Name of Institute: ITE
Name of Faculty: Asst. Prof. Miloni Ganatra

Course code: EC0524
Course name: System Verilog for Verification
Pre-requisites: Digital Electronics & Digital System Design using HDL
Credit points: 4
Offered Semester: 5th

Course Coordinator (weeks 01 - 12)
Full Name: Asst. Prof. Miloni Ganatra
Department with siting location: E.C -Machine Lab, 2nd Floor, Bhanwar Building
Telephone:9974592124
Email: miloniganatra.ec@indusuni.ac.in
Consultation times: 2nd & 4th Saturday.

Course Lecturer (weeks 01 - 12)
Full Name: Asst. Prof. Miloni Ganatra
Department with siting location: E.C -Machine Lab, 2nd Floor, Bhanwar Building
Telephone:9974592124
Email: miloniganatra.ec@indusuni.ac.in
Consultation times: 2nd & 4th Saturday.

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

1) The main objective of this course is to learn to design a testbench for verification of digital designs using systemverilog.

2) This course provides methods and guidelines to design an effective testbench for digital designs.

3) The information on basic components, required to design a testbench, are covered in this course.

Course Outcomes (CO)

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

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

1) Understand coverage-driven random testing in a layered test-bench environment.

2) Understand new System Verilog data types such as arrays, structures, enumerated types, and packed variables and Procedural Statements and Routines.

3) Design OOP to build classes, construct objects, and use handles.

4) Create multiple threads in your testbench, use interprocess communication to exchange data between these threads and synchronize them.

5) Understand different types of coverage and how you can use functional coverage to measure your progress as you follow a verification plan.

Course Outline

Unit 1 **[10 hours]**

VERIFICATION GUIDELINES

- Introduction
- The Verification Process
- The Verification Plan
- The Verification Methodology Manual
- Basic Testbench Functionality
- Directed Testing
- Methodology Basics
- Constrained-Random Stimulus
- What Should You Randomize?
- Functional Coverage
- Testbench Components
- Layered Testbench
- Building a Layered Testbench
- Simulation Environment Phases
- Maximum Code Reuse
- Testbench Performance

DATA TYPES

- Built-in Data Types
- Fixed-Size Arrays
- Dynamic Arrays
- Queues
- Associative Arrays
- Linked Lists
- Array Methods
- Choosing a Storage Type
- Creating New Types with typedef

- Creating User-Defined Structures
- Enumerated Types
- Constants
- Strings
- Expression Width
- Net Types

Unit 2 **[13 hours]**

PROCEDURAL STATEMENTS AND ROUTINES

- Procedural Statements
- Tasks, Functions, and Void Functions
- Task and Function Overview
- Routine Arguments
- Returning from a Routine
- Local Data Storage
- Time Values

BASIC OOP

- OOP Terminology
- Creating New Objects
- Object Deallocation
- Using Objects
- Static Variables vs. Global Variables
- Class Routines
- Defining Routines Outside of the Class
- Scoping Rules
- Using One Class Inside Another
- Understanding Dynamic Objects
- Copying Objects
- Public vs. Private

Unit 3 **[13 hours]**

CONNECTING THE TESTBENCH AND DESIGN

- Separating the Testbench and Design
- The Interface Construct
- Stimulus Timing
- Interface Driving and Sampling
- Connecting It All Together
- Top-Level Scope
- Program – Module Interactions
- SystemVerilog Assertions
- The Four-Port ATM Router

THREADS AND INTERPROCESS COMMUNICATION

- Working with Threads
- Interprocess Communication
- Events
- Semaphores
- Mailboxes

- Building a Testbench with Threads and IPC

Unit 4 **[10 hours]**

ADVANCED OOP AND GUIDELINES

- Introduction to Inheritance
- Factory Patterns
- Type Casting and Virtual Methods
- Composition, Inheritance, and Alternatives
- Copying an Object
- Callbacks

FUNCTIONAL COVERAGE

- Coverage Types
- Functional Coverage Strategies
- Simple Functional Coverage Example
- Anatomy of a Cover Group
- Triggering a Cover Group
- Data Sampling
- Cross Coverage
- Coverage Options
- Parameterized Cover Groups
- Analyzing Coverage Data
- Measuring Coverage Statistics During Simulation

Method of delivery

(Face to face lectures, Online Platform, Active Learning Techniques, PPT, Chalk Board)

Study time

(9 hours per week including class attendance)

CO-PO Mapping (PO: Program Outcomes)

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

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

Figure 1: Blooms Taxonomy

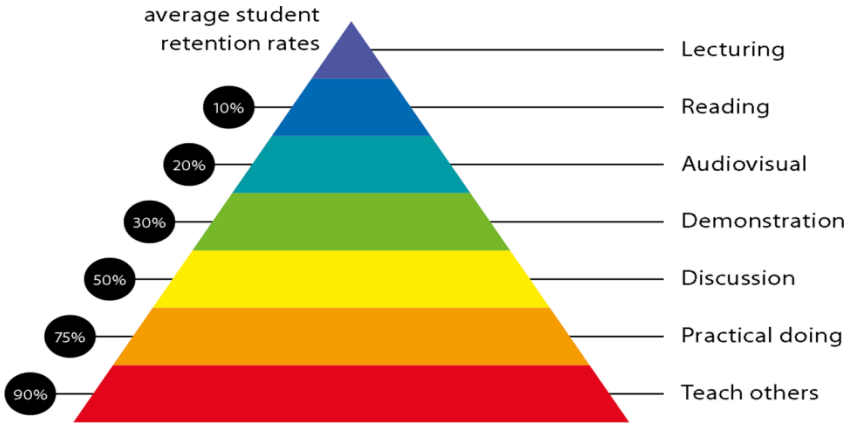

Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has	**1 Professional knowledge, grounding & awareness**

developed and how it relates to other areas.	
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

Lab Experiments & Outcome of Sensor & Transducer Lab:

Outcome:

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

1. Understand and use the SystemVerilog RTL design and synthesis features, including new data types, literals, procedural blocks, statements, and operators, relaxation of Verilog language rules, fixes for synthesis issues, enhancements to tasks and functions, new hierarchy and connectivity features, and interfaces.

2. Appreciate and apply the SystemVerilog verification features, including classes, constrained random stimulus, coverage, strings, queues and dynamic arrays, and learn how to utilize these features for more effective and efficient verification.

Lab Experiments:

Lab 1. Familiarization with Synopsys VCS
Lab 2. Structural Modeling of a Master-Slave Flip-Flop
Lab 3. Hierarchical Modeling
Lab 4. Behavioral Modeling of a Counter
Lab 5. Scalable Multiplexer
Lab 6. Sum of Products
Lab 7. Register File Modeling
Lab 8. Arithmetic-Logic Unit Modeling
Lab 9. Sequence Controller
Lab 10. Final Project: The RISC-Y CPU

Lecture/tutorial times

(Give lecture times in the format below)

Example:
Lecture
Monday 2:00-3:00 PM
Wednesday 10.00 – 11.00 AM
Thursday 11:10-12:10 PM

Laboratory:
Thursday: 9:00- 11:00 PM

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Text books:

1. SystemVerilog for Verification A Guide to Learning the Testbench Language Features by Spear Chris and Tumbush Greg.

Reference Books:

1. SystemVerilog Assertions and Functional Coverage by Guide to Language, Methodology and Applications by Ashok Mehta

Additional Materials (Web Resources)

1.https://nptel.ac.in/courses/108/103/108103179/

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

CIE 60 marks:
(40 marks mid semester examination + 20 marks internal evaluation)

Internal Evaluation (20 Marks):
03 marks: attendance
10 marks: Seminar Presentation
07 marks: Quiz
Final exam (closed book)—40 Marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

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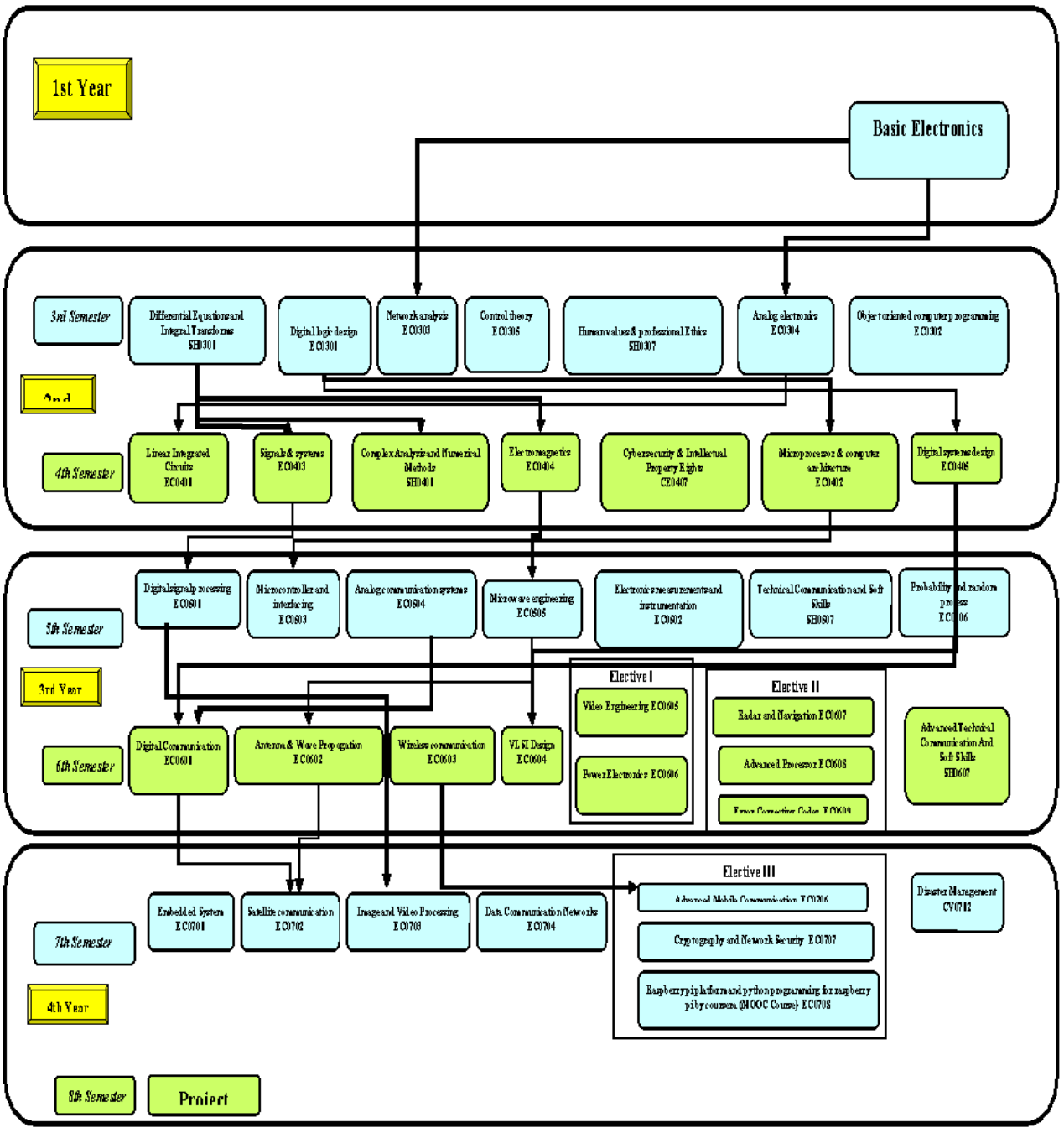
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Introduction,The Verification Process,The Verification Plan,The Verification Methodology Manual,Basic Testbench Functionality,Directed Testing Methodology Basics	**CO1, CO2, CO4**	Board,Chalk, PPT
	Weeks 2	Constrained-Random Stimulus ,What Should You Randomize?,Functional Coverage,Testbench Components,Layered Testbench,Building a Layered Testbench,Simulation Environment Phases,Maximum Code Reuse,Testbench Performance	**CO1, CO2, CO5**	Board,Chalk, PPT
	Week 3	Built-in Data Types,Fixed-Size Arrays,Dynamic Arrays,Queues,Associative Arrays,Linked Lists,Array Methods,Choosing a Storage Type,Creating New Types with typedef,Creating User-Defined Structures,Enumerated Types,Constants,Strings,Expression Width Net Types	**CO1, CO2, CO3**	Board,Chalk, PPT
	Week 4	Procedural Statements,Tasks, Functions, and Void Functions,Task and Function Overview,Routine Arguments,Returning from a Routine,Local Data Storage,Time Values	**CO1, CO2, CO5**	Board,Chalk, PPT
	Week 5	OOP Terminology,Creating New Objects,Object Deallocation,Using Objects,Static Variables vs. Global Variables,Class Routines, Defining Routines Outside of the Class	**CO1, CO2, CO3**	Board,Chalk, PPT

