conducted for 50 marks and scaled down to 05 marks.

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component.

- The minimum marks to be secured in CIE to appear for SEE shall be the 12 (40% of maximum marks-30) in the theory component and 08 (40% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included. The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50.

Suggested Learning Resources:**Textbooks**

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, Tata McGraw Hill, 2002. (Listed topics only from Chapters 1, 2, 4, 5, 8).
2. Andrew N Sloss, Dominic System and Chris Wright, "ARM System Developers Guide", Elsevier, Morgan Kaufman publisher, 1st Edition, 2008.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills


 H. O. D.
 Dept. Of Electronics & Commun.
 Alva Institute of Engg & Techno....
 Myar, MOODBIDRI - 574 225

Introduction to wireless LAN: Architectural Comparison, Characteristics, Access Control. (15.1 of Text)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animations showing Framing, CSMA, Connecting devices, Problems on ALOHA, CSMA, Framing and Standard ethernet. Self-Study: Fast Ethernet, Gigabit ethernet & IEEE802.11 wireless LANs RBT Level: L1, L2, L3
Module-3	
<p>Network Layer: Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution (18.1(excluding 18.1.3), 18.2, 18.4 of Text)</p> <p>Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPV4 Datagrams. (19.1of Text), IPv6 addressing and Protocol (22.1 and 22.2).</p> <p>Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing. (20.1, 20.2 of Text)</p>	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation of DHCP, routing protocols, Numericals on Addressing. Self-Study: Network Layer performance, RIP, OSPF RBT Level: L1, L2, L3
Module-4	
<p>Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-BackN Protocol, Selective repeat protocol, Piggybacking (23.1, 23.2.1, 23.2.2, 23.2.3, 23.2.4, 23.2.5 of Text)</p> <p>Transport-Layer Protocols in the Internet: User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control L1, L2, L3 Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Error control, TCP congestion control. (24.2, 24.3.1, 24.3.2, 24.3.3, 24.3.4, 24.3.6, 24.3.8, 24.3.9 of Text)</p> <p>*Note: Exclude FSMs for CIE and SEE</p>	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation/Implementation of Flow control protocols and TCP using simulators, Self-Study: Flow Control in TCP RBT Level: L1, L2, L3
Module-5	
<p>Application Layer: Introduction: providing services, Application- layer paradigms, Standard Client - Server Protocols: Hyper Text Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Domain Name system: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, security of DNS. (25.1, 26.1.2, 26.2, 26.3, 26.6 of Text)</p> <p>Quality of Service (30.1, 30.2.) Network Security (31.1)</p>	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Animation/Implementation of HTTP, FTP, DNS using network simulators, Self Study: WWW, TELNET RBT Level: L1, L2, L3
<p>Course outcomes (Course Skill Set)</p> <p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Understand the concepts of networking thoroughly. 2. Identify the protocols and services of different layers. 3. Distinguish the basic network configurations and standards associated with each network. 4. Discuss and analyse the various applications that can be implemented on networks. 	
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end</p>	

examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill, 2013, ISBN: 1-25-906475-3.

Reference Books:

1. James J Kurose, Keith W Ross, "Computer Networks", Pearson Education.
2. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson India, 1st edition.
3. Andrew Tannenbaum, "Computer Networks", Prentice Hall.
4. William Stallings, "Data and Computer Communications", Prentice Hall.

Web links and Video Lectures (e-Resources)

- <https://nptel.ac.in/courses/106105183>.
- TCP/IP Tutorial and Technical Overview, (IBM Redbook) - Download From <http://www.redbooks.ibm.com/abstracts/gg243376.html>
- TCP/IP Guide, Charles M Kozierok, Available Online - <http://www.tcpipguide.com/>
- Request for Comments (RFC) - IETF - <http://www.ietf.org/rfc.html>
- <https://cosmolearning.org/courses/computer-networks-524/video-lectures/>
- https://www.eecis.udel.edu/~bohacek/videoLectures/ComputerNetworking/ComputerNetworking_v2.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Implementation of simple networks and various networking protocols and algorithms using simulators like NCTUns / CISCO packet tracer and measurement of various parameters using WireShark
- Implementation of simple networks and various networking protocols and algorithms in C/C++/Python

Datta
H. O. D.
Dept. Of Electronics & Communication
Alva - Institute of Engg. & Technology
Mysr. MOODBIDRI - 574 22

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 (Effective from the academic year 2021 – 22)
 V Semester

ELECTROMAGNETIC WAVES

Course Code	21EC54	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	(3:0:0:0)	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	03	Exam Hours	03

Course objectives: This course will enable students to :

- Study the different coordinate systems, Physical significance of Divergence, Curl and Gradient.
- Understand the applications of Coulomb's law and Gauss law to different charge distributions and the applications of Laplace's and Poisson's Equations to solve real time problems on capacitance of different charge distributions.
- Understand the physical significance of Biot-Savart's, Amperes's Law and Stokes's theorem for different current distributions.
- Infer the effects of magnetic forces, materials and inductance.
- Know the physical interpretation of Maxwell's equations and applications for Plane waves for their behavior in different media.
- Acquire knowledge of Poynting theorem and its application of power flow.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
3. Adopt Problem Based Learning (PBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize & analyze information rather than simply recall it.
4. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
5. Using videos for demonstration of the fundamental principles to students for better understanding of concepts.