	Week 6	Scoping Rules,Using One Class Inside Another,Understanding Dynamic Objects,Copying Objects,Public vs. Private	**CO1, CO2, CO3**	Board,Chalk, PPTMid Sem Examination
	Week 7	Separating the Testbench and Design,The Interface Construct ,Stimulus Timing,Interface Driving and Sampling,Connecting It All Together	**CO1, CO2, CO3, CO4**	Board,Chalk, PPT
	Week 8	Top-Level Scope,Program – Module Interactions,SystemVerilog Assertions,The Four-Port ATM Router	**CO1, CO2, CO3, CO4**	Board,Chalk, PPT
	Week 9	Working with Threads,Interprocess Communication,Events,Semaphores,Mailboxes,Building a Testbench with Threads and IPC	**CO1, CO2, CO3, CO4**	Board,Chalk, PPT
	Week 10	Introduction to Inheritance,Factory Patterns,Type Casting and Virtual Methods,Composition, Inheritance, and Alternatives,Copying an Object, Callbacks	**CO1, CO2, CO3, CO5**	Board,Chalk, PPT
	Week 11	Coverage Types,Functional Coverage Strategies,Simple Functional Coverage Example,Anatomy of a Cover Group,Triggering a Cover Group,Data Sampling	**CO1, CO2, CO3, CO5**	Board,Chalk, PPT
	Week 12	Cross Coverage,Coverage Options,Parameterized Cover Groups,Analyzing Coverage Data,Measuring Coverage Statistics During Simulation	**CO1, CO2, CO3, CO5**	Board,Chalk, PPT

PROGRAM MAP:


1st Year
Basic Electronics
3rd Semester
Differential Equations and Integral Transforms SEH301
Digital logic design EC0301
Network analysis EC0303
Control theory EC0305
Human values & professional Ethics SEH307
Analog electronics EC0304
Object oriented computer programming EC0302
4th Semester
Linear Integrated Circuits EC0401
Signals & systems EC0403
Complex Analysis and Numerical Methods SEH401
Electromagnetics EC0404
Cybersecurity & Intellectual Property Rights CE0407
Microprocessor & computer architecture EC0402
Digital systems design EC0406
5th Semester
Digital signal processing EC0501
Microcontroller and interfacing EC0503
Analog communication systems EC0504
Microwave engineering EC0505
Electronics measurements and instrumentation EC0502
Technical Communication and Soft Skills SEH507
Probability and random process EC0506
3rd Year
Elective I
Video Engineering EC0605
Power Electronics EC0606
Elective II
Radar and Navigation EC0607
Advanced Processor EC0608
6th Semester
Digital Communication EC0601
Antenna & Wave Propagation EC0602
Wireless communication EC0603
VLSI Design EC0604
Advanced Technical Communication And Soft Skills SEH607
Elective III
Cryptography and Network Security EC0707
Raspberry pi platform and python programming for raspberry pi by coursera (MOOC Course) EC0708
Disaster Management CV0712
7th Semester
Embedded System EC0701
Satellite communication EC0702
Image and Video Processing EC0703
Data Communication Networks EC0704
4th Year
8th Semester
Project

Name of Institute: Institute of Technology and Engineering
Name of Faculty: Asst. Prof Abhishek Vaghela

Course code:
Course name: Microprocessor and Microcontroller
Pre-requisites: Digital Electronics, Microprocessor and Computer Architecture
Credit points: 4
Offered Semester: IV

Course coordinator (weeks 12)
Full name: Asst. Prof. Abhishek Vaghela
Department with siting location: EC Department, Signal Processing and Simulation Lab (Lab – 6)
Telephone: 3204
Email: abhishekvaghela.ec@indusuni.ac.in
Consultation times: Monday – Friday (4:00 PM to 4: 50 PM)

Course lecturer (weeks 12)
Full name: Asst. Prof. Abhishek Vaghela
Department with siting location: EC Department, Signal Processing and Simulation Lab (Lab – 6)
Telephone: 3204
Email: abhishekvaghela.ec@indusuni.ac.in
Consultation times: Monday – Friday (4:00 PM to 4: 50 PM)

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

By participating in and understanding all facets of this course a student will:

1) To introduce students to the architecture and operation of microprocessor & microcontrollers.
2) To familiarize students with programming of microcontroller.
3) To Introduce students to Embedded C programming
4) To familiarize students to interface various peripherals to the microcontroller.
5) To provide a strong foundation for designing real world applications using microcontroller.

Course Outcomes (CO)

1) Asses and solve basic binary math operations using microcontroller.
2) Apply knowledge and demonstrate programming proficiency using various addressing modes and data transfer instructions of the target microcontroller.
3) Compare accepted standards and guidelines to select appropriate microcontroller to meet the specified performance requirement.
4) Analyse assembly and C language programs of a microcontroller
5) Design electrical circuitry for interfacing various peripherals to the microcontroller.
6) Evaluate assembly and C language programs and download the machine code that will provide solutions to the real-world problems.

Course Outline

Unit	Contents	Total Hours
1	**Microprocessor Based Systems:** Microprocessor, Microcontroller, Von Neumann and Harvard Architecture, CISC and RISC Processors **8085 Microprocessor:** Architectural Block Diagram, Pin diagrams, Pin functions, Bus Organization, Internal operations and registers, Instruction set of 8085 processor	**10**
2	**8051 Microcontroller architecture:** Introduction to MCS -51 Family microcontrollers, Architectural block Diagram, Pin diagram, General Purpose and Special Function Registers, , Oscillator and clock circuit, Reset circuit, I/O Port circuits, Memory organization, Internal program and data memory, Introduction to program development tools **8051 Assembly language instructions :** Programming model of 8051, Addressing modes, data transfer instructions, I/O Port programming, Arithmetic and Logical instructions, Bit level instructions, Branching instructions (Jump and loop Jump and call), Concept of stack, subroutine and related instructions. **8051 Programming in C:Data types in 8051 C:** programming for time delay, I/O programming in 8051 C, Logic operations in 8051 C, Control statements and loops in embedded C, Functions and Arrays in	**10**

	embedded C, Data conversion programs in 8051 C, , Accessing code ROM space using 8051 C.	
3	**8051 Timer/Counter and Programming:** Use of counter as timer, Timer/Counters and associated registers, Various modes of timer/counter operations, Time delay programs in Assembly language/ Embedded C. **8051 Serial Port and Programming:** Basics of serial communication, RS232 standards, 8051 connection to RS232, Serial data input/output and associated registers, Various modes of serial data communication, serial data communication programs in Assembly language/ Embedded C **8051 Interrupts: Concept of Interrupt:** interrupt versus polling, Types of interrupts in 8051, Reset, interrupt control and associated registers, interrupt vectors, Interrupt execution, RETI instruction, software generated interrupt, interrupt handler subroutine for timer/counter and serial data transmission/reception in Assembly language/ Embedded C	**10**
4	**Applications and design of microcontroller based systems:** Interfacing of LEDs, 7 Segment display device, LCD display, DIP Switches, Push Button switches, Interfacing A/D converter, D/A converter, Relay, opto isolator stepper motor and DC motor **Introduction to ARM Cortex-M processor:** Cortex- M processor family, Advantages of the Cortex-M processors, Applications of the ARM Cortex-M processors, Architecture of Cortex - M processor, Introduction to Instruction set and programming of ARM Cortex-M processor	**10**

Method of delivery

Lectures
Laboratories

Study time

3 Hour’s theory and 2 Hour’s Practical session per week

CO-PO Mapping (PO: Program Outcomes)

CO/PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	√					√	√	√				
2	√					√	√	√				
3		√		√						√		
4		√		√						√		
5	√		√	√								

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

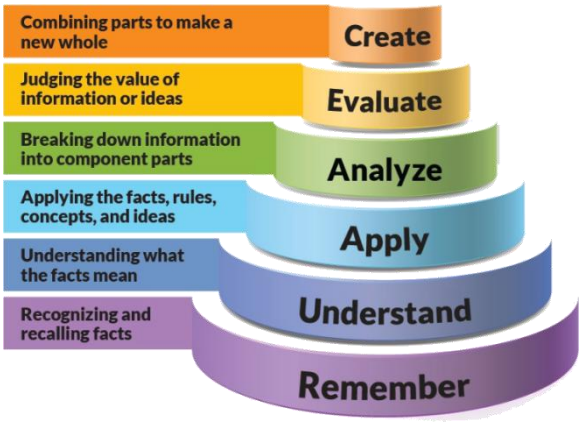


Figure 1: Blooms Taxonomy

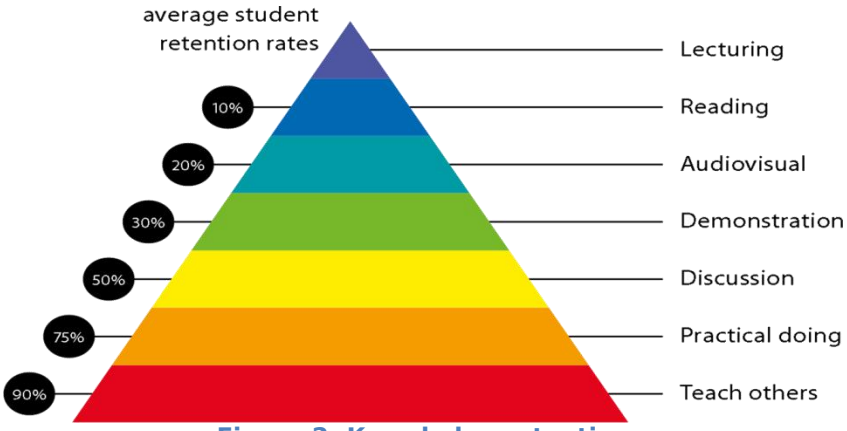


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of Electronics and Communication Engineering Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

Sr.No	Title	Learning Outcomes
1	Introduction to IDE and Assembler directives.	Able to use keil IDE for ALP programming
2	8051 Assembly language programming for addition, subtraction, multiplication and division of two 8-bit numbers .	Able to write assembly language programs of 8051 in keil , able to use Keil IDE
3	8051 Assembly language programming for block data transfer between internal and external memory including overlapping blocks.	Able to write assembly language programs of 8051 in keil , able to use Keil IDE
4	8051 Assembly language programming using Arithmetic instructions	Able to write assembly language programs of 8051 in keil , able to use Keil IDE
5	8051 Assembly language programming using Logical Instructions	Able to write assembly language programs of 8051 in keil , able to use Keil IDE
6	8051 Assembly language programming for code conversions	Able to write assembly language programs of 8051 in keil , able to use Keil IDE
7	8051 Assembly language programming for Timers in different modes.	Able to use timer of 8051 microcontroller
8	I/O port programming in embedded C.	Able to Write embedded c code for I/O port
9	Timers and Counters programming in embedded C for time delay and frequency measurement using ISRs.	Able to write embedded c code for timers and counter
10	Digital clock programming using 7- segment display in embedded C.	Able to interface 7 segment write embedded c code for interfacing 7 segment display.
11	Programming of LCD in embedded C.	Able to interface LCD and write embedded c code for LCD
12	Serial communication and UART programming in Embedded C.	Able to write embedded c code for UART

Lecture/tutorial times

(Give lecture times in the format below)

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

Text books

1. Microprocessor Architecture, Programming, and Applications with the 8085, By Romesh Gaonkar, Penram International Publishing (India) LTD.

2. The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2/e by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay (Second Edition , Pearson Education)

3. The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors, by Joseph Yiu, Publisher: Elsevier, ISBN: 9789351071754, 9351071758

Reference Books:

1. The 8051 Microcontroller & Embedded Systems using Assembly and C By K. J. Ayala, D. V. Gadre (Cengage Learning , India Edition).

2. Using the MCS-51 Microcontrollers By Han Way Huang Oxford Uni Press

3. Programming and Customizing the 8051 Microcontroller by Myke Predko Tata Mcgraw Hill.

Additional Materials

1. Microcontroller Course (http://nptel.ac.in/courses/Webcoursecontents/IITKANPUR/microcontrollers/micro/ui/TOC.htm)

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Example:

Mid Semester Exam	40%
Attendance	**5%**
Simulation Project	10%
Assignment	5%
Final exam (*closed book*)	40%

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

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Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment).

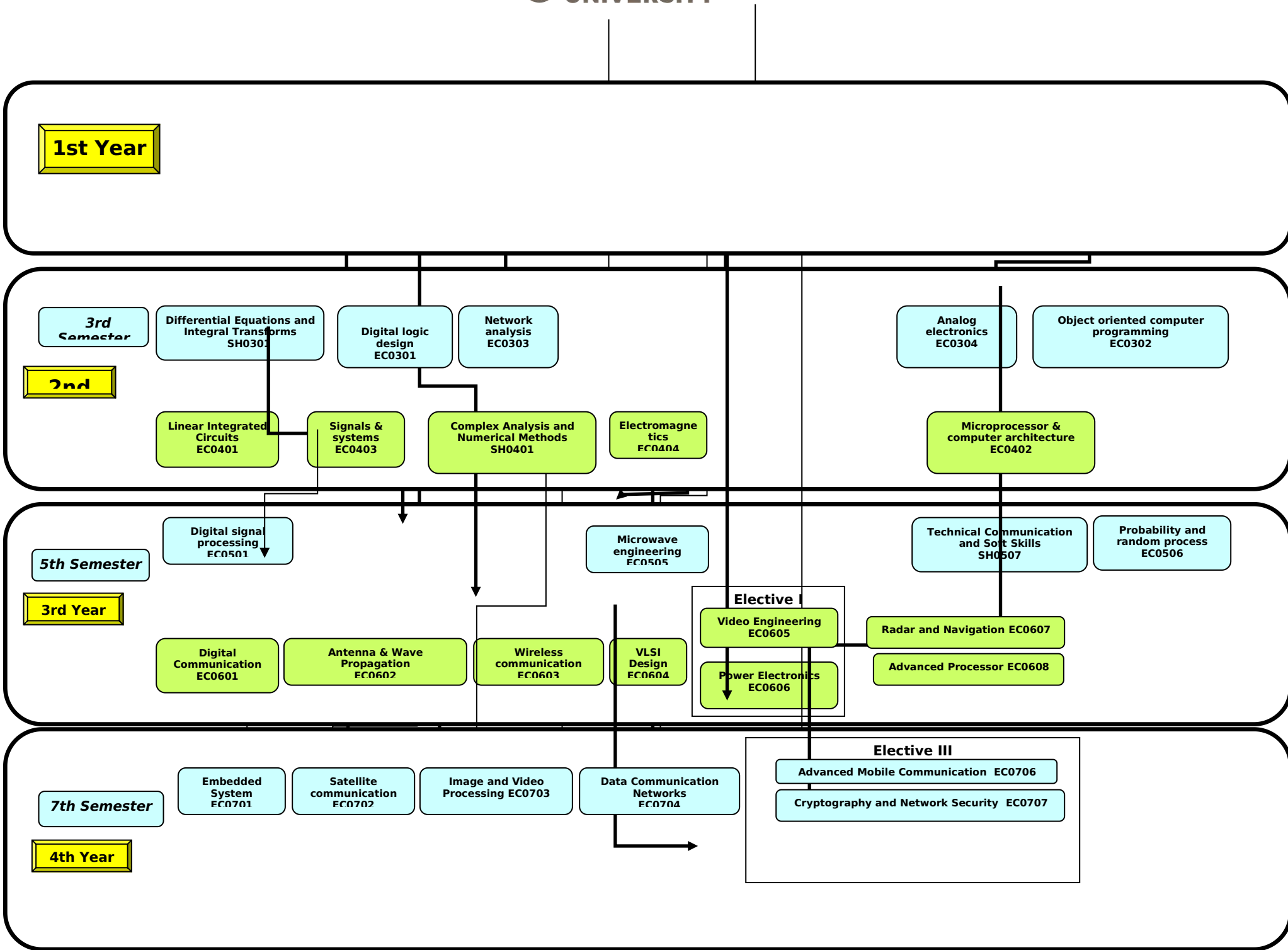
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Introduction to Microprocessor based systems, 8085 architecture , pin functions of 8085	CO1,CO2	BB,PPT
	Weeks 2	Instruction set of 8085	CO1,CO2	BB,PPT
	Week 3	Introduction to 8051 microcontroller, it architecture, Registers, Memory organization	CO2,CO3	BB,PPT
	Week 4	Instruction set of 8051, addressing modes of 8051	CO3,CO1,CO2	BB,PPT
	Week 5	Embedded C programming of 8051	CO3,CO4,CO5	BB,PPT

	Week 6	Timer / Counter programming of 8051 in assembly and C	CO3,CO4,CO5	BB,PPT
	Week 7	Serial port programming of 8051 in assembly and C	CO3,CO4,CO5	BB,PPT
	Week 8	Interrupt programming of 8051 in assembly and C	CO3,CO4,CO5	BB,PPT
	Week 9	Interfacing of Peripherals such as LED, Switch, 7 Segment Display and LCD	CO4,CO5,CO6	BB,PPT
	Week 10	Interfacing of A/D and D/A Converter, DC Motor and Stepper motor interfacing	CO5,CO6	BB,PPT
	Week 11	Introduction to Cortex-M family, Advantages of Cortex-M, Application of ARM Cortex-M processor	C01,CO2,CO3	BB,PPT
	Week 12	Architecture of Cortex - M processor, Introduction to Instruction set and programming of ARM Cortex-M processor	CO3,CO4,CO5	BB,PPT

ज्ञानेन प्रकाशते जगत्
INDUS UNIVERSITY



Name of Institute: **Institute of Technology & Engineering**
Name of Faculty: **Dr. Minesh Thaker**

Course code: EC0526
Course name:Advanced Electronics
Pre-requisites: Basic Electronics
Credit points: 4
Offered Semester: 5th

Course coordinator (weeks 01 - 14)
Full name: Dr. Minesh Thaker
Department with siting location: Electronics & Communication Engineering
Telephone: 9909039918

Email: mineshthaker.ec@indusuni.ac.in
Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Course lecturer (weeks 01 - 14)
Full name: Dr. Minesh Thaker
Department with siting location: Electronics & Communication Engineering
Telephone: 9909039918

Email: mineshthaker.ec@indusuni.ac.in
Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

By participating in and understanding all facets of this course a student will:

- Analyse the various biasing techniques using JFET/MOSFET,Design the biasing techniques for applications using JFET/MOSFET.
- Analyse the various single tuned ,double tuned and stagger tuned amplifiers, Explain the effect of various tuned amplifiers on bandwidth
- Compare the various optoelectronic devices,Analyse and design the CMOS Opamp

Course Outcomes (CO)

1. To design the circuits using MOSFET, Tuned Amplifier,optoelectronics devices
2. To Construct the circuit and make project using the above said components

3. Compare the various optoelectronic devices,Analyse and design the CMOS Opamp
4. Students will be able to analyse the various single tuned ,double tuned and stagger tuned amplifiers,
5. Students will be able to explain the effect of various tuned amplifiers on bandwidth

Course Outline

Unit No.	Topics
1	Tuned Amplifier Tuned amplifier Q factor,small signal tuned amplifier,Effect of cascading single tuned amplifiers on bandwidth,Effect of cascading double tuned amplifiers on bandwidth,Stagger tuned amplifier,comparison of tuned amplifiers,large signal tuned amplifiers,Stability of tuned amplifier,Neutralization.
2	Design using FETs JFET biasing techniques, fixed biasing technique ,voltage divider bias,self bias,Trans conductance and drain curves,CS,CD,CG amplifiers MOSFET amplifiers, comparison of MOSFET amplifiers,MOSFET biasing techniques.
3	Design of CMOS operational amplifier [12hours] OPamp Specifications,Design Approach and stability,Two stage op amps, Compensation,folded cascode theory, common mode feedback, oscillators amplifiers in negative feedback
4	Opto-electronic Devices spectral response of human eye, photo- conductive sensors, photo-voltaic sensors, photo-emission sensors,light emitters,LCD,Nixie,tube, Alphanumeric Displays,LCD pannels,plasma display panels, Opto-couplers Introduction to memories, semiconductor memories.
Text books:	Electronics Devices and Circuits by S Salivahanan And N Suresh kumar Tata Macgrohil.3rd Edition
Reference Books/Notes	Design of CMOS Operational Amplifiers by Rasoul Dehghani Artech House,

Method of delivery

1. Chalk and talk
2. PowerPoint Presentations
3. Self-study material
4. NPTEL notes

Study time

3 hours per week Lectures and 2 Hours practical per week

CO-PO Mapping (PO: Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√				√			
CO2	√	√	√		√				√			
CO3	√				√				√			
CO4	√				√				√		√	
CO5	√	√	√		√						√	
CO6	√	√	√		√							

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

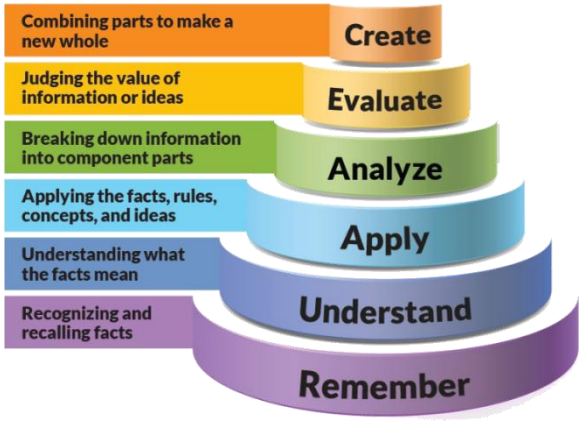


Figure 1: Blooms Taxonomy

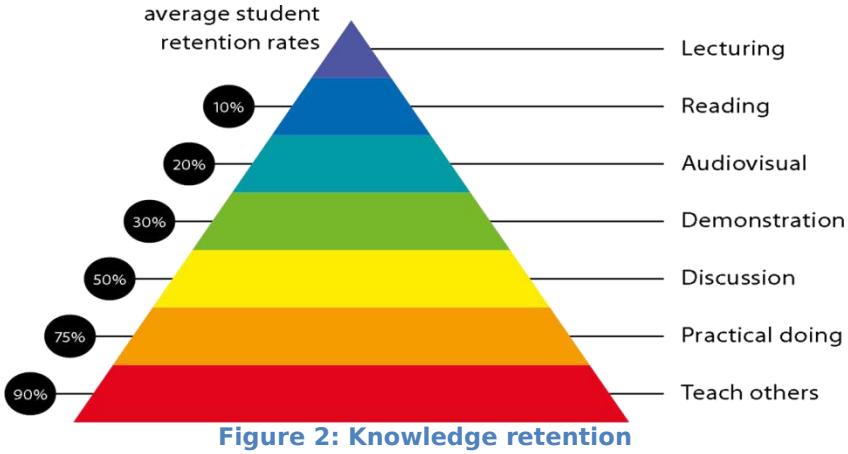


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities

Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work : Not Applicable

Lecture/tutorial times

(Give lecture times in the format below)

Monday-10.00 to 11.00 AM
Wednesday: 12.20 to 1.20 PM
Thursday: 9:00 to 10:00 AM
Friday: 9:00 to 11:00

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

1. Text Books and Reference Books
2. Online Resources

Text books

Mention in syllabus

Additional Materials

1. https://www.edx.org/course/introduction-to-computer-science-and-programming-using-pyt hon-2
2. http://www.openculture.com/2017/05/learn-python-with-a-free-online-course-from-mit.ht ml
3. https://www.edx.org/course/introduction-to-python-absolute-beginner-3
4. https://onlinecourses.nptel.ac.in/noc19_cs40

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

1. Theory CIE 60 marks:
a. Midsem exam: 40 Marks
b. Assignment: 10 Marks
c. Quiz: 10 Marks

2. Practical CIE 60 marks:
a. Experiment Performance 30 Marks
b. File work + Skill Test 20 Marks
c. Internal Viva 10 Marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available

during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10 % of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

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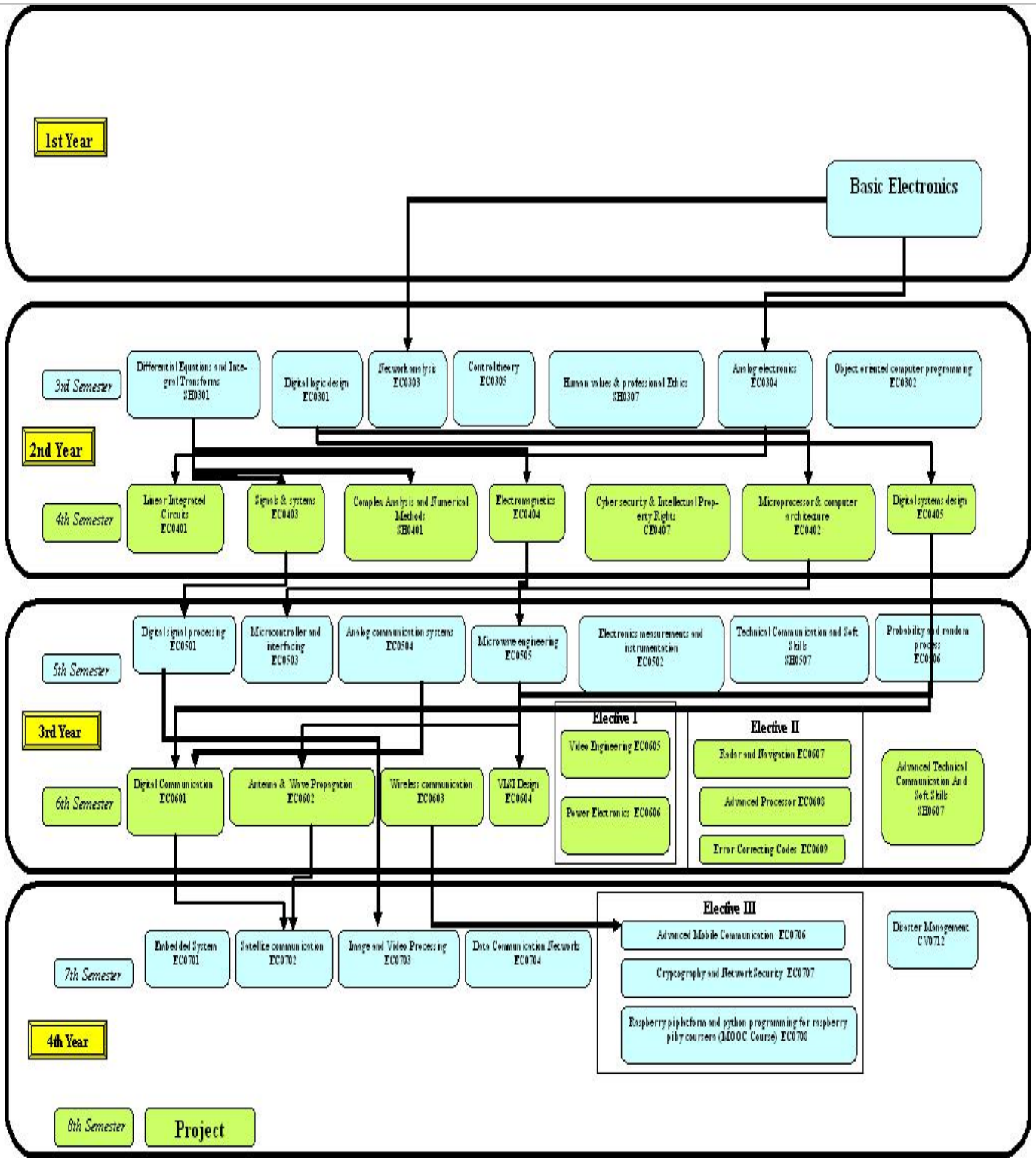
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Tuned amplifier Q factor,small signal tuned amplifier,Effect of cascading single tuned amplifiers on bandwidth,Effect of cascading double tuned amplifiers	CO1 CO3	Chalk and talk PowerPoint Presentations
	Weeks 2	Stagger tuned amplifier,comparison of tuned amplifiers	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 3	large signal tuned amplifiers,Stability of tuned amplifier,N eutralization.	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 4	JFET biasing techniques, fixed biasing technique ,voltage divider bias,self bias,	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 5	Trans conductance and drain curves,CS,CD,CG amplifiers MOSFET amplifiers,	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 6	comparison of MOSFET amplifiers,MOSFET biasing techniques	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 7	OPamp Specifications,Design Approach and stability,Two stage op amps,	CO2 CO3 CO5	Chalk and talk PowerPoint Presentations
	Week 8	Compensation,folded cascode theory, common mode feedback, oscillators amplifiers in negative feedback	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 9	Opto-electronic Devices spectral response of human eye,	CO2 CO3	Chalk and talk PowerPoint Presentations