Module-1

Revision of Vector Calculus – (Text 1: Chapter 1)

Coulomb's Law, Electric Field Intensity and Flux density: Experimental law of Coulomb, Electric field intensity, Field due to continuous volume charge distribution, Field of a line charge, Field due to Sheet of charge, Electric flux density, Numerical Problems. (Text: Chapter 2.1 to 2.5, 3.1)

Teaching-Learning Process	Chalk and Talk would be helpful for the quantitative analysis. Videos of the Basic principles of the devices would help students to grasp better. RBT Level: L1, L2, L3
Module-2	
Gauss's law and Divergence: Gauss 'law, Application of Gauss' law to point charge, line charge, Surface charge and volume charge, Point (differential) form of Gauss law, Divergence. Maxwell's First equation (Electrostatics), Vector Operator ∇ and divergence theorem, Numerical Problems (Text: Chapter 3.2 to 3.7). Energy, Potential and Conductors: Energy expended or work done in moving a point charge in an electric field, The line integral, Definition of potential difference and potential, The potential field of point charge, Potential gradient, Numerical Problems (Text: Chapter 4.1 to 4.4 and 4.6). Current and Current density, Continuity of current. (Text: Chapter 5.1, 5.2)	
Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation RBT Level: L1, L2, L3
Module-3	
Poisson's and Laplace's Equations: Derivation of Poisson's and Laplace's Equations, Uniqueness theorem, Examples of the solution of Laplace's equation, Numerical problems on Laplace equation (Text: Chapter 7.1 to 7.3) Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, Curl, Stokes' theorem, Magnetic flux and magnetic flux density, Basic concepts Scalar and Vector Magnetic Potentials, Numerical problems. (Text: Chapter 8.1 to 8.6)	
Teaching-Learning Process	Chalk and talk method, Power point presentation and videos. RBT Level: L1, L2, L3
Module-4	
Magnetic Forces: Force on a moving charge, differential current elements, Force between differential current elements, Numerical problems (Text: Chapter 9.1 to 9.3). Magnetic Materials: Magnetization and permeability, Magnetic boundary conditions, The magnetic circuit, Potential energy and forces on magnetic materials, Inductance and mutual reactance, Numerical problems (Text: Chapter 9.6 to 9.7). Faraday's law of Electromagnetic Induction –Integral form and Point form, Numerical problems (Text: Chapter 10.1)	
Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation RBT Level: L1, L2, L3
Module-5	
Maxwell's equations Continuity equation, Inconsistency of Ampere's law with continuity equation, displacement current, Conduction current, Derivation of Maxwell's equations in point form, and integral form, Maxwell's equations for different media, Numerical problems (Text: Chapter 10.2 to 10.4) Uniform Plane Wave: Plane wave, Uniform plane wave, Derivation of plane wave equations from Maxwell's equations, Solution of wave equation for perfect dielectric, Relation between E and H, Wave	

propagation in free space, Solution of wave equation for sinusoidal excitation, wave propagation in any conducting media (γ , α , β , η) and good conductors, Skin effect or Depth of penetration, Poynting's theorem and wave power, Numerical problems. (Text: Chapter 12.1 to 12.4)

Teaching-Learning Process

Chalk and Talk, PowerPoint Presentation

RBT Level: L1, L2, L3

Course Outcomes

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

- Evaluate problems on electrostatic force, electric field due to point, linear, volume charges by applying conventional methods and charge in a volume.
- Apply Gauss law to evaluate Electric fields due to different charge distributions and Volume Charge distribution by using Divergence Theorem.
- Determine potential and energy with respect to point charge and capacitance using Laplace equation and Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations
- Calculate magnetic force, potential energy and Magnetization with respect to magnetic materials and voltage induced in electric circuits.
- Apply Maxwell's equations for time varying fields, EM waves in free space and conductors and Evaluate power associated with EM waves using Poynting theorem

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
 2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:**Text Book:**

1. W.H. Hayt and J.A. Buck, —Engineering Electromagnetics], 8th Edition, Tata McGraw-Hill, 2014, ISBN-978-93-392-0327-6.

Reference Books:

1. Elements of Electromagnetics – Matthew N.O., Sadiku, Oxford university press, 4thEdn.
2. Electromagnetic Waves and Radiating systems – E. C. Jordan and K.G. Balmain, PHI, 2ndEdn.
3. Electromagnetics- Joseph Edminister, Schaum Outline Series, McGraw Hill.
4. N. NarayanaRao, — Fundamentals of Electromagnetics for Engineering], Pearson

Web links and Video Lectures (e-Resources):

- <https://archive.nptel.ac.in/courses/108/104/108104087/>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Quizzes, Seminars


 H. O. D.
 Dept. Of Electronics & Communication
 Alva's Institute of Engg. & Technology
 Mijar, MOODBIDRI - 574 225

VI Semester

TECHNOLOGICAL INNOVATION MANAGEMENT AND ENTREPRENEURSHIP			
Course Code (HSMC)	21EI61/21BM61/21EC61	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	03
Course objectives: This course will enable students to: <ul style="list-style-type: none">• Understand basic skills of Management• Understand the need for Entrepreneurs and their skills• Identify the Management functions and Social responsibilities.• Understand the identification of Business, drafting the Business plan and sources of funding.			
Teaching-Learning Process (General Instructions) The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following: <ul style="list-style-type: none">• Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.• Show Video/animation films to explain the functioning of various techniques.• Encourage collaborative (Group) Learning in the class• Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking• Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.• Topics will be introduced in multiple representations.• Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.• Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the students' understanding.			
Module-1			
Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession (Selected topics of Chapter 1, Text 1). Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making (Text 1).			
Teaching-Learning Process	Chalk and talk method, Power point presentation, Case studies RBT Level:L2,L3		
Module-2			
Organizing and Staffing: Organization- Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalization-Process Departmentalization, Purpose Departmentalization, Committees– Meaning, Types of Committees. Staffing- Need and Importance, Recruitment and Selection Process. Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication (Text 1).			
Teaching-Learning Process	Chalk and talk method, Power point presentation, Industrial visit RBT Level:L2,L3		
Module-3			

Leadership-Meaning, Characteristics, Behavioral Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling - Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process (Text 1).
Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance (Text 1).

Teaching-Learning Process	Chalk and talk method, Power point presentation, Field visit to understand present scenario. RBT Level:L2,L3,L4
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Module-4

Entrepreneurship: Introduction, Evolution of the concept of Entrepreneurship, Entrepreneurship today, Types of Entrepreneurs, Intrapreneurship, Entrepreneurial competencies, Capacity Building for Entrepreneurs.
Identification of Business Opportunities: Introduction, Mobility of Entrepreneurs, Business opportunities in India, Models for Opportunity Evaluation.