	Week 10	photo- conductive sensors, photo-voltaic sensors,	CO2 CO5	Chalk and talk PowerPoint Presentations
	Week 11	photo-emission sensors,light emitters,LCD,N ixie,tube,	CO4 CO5	Chalk and talk PowerPoint Presentations
	Week 12	Alphanumeric Displays,LCD pannels,plasma display panels	CO4 CO5	Chalk and talk PowerPoint Presentations
	Week 13	Opto-couplers I ntroduction to memories, semiconductor memories.	C05	Chalk and talk PowerPoint Presentations
	Week 14	Revision		

Program map for B.Tech (Electronics & Communication Engineering)



Name of Institute: Indus Institute of Technology and Engineering (IITE)
Name of Faculty: Divyangna Gandhi

Course code: EC0516
Course name: Principles of Communication Systems

Pre-requisites: Various basic mathematics such as Fourier series and Transform, basic electronic and basics of Communication

Credit points: 03
Offered Semester: 5th

Course Coordinator (weeks 15)
Full Name: Divyangna Gandhi
Department with sitting location: 2nd Floor, Bhanwar Building, EC Lab 5(Digital and Networking Lab), IITE - IU
Telephone: 3202
Email: Divyangnagandhi.ec@indusuni.ac.in
Consultation times: 4:00PM to 4:45PM

Course Lecturer (weeks 15)
Full Name: Divyangna Gandhi
Department with sitting location: 2nd Floor, Bhanwar Building, EC Lab 5(Digital and Networking Lab), IITE - IU
Telephone: 3202
Email: Divyangnagandhi.ec@indusuni.ac.in
Consultation times: 4:00PM to 4:45PM

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives
By participating in and understanding all facets of this course a student will:

- To understand how the information transfers over a longer distance and different techniques involved in such communication.
- To analyze system requirements of analog communication systems.
- To understand the need for modulation.
- To understand the generation and detection of various analog modulation techniques with mathematical analysis.

- To analyze the noise performance of analog modulation techniques.
- To provide theoretical knowledge of each block in AM and FM receivers. To understand the basic operating principles of amplifiers.

Course Outcomes (CO)

- Understand how the information transfers over a longer distance and different techniques involved in such communication.
- Analyze system requirements of analog communication systems
- Understand the need for modulation.
- Understand the generation and detection of various analog modulation techniques with mathematical analysis.
- To analyze the noise performance of analog modulation techniques
- Provide theoretical knowledge of each block in AM and FM receivers.

Course Outline

Basic foundation of communication system
Modulation system
Noise
Receiver

Method of delivery

(Face to face lectures, self-study material, Active Learning Techniques)

Study time

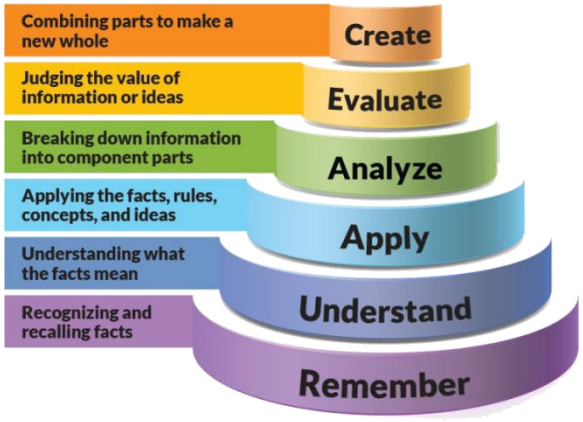
(3 Hour's theory)

CO-PO Mapping (PO: Program Outcomes)

PO / CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	√											
2	√						√					
3		√		√								
4		√	√	√	√		√					
5		√					√					
6		√			√							

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

Figure 1: 

Blooms Taxonomy

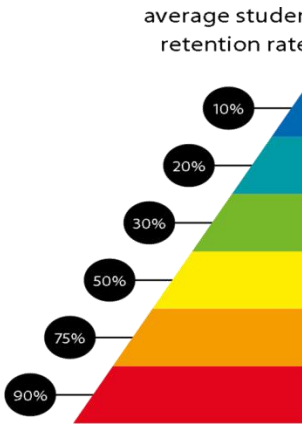


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**

Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
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Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Lecture/tutorial times

Example:

Lecture	**Monday**	**03.10 – 04.10PM**	**Online mode**
Lecture	**Tuesday**	**09.00 – 10.00AM**	**Online mode**
Lecture	**Thursday**	**02:00 – 03.00PM**	**Online mode**

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books

Text books	Modern digital and analog Communication systems, B. P. Lathi, Oxford University Press, 4th Ed, 2010.
	Electronic Communications, Dennis Roddy and John Coolen, Pearson, 4th edition, 2011.
Reference Books	Taub & Schilling: Principles of Communication Systems, Tata McGraw-Hill
	Leon W.Couch, II: Digital and Analog Communication Systems, Pearson, Education (Seventh Edition)

Additional Materials

NPTEL- Lecture https://nptel.ac.in/courses/108/104/108104091/

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Example:

Midterm Exam	40%	Objective (1-4)
Presentation	5%	Objectives (1-5)
Attendance	5%	
Tutorial/Assignment	10%	Objectives (1-4, 6)
Final exam (*closed book*)	40%	Objectives (1-6)

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

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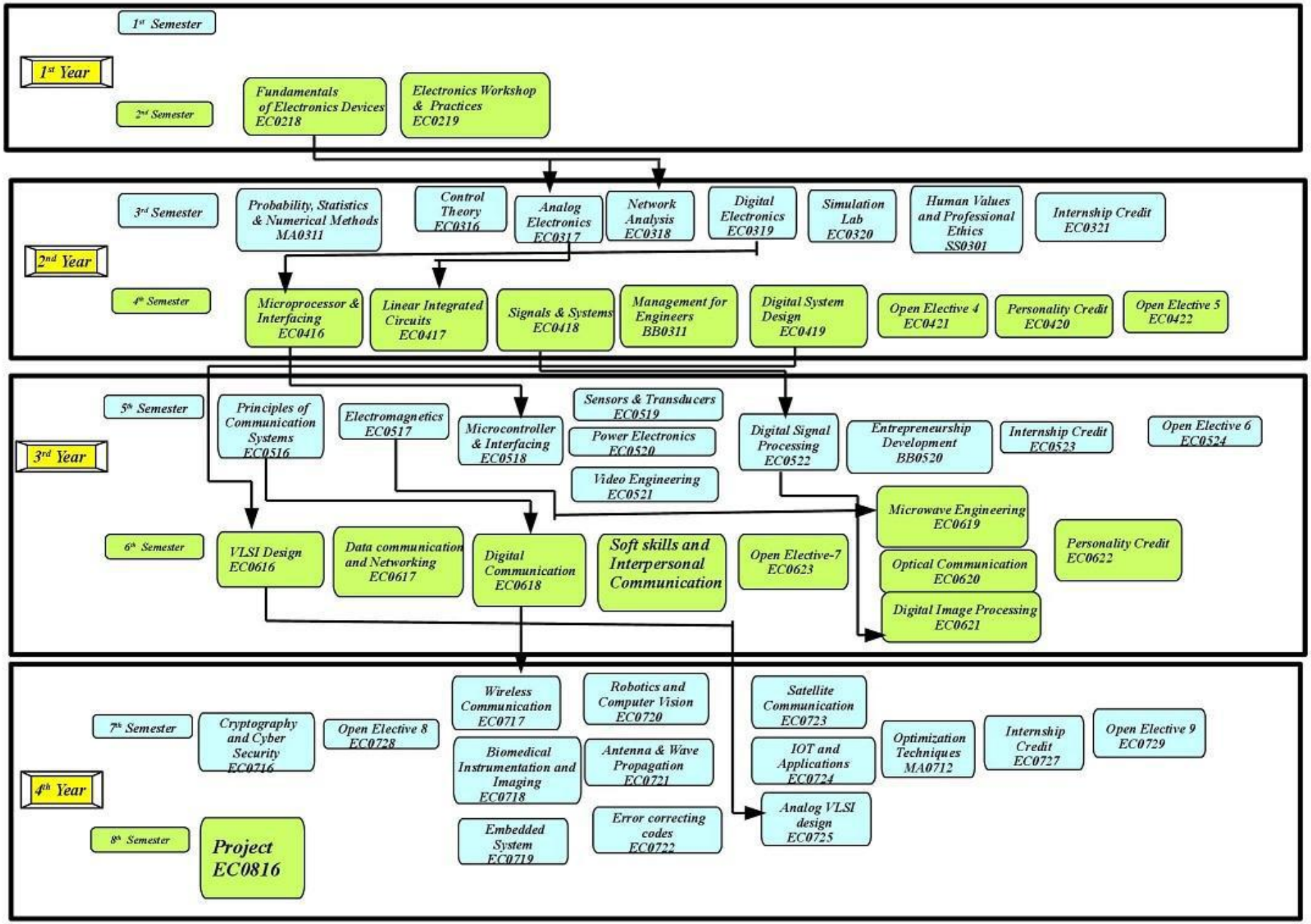
Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

Course schedule

	Week 15	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	To aware students with theoretical and practical syllabus, assessment scheme for theory (CIE, End sem exam), practical (CIE, End sem exam) and all the details about subject activities has to be carry out throughout the semester	1	BB,PPT
		Introduction to Communication and signals		
	Weeks 2	Types of Signals, Signals and Vectors, Signal comparison using correlation	1,2	BB,PPT
	Week 3	Orthogonal signal set, Fourier Series, Analysis and Transmission of Signals using Fourier Transform, Signal transmission through linear system.	1,2,3,4	BB,PPT
	Week 4	Analog and Digital Messages, Parameters of Communication systems: Signal-to-ratio, Channel Bandwidth	2,3	BB,PPT
	Week 5	Transmission Bandwidth, Signal Bandwidth, Rate of Communication, Modulation, Redundancy and Coding, Application of Communication Systems	1,5,6	BB,PPT
	Week 6	Amplitude Modulation: Baseband and Carrier Modulation, Double side band, Double Side band Suppressed Carrier	1,5,6	BB,PPT
	Week 7	Amplitude Modulation (AM), Quadrature Amplitude Modulation(QAM), Single Side	5,6	BB,PPT

		Band (SSB), Vestigial Side Band (VSB)		
	Week 8	Angle Modulation: Concept of instantaneous frequency, Bandwidth of angle modulated wave, Generation of FM waves	1,2,3	BB,PPT
	Week 9	Demodulation of FM, Phase Modulation, Comparison of AM and FM.	3,4	BB,PPT
	Week 10	Noise: Introduction, Thermal Noise, Shot Noise, Partition, Noise, Flicker Noise, Performance of AM systems in presence of Noise	1,2,4	BB,PPT
	Week 11	Performance of Angle modulated systems in presence of Noise, Pre-emphasis and De-emphasis	1,2,3	BB,PPT
	Week 12	Receivers: Super heterodyne Receiver, Tracking, Tuning, Sensitivity, Gain, Image Rejection, AGC, Adjacent channel selectivity	4,6	BB,PPT
	Week 13	FM receiver, Recent Trends and Development in Analog Communication:	4,5,6	BB,PPT
	Week 14	Applications of AM, FM and PM, FM Broadcast Radio, Frequency Stabilizers	5,6	BB,PPT
	Week 15	Revision		BB,PPT


1st Semester
1st Year
2nd Semester
Fundamentals of Electronics Devices EC0218
Electronics Workshop & Practices EC0219
3rd Semester
Probability, Statistics & Numerical Methods MA0311
Control Theory EC0316
Analog Electronics EC0317
Network Analysis EC0318
Digital Electronics EC0319
Simulation Lab EC0320
Human Values and Professional Ethics SS0301
Internship Credit EC0321
2nd Year
4th Semester
Microprocessor & Interfacing EC0416
Linear Integrated Circuits EC0417
Signals & Systems EC0418
Management for Engineers BB0311
Digital System Design EC0419
Open Elective 4 EC0421
Personality Credit EC0420
Open Elective 5 EC0422
5th Semester
Principles of Communication Systems EC0516
Electromagnetics EC0517
Microcontroller & Interfacing EC0518
Sensors & Transducers EC0519
Power Electronics EC0520
Video Engineering EC0521
Digital Signal Processing EC0522
Entrepreneurship Development BB0520
Internship Credit EC0523
Open Elective 6 EC0524
3rd Year
6th Semester
VLSI Design EC0616
Data communication and Networking EC0617
Digital Communication EC0618
Soft skills and Interpersonal Communication
Open Elective-7 EC0623
Microwave Engineering EC0619
Optical Communication EC0620
Digital Image Processing EC0621
Personality Credit EC0622
7th Semester
Cryptography and Cyber Security EC0716
Open Elective 8 EC0728
Wireless Communication EC0717
Biomedical Instrumentation and Imaging EC0718
Embedded System EC0719
Robotics and Computer Vision EC0720
Antenna & Wave Propagation EC0721
Error correcting codes EC0722
Satellite Communication EC0723
IOT and Applications EC0724
Analog VLSI design EC0725
Optimization Techniques MA0712
Internship Credit EC0727
Open Elective 9 EC0729
4th Year
8th Semester
Project EC0816

Name of Institute: ITE
Name of Faculty: Asst. Prof. Miloni Ganatra

Course code: EC0519
Course name: Sensors & Transducers
Pre-requisites: Basic Electrical & Electronics Engineering, Physics, Analog Electronics
Credit points: 4
Offered Semester: 5th

Course Coordinator (weeks 01 - 12)
Full Name: Asst. Prof. Miloni Ganatra
Department with siting location: E.C -Machine Lab, 2nd Floor, Bhanwar Building
Telephone:9974592124
Email: miloniganatra.ec@indusuni.ac.in
Consultation times: 2nd & 4th Saturday.

Course Lecturer (weeks 01 - 12)
Full Name: Asst. Prof. Miloni Ganatra
Department with siting location: E.C -Machine Lab, 2nd Floor, Bhanwar Building
Telephone:9974592124
Email: miloniganatra.ec@indusuni.ac.in
Consultation times: 2nd & 4th Saturday.

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives
By participating in and understanding all facets of this Course a student will:

1) Familiar with the constructions and working principle of different types of sensors and transducers.

2) Aware about the measuring instruments and the methods of measurement and the use of different transducers.

Course Outcomes (CO)

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

1) Use concepts in common methods for converting a physical parameter into an electrical quantity.

2) Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light.

3) Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.

4) Predict correctly the expected performance of various sensors.

5) Locate different type of sensors used in real life applications and paraphrase their importance.

6) Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers and develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system.

Course Outline

UNIT-I

[10 hours]

Mechanical and Electromechanical sensor: Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity.

Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes.

Inductive sensor: common types ,Reluctance change type, Mutual inductance change type, transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input output variable, Ferromagnetic plunger type, short analysis.

LVDT: Construction, material, output input relationship, I/O curve, discussion.
Proximity sensor

UNIT-II

[12 hours]

Capacitive sensors: Variable distance-parallel plate type, variable area-parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity.
Stretched diaphragm type: microphone, response characteristics.

Piezoelectric element: piezoelectric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors.

UNIT-III

[13 hours]

Thermal sensors:
Material expansion type: solid, liquid, gas & vapor

Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification.

Thermo emf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type.

Radiation sensors: types, characteristics and comparison.

Pyroelectric type.

UNIT-IV

[10 hours]

Magnetic sensors: Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics.

Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response.

Geiger counters, Scintillation detectors, Introduction to smart sensors

Method of delivery
(Face to face lectures, Online Platform, Active Learning Techniques, PPT, Chalk Board)

Study time
(9 hours per week including class attendance)

CO-PO Mapping (PO: Program Outcomes)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO 1	3	3	2	1	2	2	-	-	3	-	-	-
CO 2	2	1	3	3	2	1	2	-	-	-	-	-
CO 3	2	1	2	2	3	2	2	-	-	-	-	-
CO 4	2	2	3	2	1	-	-	-	-	-	-	-
CO 5	2	3	2	1	2	2	-	-	-	-	-	-
CO 6	2	3	3	2	1	1	2	-	-	-	-	-

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

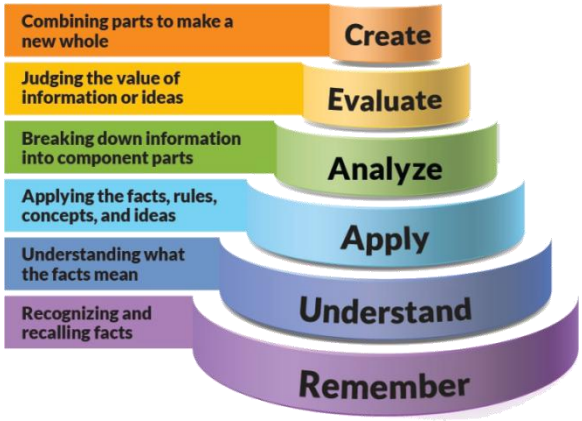


Figure 1: Blooms Taxonomy

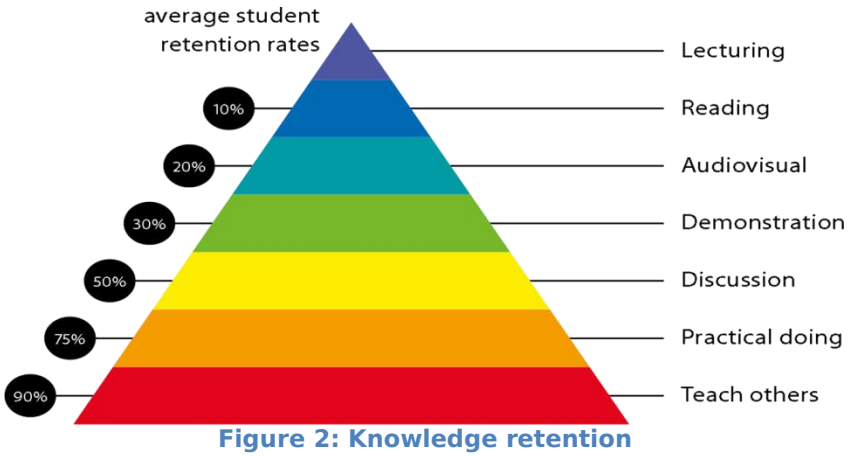


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

Lab Experiments & Outcome of Sensor & Transducer Lab:

Outcome:

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

1) Know the various types of error in instruments.
2) Obtain the knowledge about various types of Sensors & Transducers and their working principle.
3) Understand the various types of transducers like Resistive, Capacitive and Inductive.
4) Learn some of the miscellaneous transducers.

Lab Experiments:

Sr. No.	Lab Experiments
1	Characteristics of Strain gauge
2	Characteristics of load cell
3	Characteristics of RTD
4	Characteristics of Thermocouple
5	Characteristics of LVDT
6	Characteristics of Piezo-electric transducer
7	Characteristics of Proximity Sensor
8	Characteristics of Ultrasonic Sensor
9	Characteristics of Smart Sensor

Lecture/tutorial times

(Give lecture times in the format below)

Example:

Lecture Tuesday 8.30 – 10.30 am Room LH 30
Lecture/Tutorial Wednesday 8.30 – 10.30 am Room LH 30
Practicals Friday

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books:

1. Sensor & transducers, D. Patranabis, 2nd edition, PHI

Reference Books:

1. Instrument transducers, H.K.P. Neubert, Oxford University press.
2. Measurement systems: application & design, E.A.Doebelin, Mc Graw Hill

Additional Materials (Web Resources)

1. https://nptel.ac.in/courses/108/108/108108147/

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

CIE 60 marks:
(40 marks mid semester examination + 20 marks internal evaluation)

Internal Evaluation (20 Marks):
05 marks: attendance
10 marks: Seminar Presentation
05 marks: Assignment

Final exam (closed book) 40 Marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

.

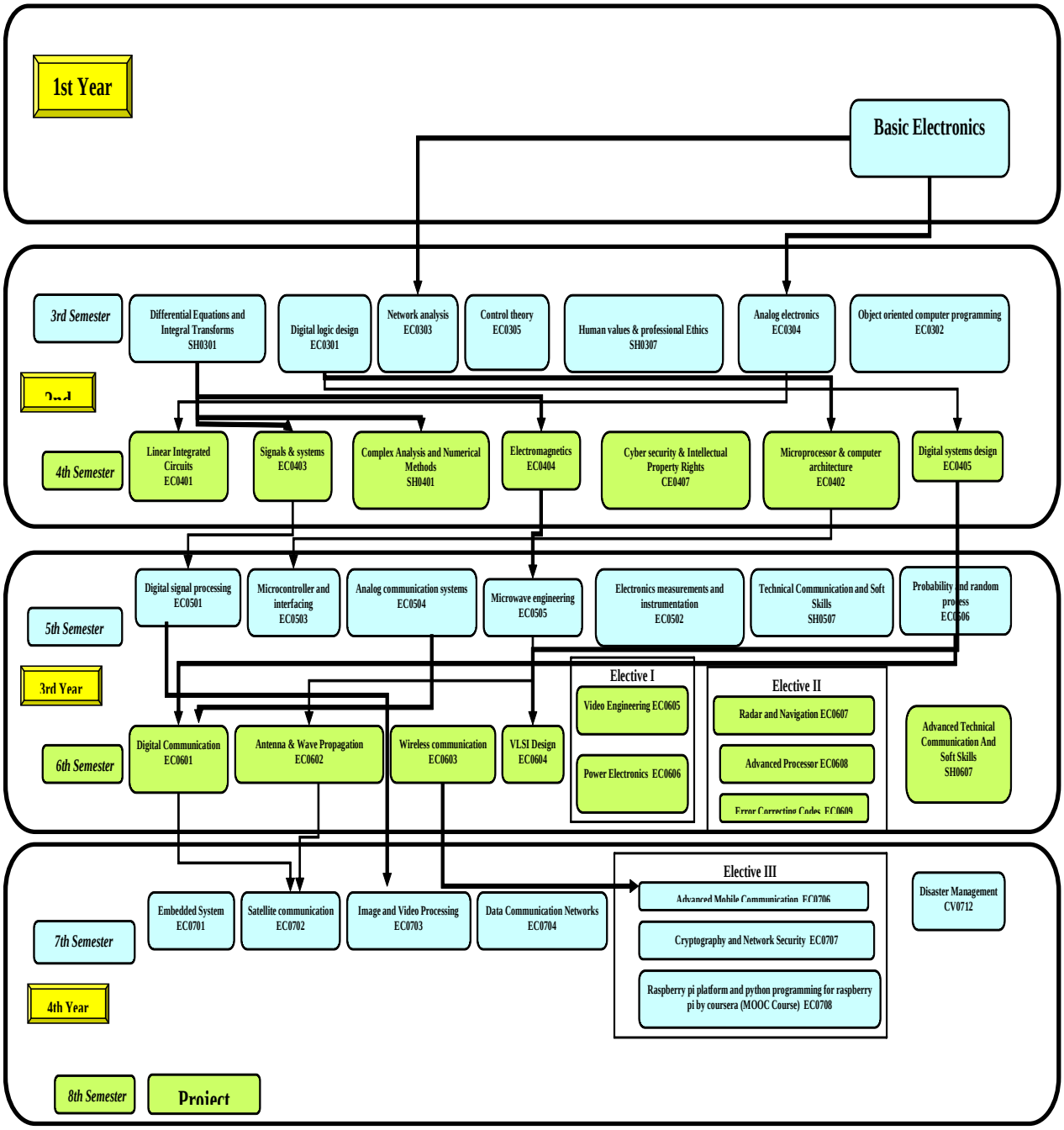
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Mechanical and Electromechanical sensor: Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. **Strain gauge:** Theory, type, materials, design consideration	**CO1, CO2, CO5**	BB,PPT
	Weeks 2	Sensitivity, gauge factor, variation with temperature, adhesive, rosettes **Inductive sensor:** common types- Reluctance change type, Mutual inductance change type.	**CO1, CO2, CO5**	BB,PPT
	Week 3	Transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input output variable Ferromagnetic plunger type, short analysis.	**CO1, CO2, CO5**	BB,PPT
	Week 4	**LVDT:** Construction, material, output input relationship, I/O curve, discussion. **Proximity sensor**	**CO1, CO2, CO5**	BB,PPT Assignment Submission
	Week 5	**Capacitive sensors:** Variable distance-parallel plate type, variable area- parallel plate. serrated plate/teeth type, cylindrical type, variable dielectric constant type, calculation of sensitivity.	**CO1, CO2, CO3**	BB,PPT