Teaching-Learning Process	Chalk and talk method, Power point presentation, Field visit to understand present scenario. RBT Level:L2,L3,L4
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Module-5

Business plans: Introduction, purpose of a Business plan, contents of a Business plan, presenting a Business plan, why do some Business plan fail? Procedure for setting up an Enterprise.
Institutions supporting Business opportunities: Central level institutions- National Board for micro, small & medium Enterprises(NBMSME),MSME-DO, National Small Industries Corporation. State level institutions- state Directorate Industries and commerce, District Industries Centres, state financial Corporations, State Industrial Development Corporation(SIDC),State Industrial Area Development Board (SIADB).
Other Institutions - NABARD, Technical consultancy organisation (TCO), Small Industries Development Bank of India(SIDBI), Export Promotion Councils, Non governmental Organisations.

Teaching-Learning Process	Chalk and talk method, Power point presentation, Case studies RBT Level:L2,L3,L4
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Course outcome (Course Skill Set)

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

1. Understand the fundamental concepts of Management and its functions.
2. Understand the different functions to be performed by managers/Entrepreneur.
3. Understand the social responsibilities of a Business.
4. Understand the Concepts of Entrepreneurship and to identify Business opportunities.
5. Understand the components in developing a business plan and awareness about various sources of funding and Institutions supporting Entrepreneur.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

4. First assignment at the end of 4th week of the semester
5. Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for **20 Marks (duration 01 hours)**

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN- 13-978-93-5260-535-4.
2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, 2nd Edition, Pearson Education 2018, ISBN 978-81-317-6226-4.

Reference Book:

1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4.

Web links and Video Lectures (e-Resources):

- <https://nptel.ac.in/courses/110107094>
- <https://nptel.ac.in/courses/110106141>
- <https://nptel.ac.in/courses/122106031>


H. O. D.
Unit Of Electronics & Communication
Viva Institute of Engg. & Technology
Mijar, MOODBIDRI - 514 443

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V Semester

Microwave Theory and Antennas			
Course Code	21EC62	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
Course objectives: This course will enable students to : <ul style="list-style-type: none">• Describe the microwave properties and its transmission media.• Describe the microwave devices for several applications.• Understand the basic concepts of antenna theory.• Identify antenna types for specific applications.			
Teaching-Learning Process (General Instructions) <p>These are sample Strategies, which teacher can use to accelerate the attainment of the various course outcomes.</p> <ol style="list-style-type: none">1. Using videos for demonstration of the fundamental principles to students for better understanding of concepts.2. Demonstration of microwave devices and Antennas in the lab environment where students can study them in real time.			
Module-1			
Microwave Sources: Introduction, Gunn Diode (Text 2: 7.1,7.1.1,7.1.2) Microwave transmission lines: Microwave frequencies, Microwave devices, Microwave systems. Transmission line equations and solutions, Reflection Coefficient and Transmission Coefficient. Standing wave and standing wave ratio. Smith chart, Single stub matching. Text 2: 0.1, 0.2, 0.3, 3.1, 3.2, 3.3, 3.5, 3.6 (except double stub matching)			
Teaching-Learning Process	Chalk and Talk would be helpful for the quantitative analysis. Videos of the Basic principles of the devices would help students to grasp better. RBT Level: L1, L2, L3		
Module-2			
Microwave Network Theory: Introduction, S matrix representation of multi-port networks (Text 1: 6.1, 6.3, 6.3.1, 6.3.2) Microwave passive devices: Coaxial connectors and Adapters, Attenuators, Phase shifters, waveguide Tees, Magic Tee, Circulator, Isolator. (Text 1: 6.4.2, 6.4.14, 6.4.15, 6.4.16, 6.4.17 A, B)			
Teaching-Learning Process	Chalk and talk method, Power point presentation RBT Level: L1, L2, L3		
Module-3			
Strip Lines: Introduction, Microstrip lines, Parallel Strip lines (Text 2: 11.1,11.2) Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam efficiency, Directivity and Gain, Antenna Aperture Effective height, Bandwidth, Radio communication Link, Antenna Field Zones (Text 3: 2.1-2.7, 2.9-2.11, 2.13).			
Teaching-Learning Process	Chalk and talk method, Power point presentation and videos. RBT Level: L1, L2, L3		

Module-4	
<p>Point sources and arrays: Introduction, Point Sources, Power patterns, Power theorem, Radiation Intensity, Arrays of 2 isotropic point sources, Pattern multiplication, Linear arrays of n Isotropic sources of equal amplitude and Spacing. (Text 3: 5.1-5.6, 5.9, 5.13)</p> <p>Electric Dipole: Introduction, Short Electric dipole, Fields of a short dipole. Radiation resistance of a short dipole. Thin linear antenna (field analysis). (Text 3: 6.1-6.5)</p>	
Teaching-Learning Process	Chalk and talk method, Power point presentation RBT Level: L1, L2, L3
Module-5	
<p>Loop and Horn antenna: Introduction: Small loop, Comparison of far fields of small loop and Short dipole. Radiation resistance of small loop, Horn Antennas, Rectangular antennas. (Text 3: 7.1, 7.2, 7.4, 7.6, 7.7, 7.8, 7.19, 7.20)</p> <p>Antenna Types: The Helix geometry, Helix modes, Practical design consideration for mono-filar axial mode Helical Antenna, Yagi Uda array, Parabolic Reflector (Text 3: 8.3, 8.4, 8.5, 8.8, 9.5)</p>	
Teaching-Learning Process	Chalk and talk method, Power point presentation RBT Level: L1, L2, L3
<p>Course outcome (Course Skill Set)</p> <p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. Describe the use and advantages of microwave transmission 2. Analyze various parameters related to transmission lines. 3. Identify microwave devices for several applications. 4. Analyze various antenna parameters and their significance in building the RF system. 5. Identify various antenna configurations for suitable applications. 	
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.</p> <p>Continuous Internal Evaluation:</p> <p>Three Unit Tests each of 20 Marks (duration 01 hour)</p> <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester <p>Two assignments each of 10 Marks</p> <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester <p>Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)</p> <ol style="list-style-type: none"> 6. At the end of the 13th week of the semester <p>The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be scaled down to 50 marks</p> <p>(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).</p> <p>CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per</p>	

the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Microwave Engineering -Annapurna Das, Sisir K Das, TMH Publication, 2nd Edition, 2010.
2. Microwave Devices and Circuits - Samuel Y Liao, Pearson Education.
3. Antennas and Wave Propagation -John D Krauss, Ronald J Marhefka, Ahmad S Khan, 4th Edition, McGraw Hill Education, 2013.