	Week 6	Stretched diaphragm type: microphone, response characteristics , Piezoelectric element: piezoelectric effect, charge and voltage co-efficient , Crystal model, materials, natural & synthetic type, their comparison, Force & stress sensing, ultrasonic sensors.	**CO1, CO2, CO3**	BB,PPT Mid Sem Examination
	Week 7	**Thermal sensors:** Material expansion type: solid, liquid, gas & vapor , Resistance change type: RTD materials, tip sensitive & stem sensitive type	**CO1, CO2, CO3, CO4**	BB,PPT
	Week 8	Thermister material, shape, ranges and accuracy specification , Thermo emf sensor: types, thermoelectric power, general consideration,	**CO1, CO2, CO3, CO4**	BB,PPT
	Week 9	Junction semiconductor type IC and PTAT type, Radiation sensors: types, characteristics and comparison. Pyroelectric type.	**CO1, CO2, CO3, CO4**	BB,PPT
	Week 10	**Magnetic sensors:** Sensor based on Villari effect for assessment of force, torque, proximity,Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics. Geiger counters, Scintillation detectors, Introduction to smart sensors	**CO1, CO2, CO3, CO6**	BB,PPT Seminar Presentation
	Week 11	Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response.	**CO1, CO2, CO3, CO6**	BB,PPT Seminar Presentation
	Week 12	Geiger counters, Scintillation detectors, Introduction to smart sensors	**CO1, CO2, CO3, CO6**	BB,PPT Seminar Presentation

PROGRAM MAP:


1st Year
Basic Electronics
3rd Semester
Differential Equations and Integral Transforms SH0301
Digital logic design EC0301
Network analysis EC0303
Control theory EC0305
Human values & professional Ethics SH0307
Analog electronics EC0304
Object oriented computer programming EC0302
4th Semester
Linear Integrated Circuits EC0401
Signals & systems EC0403
Complex Analysis and Numerical Methods SH0401
Electromagnetics EC0404
Cyber security & Intellectual Property Rights CE0407
Microprocessor & computer architecture EC0402
Digital systems design EC0405
5th Semester
Digital signal processing EC0501
Microcontroller and interfacing EC0503
Analog communication systems EC0504
Microwave engineering EC0505
Electronics measurements and instrumentation EC0502
Technical Communication and Soft Skills SH0507
Probability and random process EC0506
3rd Year
Elective I
Video Engineering EC0605
Power Electronics EC0606
Elective II
Radar and Navigation EC0607
Advanced Processor EC0608
Error Correcting Codes EC0609
6th Semester
Digital Communication EC0601
Antenna & Wave Propagation EC0602
Wireless communication EC0603
VLSI Design EC0604
Advanced Technical Communication And Soft Skills SH0607
Elective III
Advanced Mobile Communication EC0706
Cryptography and Network Security EC0707
Raspberry pi platform and python programming for raspberry pi by coursera (MOOC Course) EC0708
Disaster Management CV0712
7th Semester
Embedded System EC0701
Satellite communication EC0702
Image and Video Processing EC0703
Data Communication Networks EC0704
4th Year
8th Semester
Project

Name of Institute: **Institute of Technology & Engineering**
Name of Faculty: **Prof.Zalak Patel**

Course code: EC0522
Course name: Digital Signal Processing
Pre-requisites: Signals & Systems
Credit points: 5
Offered Semester: 5th

Course coordinator (weeks 01 - 14)
Full name: Prof. Zalak Patel
Department with siting location: Electronics & Communication Engineering
Telephone: 7878452549
Email: zalakpatel.ec@indusuni.ac.in
Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Course lecturer (weeks 01 - 14)
Full name: Prof. Zalak Patel
Department with siting location: Electronics & Communication Engineering
Telephone: 7878452549
Email: zalakpatel.ec@indusuni.ac.in
Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

By participating in and understanding all facets of this course a student will:

1. To study about discrete time systems and to learn about FFT algorithm
2. To study the design techniques for FIR and IIR digital filters
3. To study the finite word length effects in signal processing
4. To understand the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation

Course Outcomes (CO)

1. To apply DFT for the analysis of digital signals & systems

2. Design FIR and IIR filters by hand to meet specific magnitude and phase requirements.
3. Design and implement digital filters by hand and by using Matlab.
4. Use computers and MATLAB to create, analyze and process signals, and to simulate and analyze systems sound and image synthesis and analysis, to plot and interpret magnitude and phase of LTI system frequency responses.
5. To choose digital signal processing algorithms to implement communication systems. apply DSP programming tools and use them for applications

Course Outline

Unit No.	Topics
1	**DFT & FFT** Introduction of DFT Matrix relation for computing DFT and IDFT DFT Properties Relation between DFT and other transform Comparison between linear and circular convolution Application of DFT Introduction to FFT Radix 2 FFT algorithm (DIT) Radix 2 FFT algorithm(DIF) IFFT Linear filtering approach to computation of DFT Quantization error
2	**IIR Filter design** Introduction of Structure for IIR system Direct form Cascade form Parallel Lattice Structure Introduction to digital filter IIR filter design Impulse invariant Bilinear Matched Z transformation Design Butterworth filter Design chebyshev filter Designing Highpass, bandpass and bans stop filter
3	FIR filter design Structure of FIR systems Direct form , Cascaded form Lattice structure, Transposed structure Introduction of FIR filter FIR filter design & specification FIR filter design using windows FIR filter design using DFT method FIR filter design using sampling method Quantization error
4	DSP Processor Introduction of DSP processor Von Neumann model Hardward Architecture Texas Instrument's TMS320 family Comparison of Microprocessor with DSP processor

	Application of DSP
Text books:	1. V. Udayashankara," modern digital signal processing", third edition PHI Learning, 2016. ISBN 9788120345676 2. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth edition, Pearson education / Prentice Hall, 2007, ISBN 13: 9780131873742
Reference Books/Notes	1. Alan V.Oppenheim, Ronald W. Schafer & Hohn. R.Back, "Discrete Time Signal Processing", Pearson Education, 2nd edition, 2005, ISBN 13: 9780131988422 2. Sanjit K. Mitra, "Digital Signal Processing -A Computer Based Approach", Third Edition, Tata Mc Graw Hill, 2007, ISBN 13: 9780077366766

Method of delivery

1. Chalk and talk
2. PowerPoint Presentations
3. Self-study material
4. NPTEL notes

Study time

3 hours per week Lectures, 2 hours tutorial and 2 Hours practical per week

CO-PO Mapping (PO: Program Outcomes)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO 1	√	√	√		√				√			
CO 2	√	√	√		√				√			
CO 3	√	√	√		√				√			
CO 4	√	√	√		√				√		√	
CO 5	√	√	√		√						√	

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

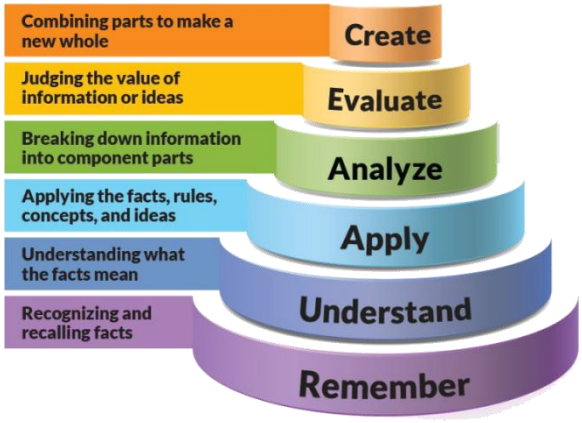


Figure 1: Blooms Taxonomy

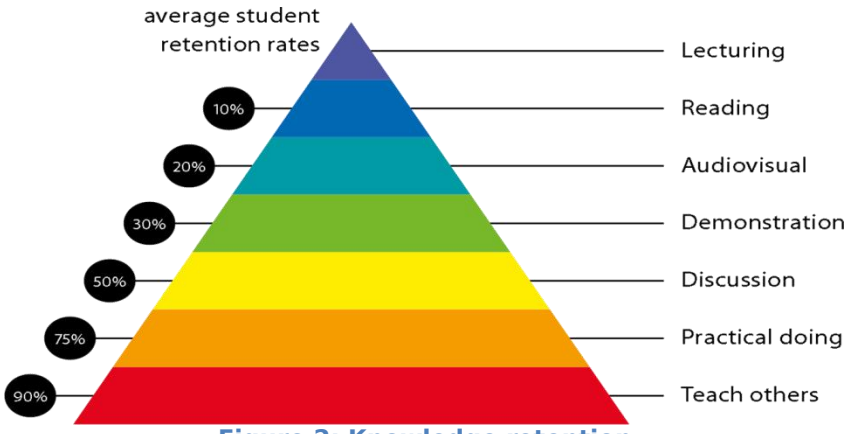


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**

Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work:

Experiment. No.	Title	Learning Outcomes
1	Introduction of MATLAB Write a MATLAB program to Generate 1. Unit Step Sequence 2. Exponential Sequence 3. Sinusoidal sequence etc	Use computers and MATLAB to create, analyse and process signals, and to simulate and analyse.
2	Write a MATLAB program to perform different operation on sequences	Understand the basic operations of Signal processing
3	Write a MATLAB program for Signal Smoothing by a moving-	Able to remove noise using Moving averaging filter

	average Filter	
4	Write a MATLAB program to generate Linear convolution any two sequences.	Develop Linear convolution Algorithms using MATLAB Software package
5	Write a MATLAB program to generate Circular convolution of any two sequences.	Develop Circular convolution Algorithms using MATLAB Software package
6	Write a MATLAB program to generate Linear & circular convolution using DFT & IDFT.	Develop Linear & circular Convolution using DFT & IDFT by MATLAB signal processing
7	Design and implement IIR (LPF/HPF)filters in MATLAB.	
8	Design a IIR Butterworth filter & IIR Chebyshev filter using MATLAB.	Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital IIR- Butterworth, Chebyshev filters
9	Write a MATLAB program to verify FIR filters using different Window Techniques.	Analyze and Observe Magnitude and phase characteristics (Frequency response Characteristics) of digital FIR filters using window techniques
10	Parallel Form Realizations of an IIR Transfer Function in MATLAB	Able to generate parallel form coefficient using MATLAB

Lecture/tutorial times

(Give lecture times in the format below)

Online class Time Table

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

1. Text Books and Reference Books
2. Online Resources

Text books

Mention in syllabus

Additional Materials

1. https://nptel.ac.in/courses/117102060/
2. https://in.mathworks.com/solutions/dsp.html

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

1. Theory CIE 60 marks:
a. Midsem exam: 40 Marks
b. Assignment: 10 Marks
c. Quiz: 10 Marks

2. Practical CIE 60 marks:
a. Experiment Performance 30 Marks
b. File work + Skill Test 20 Marks
c. Internal Viva 10 Marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10 % of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

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Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

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Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

.

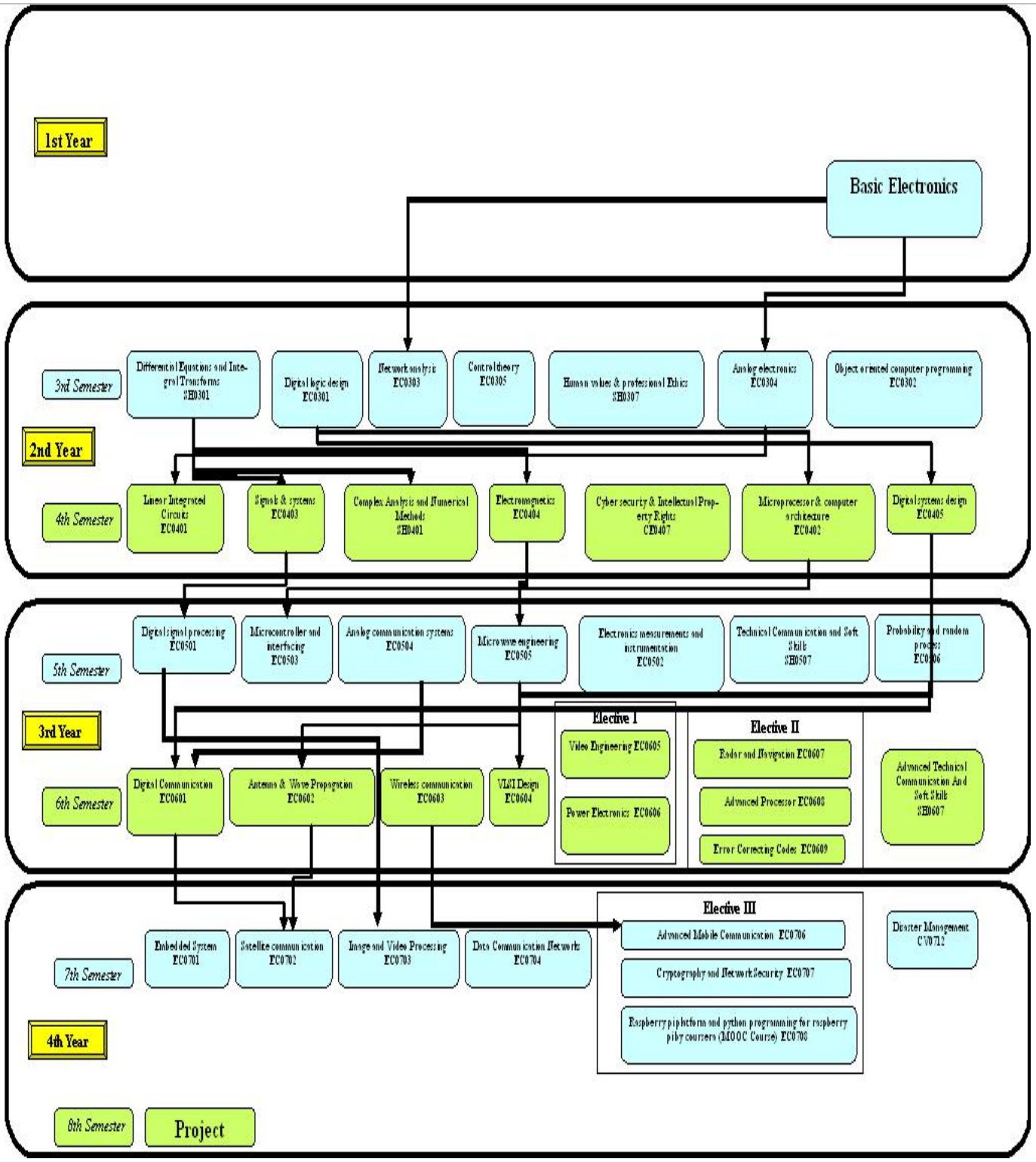
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	**DFT & FFT** Introduction of DFT Matrix relation for computing DFT and IDFT DFT Properties	CO1 CO3	Chalk and talk PowerPoint Presentations
	Weeks 2	Relation between DFT and other transform Comparison between linear and circular convolution Application of DFT	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 3	Introduction to FFT Radix 2 FFT algorithm (DIT) Radix 2 FFT algorithm(DIF)	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 4	IFFT Linear filtering approach to computation of DFT Quantization error	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 5	**IIR Filter design** Introduction of Structure for IIR system Direct form Cascade form Parallel Lattice Structure	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 6	Introduction to digital filter IIR filter design Impulse invariant Bilinear Matched Z	CO2 CO3	Chalk and talk PowerPoint Presentations

		transformation		
	Week 7	Design Butterworth filter Design chebyshev filter Designing Highpass, bandpass and bans stop filter	CO2 CO3 CO5	Chalk and talk PowerPoint Presentations
	Week 8	FIR filter design Structure of FIR systems Direct form , Cascaded form Lattice structure, Transposed structure	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 9	Introduction of FIR filter FIR filter design & specification FIR filter design using windows	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 10	FIR filter design using DFT method FIR filter design using sampling method Quantization error	CO2 CO5	Chalk and talk PowerPoint Presentations
	Week 11	DSP Processor Introduction of DSP processor Von Neumann model	CO4 CO5	Chalk and talk PowerPoint Presentations
	Week 12	Hardward Architecture Texas Instrument's TMS320 family Comparison of Microprocessor with DSP processor	CO4 CO5	Chalk and talk PowerPoint Presentations
	Week 13	Application of DSP	C05	Chalk and talk PowerPoint Presentations
	Week 14	Revision		

Program map for B.Tech (Electronics & Communication Engineering)



Name of Institute: Indus Institute of Technology & Engineering
Name of Faculty: Prof. Zalak Patel

Course code: EC0505
Course name: Electromagnetics
Pre-requisites: Engineering Physics, Applied Mathematics
Credit points: 04
Offered Semester: 5th

Course Coordinator (weeks 15)
Full Name: Prof. Zalak Patel
Department with sitting location: EC (Antenna & Microwave Lab), Bhanwar Building
Telephone: 3203
Email: zalakpatel.ec@indusuni.ac.in
Consultation times: 3:30 to 4:15 PM

Course Lecturer (weeks 15)
Full Name: Prof. Zalak Patel
Department with sitting location: EC (Antenna & Microwave Lab), Bhanwar Building
Telephone: 3203
Email: zalakpatel.ec@indusuni.ac.in
Consultation times: 3:30 to 4:15 PM

Students will be contacted throughout the Session via Mail with important information relating to this Course.

Course Objectives

By participating in and understanding all facets of this Course a student will:

1. To determine electric and magnetic fields for given problems.
2. To relate the physical basis of Maxwell's equations in integral form and differential form, and apply them for the solution of appropriate problems involving static as well as time varying fields.
3. To acquire basic knowledge of Uniform plane waves.

Course Outcomes (CO)

After completion of this course, expected outcome from the students,

1. Solve the problems on dot product, cross product and co-ordinate systems & conversion.

2. Apply vector calculus to understand the behaviour of static electric fields in standard configurations.
3. Apply vector calculus to understand the behaviour of static magnetic fields in standard configurations.
4. Describe and analyse electromagnetic wave propagation in free-space based on Maxwell's equation.
5. Analyse the uniform plane wave motion in good conductors, perfect dielectric and inside lossy material.

Course Outline

(Key in topics to be dealt)

UNIT-I

[7 hours]

Vector Analysis

Scalars & Vectors, Dot and Cross products, Co-ordinate systems and conversions.

Electrostatics I

Coulomb's law, Electric field intensity, Concept of electric flux density, Gauss's law and its applications, Differential volume element, Divergence, Maxwell's first eqn. and divergence theorem.

UNIT-II

[11 hours]

Electrostatics II

Conductor properties & boundary conditions, boundary condition for perfect dielectric materials, Poisson's and Laplace equation, Uniqueness theorem, Examples.

UNIT-III

[12 hours]

Steady magnetic field

Biot-Savart's law, Ampere's circuital law, Point form of Ampere's circuital law, concept of flux density, Scalar and vector magnetic potential, Stoke's theorem for magnetic field

Time Varying Fields and Maxwell's Equations

Faraday's law, Displacement current, Maxwell's equations in point and integral forms for time varying fields

UNIT-IV

[12 hours]

The Uniform Plane Wave

The wave equation, wave motion in free space, waves motion in perfect dielectric, Plane waves inside the lossy matter, Poynting vector and Wave power, Propagation in good conductor, Phenomena of skin effect, Reflection of uniform plane waves.

Method of delivery

CO \ PO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
1	√					√	√	√				
2	√					√	√	√				
3		√		√						√		
4		√		√						√		
5		√		√						√		

(Face to face lectures, self study material, Active Learning Techniques)

Study time

(5 hours per week including class attendance)

CO-PO Mapping (PO: Program Outcomes)

Blooms Taxonomy and Knowledge retention(For reference)

(Blooms taxonomy has been given for reference)

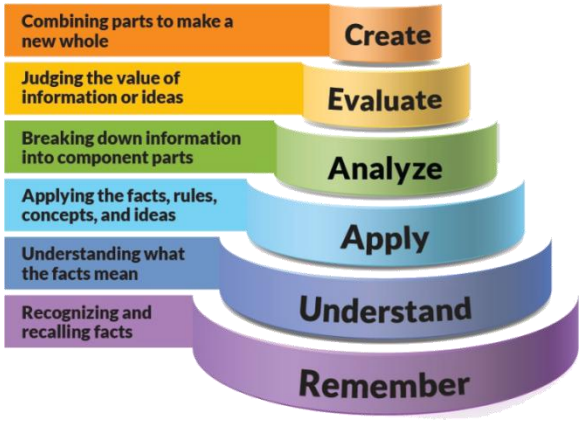


Figure 1: Blooms Taxonomy

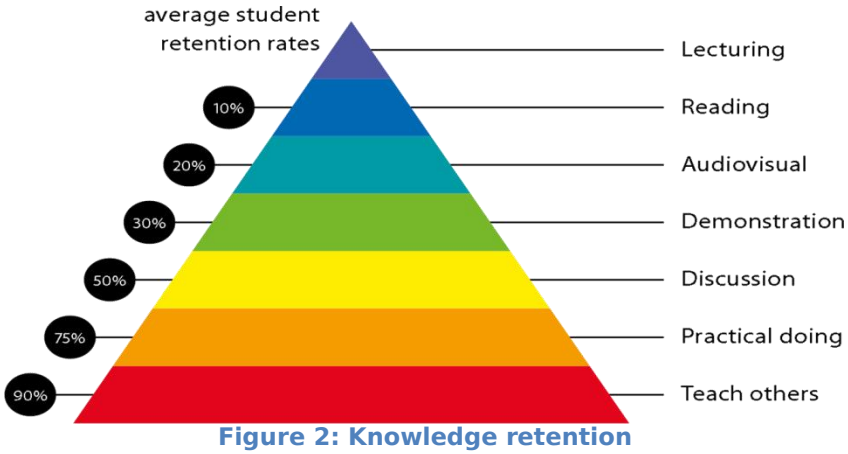


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
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Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Lecture/tutorial times

Lecture	Monday	11:10 TO 12:00 PM
Lecture	Tuesday	2:00 to 3:00 PM
Lecture	Friday	10:00 to 11:00 PM

Attendance Requirements

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the Course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for mid and end semester examinations.

Details of referencing system to be used in written work

Text books

1. Engineering Electromagnetics, W H Hayt, J A buck, 7th Edition, TMH Publication.

Additional Materials

Reference Books

1. Electromagnetic Waves & Radiating Systems, Edward C. Jordan, Keith G. Balmain, 2nd Edition, PHI publication.
2. Fields and Waves in Communication Electronics, Simon Ramo, John R. Whinnery, Wiley Publication

Web Resources

1. http://nptel.ac.in/courses/115101005/
2. http://nptel.ac.in/courses/108104087/
3. http://nptel.ac.in/courses/117103065/
4. ece3300+smith chart

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

Attendance	5%
Seminar/Tutorial	**10**%
Assignment	**5**%
Mid semester	40%
Final exam (*closed book*)	40%

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in mid semester or end semester will be considered for supplementary assessment in the respective components (i.e mid semester or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (mid semester or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

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Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of -% of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

Plagiarism - Plagiarism is not acceptable and may result in the imposition of severe penalties. Plagiarism is the use of another person's work, or idea, as if it is his or her own - if you have any doubts at all on what constitutes plagiarism, please consult your Course coordinator or lecturer. Plagiarism will be penalized severely.

Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

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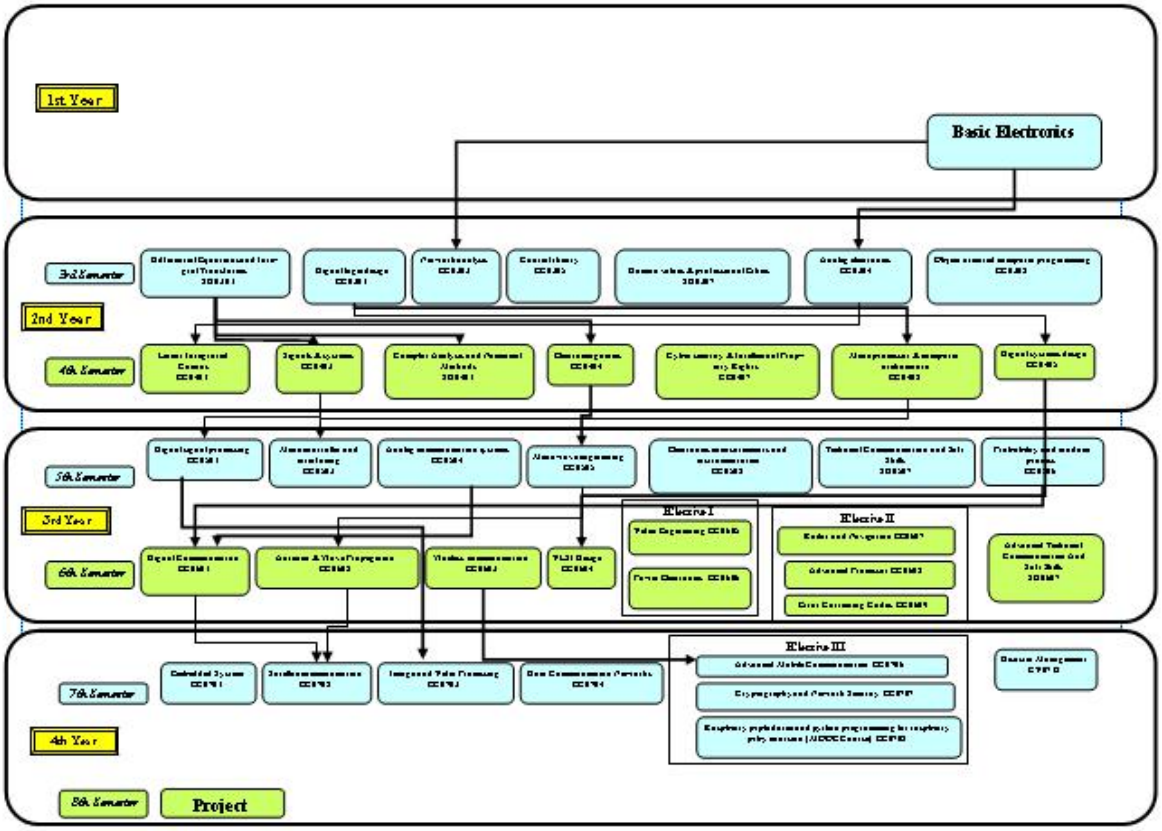
Course schedule (Antenna & Wave Propagation)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Scalars & Vectors, Dot and Cross products, Co-ordinate systems and conversions	CO1	Assignment
	Weeks 2	Coulomb's law, Electric field intensity, Concept of electric flux density	CO1, CO2	Tutorial
	Week 3	Gauss's law and its applications, Differential volume element, Divergence, Maxwell's first eqn. and divergence theorem.	CO2	Tutorial
	Week 4	Conductor properties & boundary conditions, boundary condition for perfect dielectric materials	CO2	Tutorial
	Week 5	Poisson's and Laplace equation, Uniqueness theorem, Examples	CO1, CO2	Tutorial
	Week 6	Biot-Savart's law, Ampere's circuital law, Point form of Ampere's circuital law	CO3	Assignment
	Week 7	Concept of flux density, Scalar and vector magnetic potential, Stoke's theorem for magnetic field	CO3	Tutorial
	Week 8	Time Varying Fields and Faraday's law, Displacement current	CO4	Tutorial
	Week 9	Maxwell's equations in point and integral forms for time varying fields	CO4	*Midsem Exam*
	Week 10	The wave equation, wave motion in free space	CO5	Seminar