Reference Books:

1. Microwave Engineering -David M Pozar, John Wiley India Pvt Ltd., Pvt Ltd., 3rd edition, 2008.
2. Microwave Engineering-Sushrut Das, Oxford Higher Education, 2nd Edn, 2015.
3. Antennas and Wave Propagation- Harish and Sachidananda, Oxford University Press, 2007.

Web links and Video Lectures (e-Resources)

- Nptel Videos and Lectures
- https://www.tutorialspoint.com/antenna_theory/antenna_theory_horn.html
- <http://www.antenna-theory.com/antennas/smallLoop.php>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Lab based demos for the devices can be done in the form of experiments.
- Mini Projects can be given to students involving design of microwave devices and Antennas.

Dattatraya
 H. O. D.
 Dept. Of Electronics & Communication
 Institute of Engg. & Technology,
 Muz. MOODGIRI - 74 224

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VI Semester

Semester

VLSI Design and Testing

Course Code	21EC63	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	3:0:0:1	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- Impart knowledge of MOS transistor theory and CMOS technology
- Learn the operation principles and analysis of inverter circuits.
- Infer the operation of Semiconductor memory circuits.
- Demonstrate the concept of CMOS testing.

Teaching-Learning Process (General Instructions)

The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Arrange visits to nearby PSUs and industries.
- Show Video/animation films to explain the functioning of various fabrication & testing techniques.
- Encourage collaborative (Group) Learning in the class
- Topics will be introduced in multiple representations.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction: A Brief History, MOS Transistors, CMOS Logic (1.1 to 1.4 of TEXT1)

MOS Transistor Theory: Introduction, Long-channel I-V Characteristics, Non-ideal I-V Effects, DC Transfer Characteristics (2.1, 2.2, 2.4 and 2.5 of TEXT1).

Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, Videos on transistor working Self-study topics: MOSFET Scaling and Small-Geometry Effects RBT Level: L1, L2, L3
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Module-2

Fabrication: CMOS Fabrication and Layout, Introduction, CMOS Technologies, Layout Design Rules, (1.5 and 3.1 to 3.3 of TEXT1).

Delay: Introduction, Transient Response, RC Delay Model, Linear Delay Model, Logical Efforts of Paths (4.1 to 4.5 of TEXT1, except sub-sections 4.3.7, 4.4.5, 4.4.6, 4.5.5 and 4.5.6).

Teaching-Learning Process	Chalk and talk method, Power point presentation, YouTube videos, Videos on fabrication Self-study topics: Layouts of complex design using Euler's method RBT Level: L1, L2, L3
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Module-3

Semiconductor Memories: Introduction, Dynamic Random Access Memory (DRAM) and Static Random Access Memory (SRAM), Nonvolatile Memory, Flash Memory, Ferroelectric Random Access Memory (FRAM) (10.1 to 10.6 of TEXT2)

Teaching-Learning	Chalk and talk method, PowerPoint Presentation, YouTube videos on Standard
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Process	cell memory Design Self-study topics: Memory array design RBT Level: L1, L2, L3
Module-4	
Faults in digital circuits: Failures and faults, Modelling of faults, Temporary faults Test generation for combinational logic circuits: Fault diagnosis of digital circuits, test generation techniques for combinational circuits, Detection of multiple faults in combinational logic circuits. (1.1 to 1.3, 2.1 to 2.3 of TEXT3)	
Teaching-Learning Process	Chalk and talk method, PowerPoint Presentation, YouTube videos, videos on testing algorithms for test generation Self-study topics: Testable combinational logic circuits RBT Level: L1, L2, L3
Module-5	
Test generation for sequential circuits: Testing of sequential circuits as iterative combinational circuits, state table verification, test generation based on circuits structure, functional fault models, test generation based on functional fault models. Design of testable sequential circuits: Controllability and Observability, Adhoc design rules, design of diagnosable sequential circuits, The scan path technique, LSSD, Random Access scan technique, partial scan. (4.1 to 4.5, 5.1 to 5.7 of TEXT3)	
Teaching-Learning Process	Chalk and talk method/Power point presentation, YouTube videos Self-study topics: Memory testing techniques RBT Level: L1, L2, L3
Course outcomes (Course Skill Set) At the end of the course the student will be able to: <ol style="list-style-type: none"> 1. Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling. 2. Draw the basic gates using the stick and layout diagram with the knowledge of physical design aspects. 3. Interpret memory elements along with timing considerations. 4. Interpret testing and testability issues in combinational logic design. 5. Interpret testing and testability issues in combinational logic design. 	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.	
Continuous Internal Evaluation: Three Unit Tests each of 20 Marks (duration 01 hour) <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester Two assignments each of 10 Marks <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20	

Marks (duration 01 hours)

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:**Text Books:**

1. "CMOS VLSI Design- A Circuits and Systems Perspective", Neil H E Weste, and David Money Harris 4th Edition, Pearson Education.
2. "CMOS Digital Integrated Circuits: Analysis and Design", Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill.
3. "Digital Circuit Testing and Testability", Lala Parag K, New York, Academic Press, 1997.

Reference Books:

1. "Basic VLSI Design", Douglas A Pucknell, Kamran Eshraghian, 3rd Edition, Prentice Hall of India publication, 2005.
2. "Essential of Electronic Testing for Digital, Memory and Mixed Signal Circuits", Vishwani D Agarwal, Springer, 2002.

Web links and Video Lectures (e-Resources)

- https://www.youtube.com/watch?v=oLBSKNxEaHs&list=PLLy_2iUCG87Bdulp9brz9AcvW_TnFCUmM
- <https://www.youtube.com/watch?v=IRpt1fCHd8Y&list=PLCmoXVuSEVHIEJi3SwdyJ4EiCffuyqjkk>
- <https://www.youtube.com/watch?v=yLqLDBY4-Qc>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Model displayed for clear understanding of fabrication process of MOS transistor
- Practise session can be held to understand the significance of various layers in MOS process, with the help of coloured layouts


H. O. D.
 Dept. Of Electronics & Commun.
 Alva Institute of Engg. & Technol.
 Nijar, MOOUBIDKI - 574 225

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V Semester

Semester

IoT (Internet of Things) Lab			
Course Code	21EC581	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	03
Course objectives: <ul style="list-style-type: none">To impart necessary and practical knowledge of components of Internet of ThingsTo develop skills required to build real-life IoT based projects.			
Sl.No	Experiments		
1	i) To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to 'turn ON' LED for 1 sec after every 2 seconds. ii) To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to 'turn ON' LED when push button is pressed or at sensor detection.		
2	i) To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings. ii) To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.		
3	To interface motor using relay with Arduino/Raspberry Pi and write a program to 'turn ON' motor when push button is pressed.		
4	To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.		
5	To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.		
6	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thingspeak cloud.		
7	Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thingspeak cloud.		
8	To install MySQL database on Raspberry Pi and perform basic SQL queries.		
9	Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.		
10	Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.		
11	Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.		
12	Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.		
Course outcomes (Course Skill Set): At the end of the course the student will be able to: <ol style="list-style-type: none">Understand internet of Things and its hardware and software componentsInterface I/O devices, sensors & communication modulesRemotely monitor data and control devicesDevelop real life IoT based projects			
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).			

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Vijay Madiseti, Arshdeep Bahga, Internet of Things, "A Hands on Approach", University Press
2. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
3. Pethuru Raj and Anupama C Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
4. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
5. Adrian McEwen, "Designing the Internet of Things", Wiley
6. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

Dattatraya
H. O. D.
Dept. Of Electronics & Communication
Viva Institute of Engg. & Technology
Mijar, MOODBIDRI - 574 225

VI Semester

VI Semester			
Cryptography			
Course Code	21EC642	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:2:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
Course objectives: This course will enable students to:			
<ul style="list-style-type: none">• Preparation: To prepare students with fundamental knowledge/ overview in the field of Information Security with knowledge of mathematical concepts required for cryptography.• Core Competence: To equip students with a basic foundation of Cryptography by delivering the basics of symmetric key and public key cryptography and design of pseudo random sequence generation technique			
Teaching-Learning Process (General Instructions) The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:			
<ol style="list-style-type: none">1. Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.2. Show Video/animation films to explain the different Cryptographic Techniques / Algorithms3. Encourage collaborative (Group) Learning in the class4. Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.6. Topics will be introduced in a multiple representation.7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.9. Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes10. Give Programming Assignments			
Module-1			
Basic Concepts of Number Theory and Finite Fields: Divisibility and The Division Algorithm Euclidean algorithm, Modular arithmetic, Groups, Rings and Fields, Finite fields of the form $GF(p)$, Polynomial Arithmetic, Finite Fields of the Form $GF(2^n)$ (Text 1: Chapter 3)			
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique Programming on implementation of Euclidean algorithm, multiplicative inverse, Finite fields of the form $GF(p)$, construction of finite field over $GF(2^n)$. RBT Level: L1, L2, L3		
Module-2			
Introduction: Computer Security Concepts, A Model for Network Security (Text 1: Chapter 1) Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques (Text 1: Chapter 1)			
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Programming on Substitution and Transposition techniques. Self-study topics: Security Mechanisms, Services and Attacks. RBT Level: L1, L2, L3		
Module-3			

Block Ciphers: Traditional Block Cipher structure, Data encryption standard (DES) (Text 1: Chapter 2: Section 1, 2) The AES Cipher. (Text 1: Chapter 4: Section 2, 3, 4) More on Number Theory: Prime Numbers, Fermat's and Euler's theorem, discrete logarithm. (Text 1: Chapter 7: Section 1, 2, 5)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of SDES using programming languages like C++/Python/Java/Scilab. Self-study topics: DES S-Box- Linear and differential attacks RBT Level: L1, L2, L3
Module-4	
ASYMMETRIC CIPHERS: Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie - Hellman Key Exchange, Elliptic Curve Arithmetic, Elliptic Curve Cryptography (Text 1: Chapter 8, Chapter 9: Section 1, 3, 4)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of Asymmetric key algorithms using programming languages like C++/Python/Java/Scilab Numerical examples on Elliptic Curve Cryptography RBT Level: L1, L2, L3
Module-5	
Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5, Hughes XPD/KPD, Nanoteq, Rambutan, Additive generators, Gifford, Algorithm M, PKZIP (Text 2: Chapter 16)	
Teaching-Learning Process	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of simple stream ciphers using programming languages like C++/Python/Java/Scilab. RBT Level: L1, L2, L3
Course outcomes (Course Skill Set) At the end of the course the student will be able to: <ol style="list-style-type: none"> 1. Explain traditional cryptographic algorithms of encryption and decryption process. 2. Use symmetric and asymmetric cryptography algorithms to encrypt and decrypt the data. 3. Apply concepts of modern algebra in cryptography algorithms. 4. Design pseudo random sequence generation algorithms for stream cipher systems. 	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.	
Continuous Internal Evaluation: Three Unit Tests each of 20 Marks (duration 01 hour) <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester Two assignments each of 10 Marks <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours) <ol style="list-style-type: none"> 6. At the end of the 13th week of the semester 	

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. William Stallings, "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3
2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C", Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X.

Reference Books:

1. Cryptography and Network Security, Behrouz A Forouzan, TMH, 2007.
2. Cryptography and Network Security, Atul Kahate, TMH, 2003.

Web links and Video Lectures (e-Resources)

- <https://nptel.ac.in/courses/106105031>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Programming Assignments / Mini Projects can be given to improve programming skills


H. O. D.
 Dept. Of Electronics & Communication
 Alva Institute of Engg. & Technology
 Mjnar, MOODBIDRI - 574 225

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VI Semester

Python Programming			
Course Code	21EC643	CIE Marks	50
Teaching Hours/Week (L:T:P:S)	2:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
Course objectives: <ul style="list-style-type: none">• To learn programming using Python• Develop application using Python			
Teaching-Learning Process (General Instructions) <p>The sample strategies, which the teacher can use to accelerate the attainment of the various course outcomes are listed in the following:</p> <ol style="list-style-type: none">1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop student's theoretical and programming skills.2. State the need for learning Programming with real-life examples.3. Support and guide the students for self-study.4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress5. Encourage the students for group learning to improve their creative and analytical skills.6. Show short, related video lectures in the following ways:<ul style="list-style-type: none">• As an introduction to new topics (pre-lecture activity).• As a revision of topics (post-lecture activity).• As additional examples (post-lecture activity).• As an additional material of challenging topics (pre-and post-lecture activity).• As a model solution of some exercises (post-lecture activity).			
Module-1			
Python Basics, Python language features, History , Entering Expressions into the Interactive Shell, The Integer, Floating-Point, and String Data Types, String Concatenation and Replication, Storing Values in Variables, Your First Program, Dissecting Your Program, Flow control, Boolean Values, Comparison Operators, Boolean Operators, Mixing Boolean and Comparison Operators, Elements of Flow Control, Program Execution, Flow Control Statements, Importing Modules, Ending a Program Early with sys.exit(). Functions, def Statements with Parameters, Return Values and return Statements, The None Value, Keyword Arguments and print(), Local and Global Scope, The global Statement, Exception Handling, A Short Program: Guess the Number Textbook 1: Chapters 1 – 3			
Teaching-Learning Process	Chalk and talk method, Simulation of modulation techniques RBT Level: L1, L2, L3		
Module-2			
Data Structures: Lists: The List Data Type, Working with Lists Strings: Manipulating Strings, Working with Strings, Useful String Methods Tuples and Dictionaries, basics Using Data Structures to Model Real-World Things, Manipulating Strings. Textbook 1: Chapters 4 – 6			
Teaching-Learning Process	Chalk and talk method/Power point presentation RBT Level: L1, L2, L3		

Module-3	
<p>Pattern Matching with Regular Expressions, Finding Patterns of Text Without Regular Expressions, Finding Patterns of Text with Regular Expressions, More Pattern Matching with Regular Expressions, The findall() Method, Character Classes, Making Your Own Character Classes, The Caret and Dollar Sign Characters, The Wildcard Character, Review of Regex Symbols.</p> <p>Reading and Writing Files, Files and File Paths, The os.path Module, The File Reading/Writing Process, Saving Variables with the shelve Module, Saving Variables with the pprint, pprint() Function</p> <p>Textbook 1: Chapters 7, 8</p>	
Teaching-Learning Process	<p>Chalk and talk method / PowerPoint Presentation</p> <p>RBT Level: L1, L2, L3</p>
Module-4	
<p>Classes and objects: Programmer-defined types, Attributes, Rectangles, Instances as return values, Objects are mutable, Copying, Classes and functions: Time, Pure functions, Modifiers, Prototyping versus planning, Classes and methods: Object-oriented features, Printing objects, Another example, The init method, The __str__ method, Operator overloading, Type-based dispatch, Polymorphism.</p> <p>Textbook 2: Textbook 2: Chapters 15 - 18</p>	
Teaching-Learning Process	<p>Chalk and talk method / PowerPoint Presentation</p> <p>RBT Level: L1, L2, L3</p>
Module-5	
<p>HTTP, The World's simplest Web Browser, Retrieving an image over HTTP, Retrieving web pages with urllib, Parsing html and scraping the web, Parsing HTML using RE, BeautifulSoup, Reading binary files using urllib, XML, Parsing XML, Looping through nodes, JSON, Parsing JSON, API, geocoding Web Service, Security & API usage, What is database?, Database Concepts, Database Browser, Creating a database table, SQL, Spidering Twitter, Basic data modeling, Programming with multiple tables, Three kinds of Keys, JOIN</p> <p>Text book : Chapter 2, 13, 15</p>	
Teaching-Learning Process	<p>Chalk and talk method/Power point presentation</p> <p>RBT Level: L1, L2, L3</p>
<p>Course outcomes (Course Skill Set)</p> <p>At the end of the course the student will be able to:</p> <ol style="list-style-type: none"> 1. To acquire programming skills in Python 2. To demonstrate data structure representation using Python 3. To develop the skill of pattern matching and files in Python 4. To acquire Object Oriented Skills in Python 5. To develop the ability to write database applications in Python 	
<p>Assessment Details (both CIE and SEE)</p> <p>The weightage of Continuous 5 End Examination) taken together.</p> <p>Continuous Internal Evaluation:</p> <p>Three Unit Tests each of 20 Marks (duration 01 hour)</p> <ol style="list-style-type: none"> 1. First test at the end of 5th week of the semester 2. Second test at the end of the 10th week of the semester 3. Third test at the end of the 15th week of the semester <p>Two assignments each of 10 Marks</p> <ol style="list-style-type: none"> 4. First assignment at the end of 4th week of the semester 5. Second assignment at the end of 9th week of the semester <p>Group discussion/Seminar/quiz any one of three suitably planned to attain the COs and POs for 20 Marks (duration 01 hours)</p>	

6. At the end of the 13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(to have less stressed CIE, the portion of the syllabus should not be common /repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module. Marks scored out of 100 shall be reduced proportionally to 50 marks

Suggested Learning Resources:

Text Books:

1. Al Sweigart, "Automate the Boring Stuff with Python", 1st Edition, No Starch Press, 2015.
(Available under CC-BY-NC-SA license at <https://automatetheboringstuff.com/>) (Chapters 1 to 8)
2. Allen B Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (Available under CC-BY-NC license at <http://greenteapress.com/thinkpython2/thinkpython2.pdf>) (Chapters 15 - 18)
(Download pdf/html files from the above links)
3. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st, Create Space Independent Publishing Platform, 2016

Web links and Video Lectures (e-Resources)

- <https://www.youtube.com/watch?v=xQNeOTRyig>
- <https://www.youtube.com/watch?v=kqtD5dpm9C8>

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Write a program to generate Fibonacci series
- Write a program to find factorial of a number using function.
- Write a menu driven program to implement stack using Lists
- Create a DB using dictionaries containing key as USN and related fields containing Name, gender, Marks1, Marks2 & Marks3 of students. Implement the following functions to perform i) Update Name/gender/marks ii) search for usn and display the relevant fields iii) delete based on search for name iv) generate the report with avg marks more than 70%
- Write a program to implement search and replace multiple occurrences of a given substring in the main string in a list.
- Write a function called most_frequent that takes a string and prints the letters in decreasing order of frequency.
- Write a program that reads a file, display the contents, builds a histogram of the words in the file and print most common words in the file.
- Write a program that searches a directory and all of its subdirectories, recursively, and returns a list of complete paths for all files with a given suffix.

- Write python code to extract From: and To: Email Addresses from the given text file using regular expressions. <https://www.py4e.com/code3/mbox.txt>.
- Consider the sentence "From rjlowe@iupui.edu Fri Jan 4 14:50:18 2008". Write python code to extract email address and time of the day from the given sentence
- Write a program to read, display and count number of sentences of the given file.
- Write a program that gets the current date and prints the day of the week.
- Write a function called print_time that takes two Time objects and prints total time it in the form hour:minute:second.
- Write a program that takes a birthday as input and prints the user's age and the number of days, hours, minutes and seconds until their next birthday.


H. O. D.
Dept. Of Electronics & Communication
Institute of Engg. & Technology
Muz, MOODBIDRI - 574 225

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V Semester

Communication Lab II			
Course Code	21ECL55	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3
Course objectives: This laboratory course enables students to <ul style="list-style-type: none">Design and demonstrate communication circuits for different digital modulation techniques.To simulate Source coding Algorithms using C/C++/ MATLAB code.To simulate Error correcting and detecting codes using C/C++/ MATLAB code.Simulate the networking concepts and protocols using C/C++/ Network simulation tool.Understand entropies and mutual information of different communication channels.			
Sl.No.	Experiments		
Implement the following using discrete components			
1	FSK generation and detection		
2	PSK generation and detection		
3	DPSK Transmitter and receiver		
4	QPSK Transmitter and Receiver		
Implement the following in C/C++/MATLAB/Scilab/Python or any other Suitable software			
5	Write a program to encode binary data using Huffman code and decode it.		
6	Write a program to encode binary data using a (7,4) Hamming code and decode it.		
7	Write a program to encode binary data using a ((3,1,2)/suitably designed) Convolution code and decode it.		
8	For a given data, use CRC-CCITT polynomial to obtain the CRC code. Verify the program for the cases a) Without error b) With error		
Implement the following algorithms in C/C++/MATLAB/Network simulator			
9	Write a program for congestion control using leaky bucket algorithm.		
10	Write a program for distance vector algorithm to find suitable path for transmission.		
11	Write a program for flow control using sliding window protocols.		
12	Configure a simple network (Bus/star) topology using simulation software OR Configure a simple network (Ring/Mesh) topology using simulation software.		
Demonstration Experiments (For CIE)			
13	Configure and simulate simple Wireless Local Area network.		
14	Simulate the BER performance of (2, 1, 3) binary convolutional code with generator sequences $g(1) = (1\ 0\ 1\ 1)$ and $g(2) = (1\ 1\ 1\ 1)$ on AWGN channel. Use QPSK modulation scheme. Channel decoding is to be performed through Viterbi decoding. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0 . Consider binary input vector of size 3 lakh bits. Also find the coding gain.		
15	Simulate the BER performance of (7, 4) Hamming code on AWGN channel. Use QPSK modulation		

scheme. Channel decoding is to be performed through maximum-likelihood decoding. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0 . Consider binary input vector of size 5 lakh bits. Use the following parity check matrix for the (7, 4) Hamming code. Also find the coding gain.

$$H = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 & 1 \end{bmatrix}$$

16. Simulate the BER performance of rate 1/3 Turbo code. Turbo encoder uses two recursive systematic encoders with $G(D) = \left[1, \frac{1+D^4}{1+p+D^2+D^5} \right]$ and pseudo-random interleaver. Use QPSK modulation scheme. Channel decoding is to be performed through maximum a-posteriori (MAP) decoding algorithm. Plot the bit error rate versus SNR (dB), i.e. $P_{e,b}$ versus E_b/N_0 . Consider binary input vector of size of around 3 lakh bits and the block length as 10384 bits. Also find the coding gain.

Course outcomes (Course Skill Set):

On the completion of this laboratory course, the students will be able to:

1. Design and test the digital modulation circuits and display the waveforms.
2. To implement the source coding algorithm using C/C++/ MATLAB code.
3. To implement the Error Control coding algorithms using C/C++/ MATLAB code.
4. Illustrate the operations of networking concepts and protocols using C programming and network simulators.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is **50 Marks**.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by

the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours.

Rubrics suggested in Annexure-II of Regulation book

Suggested Learning Resources:

1. Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
2. K Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
3. Forouzan, "Data Communications and Networking", 5th Edition, McGraw Hill, 2013, ISBN: 1-25-906475-3.

Dattatraya
H. O. D.
 Dept. Of Electronics & Communication
 Arva - Institute of Engg. & Technology
 Mijar, MOODBIDKI - 574 225

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B.E: Electronics & Communication Engineering / B.E: Electronics & Telecommunication Engineering
NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021 – 22)

VI Semester

VLSI Laboratory			
Course Code	21ECL66	CIE Marks	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3
Course objectives: This laboratory course enables students to <ul style="list-style-type: none">• Design, model, simulate and verify digital circuits.• Design layouts and perform physical verification of CMOS digital circuits.• Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.• Perform RTL-GDSII flow and understand the stages in ASIC.			
Sl.No.	Experiments		
ASIC Digital Design			
1	4-Bit Adder <ul style="list-style-type: none">• Write Verilog Code• Verify the Functionality using Test-bench• Synthesize the design by setting proper constraints and obtain the netlist. From the report generated identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required		
2	4-Bit Booth Multiplier <ul style="list-style-type: none">• Write Verilog Code• Verify the Functionality using Test-bench• Synthesize the design by setting proper constraints and obtain the netlist. From the report generated Identify Critical path, Maximum delay, Total number of cells, Power requirement and Total area required		
3	32-Bit ALU Supporting 4-Logical and 4-Arithmetic operations, using case and if statement for ALU Behavioral Modeling <ul style="list-style-type: none">• Write Verilog Code• Verify functionality using Test-bench• Synthesize the design targeting suitable library and by setting area and timing constraints• Tabulate the Area, Power and Delay for the Synthesized netlist• Identify Critical path		
4	Latch and Flip-Flop <ul style="list-style-type: none">• Synthesize the design and compare the synthesis report (D, SR, JK)		
ASIC Analog Design			
5	a) Capture the schematic of CMOS inverter with load capacitance of 0.1pF and set the widths of Inverter with $W_n = W_p$, $W_n = 2W_p$, $W_n = W_p/2$ and length at selected technology. Carry out the following:		

	<p>i. Set the input signal to a pulse with rise time, fall time of 1ns and pulse width of 10ns and the time period of 20ns and plot the input voltage and output voltage of designed inverter?</p> <p>ii. From the simulation result compute t_{pHL}, t_{pLH} and t_d for all three geometrical settings of width?</p> <p>iii. Tabulate the results of delay and find the best geometry for minimum delay for CMOS inverter?</p> <p>b) Draw layout of inverter with $W_p/W_n = 40/20$, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.</p>
6	<p>a) Capture the schematic of 2-input CMOS NAND gate having similar delay as that of CMOS inverter computed in experiment above. Verify the functionality of NAND gate and also find out the delay t_d for all four possible combinations of input vectors. Table the results. Increase the drive strength to 2X and 4X and tabulate the results.</p> <p>b) Draw the layout of NAND with $W_p/W_n = 40/20$, use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.</p>
7	<p>a) Capture schematic of Common Source Amplifier with PMOS Current Mirror Load and find its transient response and AC response? Measure the Unit Gain Bandwidth (UGB), amplification factor by varying transistor geometries, study the impact of variation in width to UGB.</p> <p>b) Draw Layout of common source amplifier, use optimum layout methods. Verify for DRC & LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.</p>
8	<p>a) Capture schematics of two-stage operational amplifier and measure the following:</p> <ol style="list-style-type: none"> UGB dB Bandwidth Gain Margin and phase margin with and without coupling capacitance Use the op-amp in the inverting and non-inverting configuration and verify its functionality. Study the UGB, 3dB bandwidth, gain and power requirement in op-amp by varying the stage wise transistor geometries and record the observations. <p>b) Draw layout of two-stage operational amplifier with minimum transistor width set to 300 (in 180/90/45 nm technology), choose appropriate transistor geometries as per the results obtained in part a. Use optimum layout methods. Verify for DRC and LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.</p>
Demonstration Experiments (For CIE)	
9	<p>UART</p> <ul style="list-style-type: none"> • Write Verilog Code • Verify the Functionality using Test-bench • Synthesize the design targeting suitable library and by setting area and timing constraints • Tabulate the Area, Power and Delay for the Synthesized netlist, Identify Critical path
10	<p>For synthesized netlist carry out the following:</p> <ul style="list-style-type: none"> • Floor planning • Placement and Routing • Record the parameters such as no. of metal layers used for routing, flip method for placement of standard cells • Physical Verification and record the DRC and LVS reports • Generate GDSII

11	<p>Design and characterize 6T binary SRAM cell and measure the following:</p> <ul style="list-style-type: none"> • Read Time, Write Time, SNM, Power • Draw Layout of 6T SRAM, use optimum layout methods. Verify for DRC & LVS, extract parasitic and perform post layout simulations, compare the results with pre-layout simulations. Record the observations.
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Course outcomes (Course Skill Set):

On the completion of this laboratory course, the students will be able to:

1. Design and simulate combinational and sequential digital circuits using Verilog HDL.
2. Understand the synthesis process of digital circuits using EDA tool.
3. Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level netlist.
4. Design and simulate basic CMOS circuits like inverter, common source amplifier, differential amplifier, SRAM.
5. Perform RTL_GDSII flow and understand the stages in ASIC design.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 35% (18 Marks out of 50) in the semester-end examination (SEE).

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability. Rubrics suggested in Annexure-II of Regulation book
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and average marks of two tests is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is **50 Marks**.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be

03.10.2022

decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

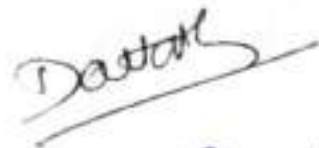
Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners).

Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours.

Rubrics suggested in Annexure-II of Regulation book



H. O. D.
Dept. Of Electronics & Communication
Viva Institute of Engg. & Technology
Mijar, MOODBIDRI - 574 22