	Week 11	waves motion in perfect dielectric, Plane waves inside the lossy matter, Poynting vector and Wave power	CO5	Seminar
	Week 12	Propagation in good conductor, Phenomena of skin effect, Reflection of uniform plane waves.	CO5	Seminar

PROGRAM MAP FOR B.Tech. (ELECTRONICS & COMMUNICATION ENGINEERING)



Name of Institute: **Institute of Technology & Engineering**
Name of Faculty: **Dr. Vrushank Shah**

Course code: EC0524
Course name:Python Programming
Pre-requisites: C Programming
Credit points: 5
Offered Semester: 5th

Course coordinator (weeks 01 - 14)
Full name: Dr. Vrushank Shah
Department with siting location: Electronics & Communication Engineering
Telephone: 9898331721

Email: vrushankshah.ec@indusuni.ac.in
Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Course lecturer (weeks 01 - 14)
Full name: Dr. Vrushank Shah
Department with siting location: Electronics & Communication Engineering
Telephone: 9898331721
Email:vrushankshah.ec@indusuni.ac.in
Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

By participating in and understanding all facets of this course a student will:

1. Importance of Python as a scientific computing tool which directly leads to employability.
2. To learn how to design and develop Python applications.
3. Skill development to apply mutable and immutable types.
4. To learn how to design object oriented concepts in python.
5. Development of GUI based applications for entrepreneurship.

Course Outcomes (CO)

1. Work with the Python standard libraries.
2. Implement mutability for various elements of Python.
3. Develop GUI based projects.

4. Design Networking configuration for chatting applications.
5. Implement Scientific Computing.
6. Solve real world problems using Python programming

Course Outline

Unit No.	Topics
1	Introduction to programming, algorithms and data structures via gcd, Downloading and installing Python, gcd in Python: variables, operations, control flow - assignments, condition-als, loops, and functions. Python: types, expressions, strings, lists, tuples. Python memory model: names, mutable and immutable values List operations: slices etc Binary search , Inductive function definitions: numerical and structural induction ,Elementary inductive sorting: selection and insertion sort,In-place sorting.
2	Basic algorithmic analysis: input size, asymptotic, complexity () notation ,Arrays vs lists ,Merge sort ,Quicksort, Stable sorting. Dictionaries More on Python functions: optional arguments, default values, Passing functions as arguments , Higher order functions on lists: map, list comprehension. Exception handling ,Basic input/output ,Handling files , String processing..
3	Backtracking: N Queens, recording all solutions, Scope in Python: local, global, nonlocal names, Nested functions, Data structures: stack, queue, Heaps. Abstract data types, Classes and objects in Python ,"Linked" lists: find, insert, delete , Binary search trees: find, insert, delete , Height-balanced binary search trees. Array computing and curve plotting, vectors and higher-dimensional arrays, matrices, numPy, sciPy and Matplotlib, Plotting using PyLab, Chat Application, Graphics and GUI Programming – Drawing using Turtle, Tkinter.
4	Python Pandas - Data alignment, aggregation, summarization, computation and analysis with Pandas. Scientific computation using Python - Statistical data analysis, image processing
Text books:	1. John V Guttag. "Introduction to Computation and Programming Using Python", Prentice Hall of India 2. Hans Petter Langtangen, A Primer on Scientific Programming with Python
Reference Books/Notes	1. Claus Fuhrer, Jan Erik Solem, Olivier Verdier, Scientific Computing with Python 3,Packt Publishing Limited 2. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education R. Nageswara Rao, "Core Python Programming", dreamtech 3. Wesley J. Chun. "Core Python Programming - Second Edition", Prentice Hall 4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and

	Algorithms in Python", Wiley 5. Kenneth A. Lambert, "Fundamentals of Python – First Programs", CEN GAGE Publication

Method of delivery

1. Chalk and talk
2. PowerPoint Presentations
3. Self-study material
4. NPTEL notes

Study time

3 hours per week Lectures and 2 Hours practical per week

CO-PO Mapping (PO: Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√				√			
CO2	√	√	√		√				√			
CO3	√	√	√		√				√			
CO4	√	√	√		√				√		√	
CO5	√	√	√		√						√	
CO6	√	√	√		√							

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

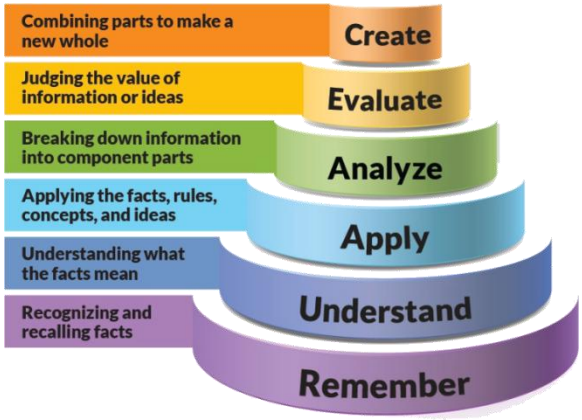


Figure 1: Blooms Taxonomy

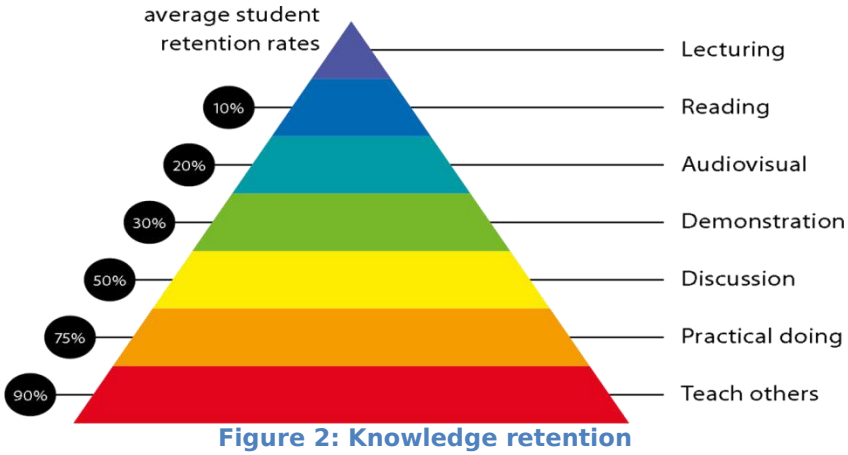


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of _____Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of sources and technologies. Acknowledge the work and ideas of others.	**2 Information literacy, gathering & processing**
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage	**5 Written communication** **6 Oral communication** **7 Teamwork**

with people in different settings. Recognize how culture can shape communication.	
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work : Not Applicable

Lecture/tutorial times

(Give lecture times in the format below)

Monday-9.00 to 10.00 AM
Wednesday: 12.20 to 1.20 PM
Thursday: 11:10 to 12:10 PM
Friday: 9:00 to 11:00

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

1. Text Books and Reference Books
2. Online Resources

Text books

Mention in syllabus

Additional Materials

1. https://www.edx.org/course/introduction-to-computer-science-and-programming-using-pyt hon-2
2. http://www.openculture.com/2017/05/learn-python-with-a-free-online-course-from-mit.ht ml
3.https://www.edx.org/course/introduction-to-python-absolute-beginner-3

4. https://onlinecourses.nptel.ac.in/noc19_cs40

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

1. Theory CIE 60 marks:
a. Midsem exam: 40 Marks
b. Assignment: 10 Marks
c. Quiz: 10 Marks

2. Practical CIE 60 marks:
a. Experiment Performance 30 Marks
b. File work + Skill Test 20 Marks
c. Internal Viva 10 Marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

Practical Work Report/Laboratory Report:

A report on the practical work is due the subsequent week after completion of the class by each group.

Late Work

Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10 % of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

Retention of Written Work

Written assessment work will be retained by the Course coordinator/lecturer for two weeks after marking to be collected by the students.

University and Faculty Policies

Students should make themselves aware of the University and/or Faculty Policies regarding plagiarism, special consideration, supplementary examinations and other educational issues and student matters.

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Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

.

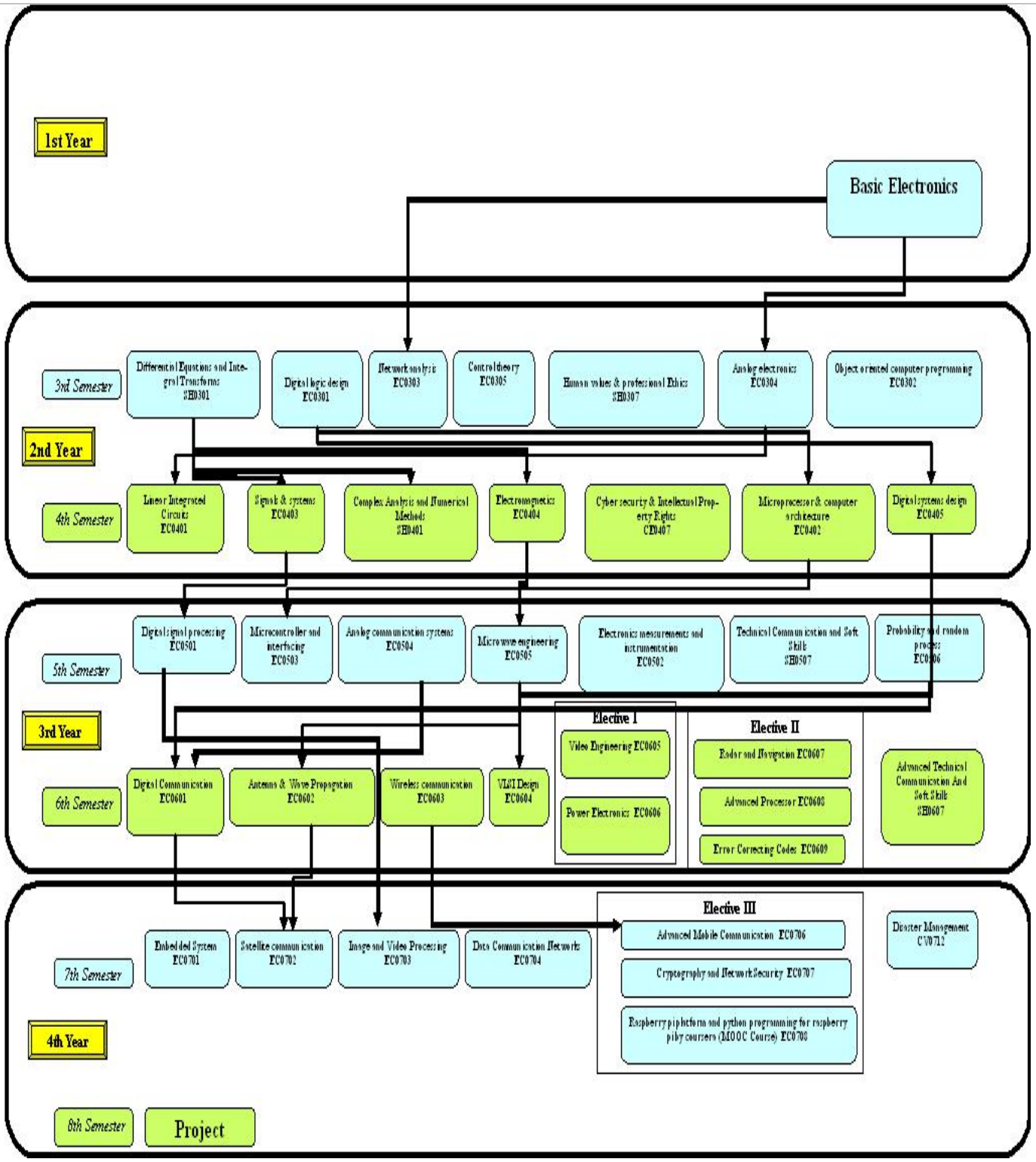
Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Informal introduction to programming, algorithms and data structures via gcd, Downloading and installing Python, gcd in Python: variables, operations, control flow - assignments, condition-als, loops, and functions	CO1 CO3	Chalk and talk PowerPoint Presentations
	Weeks 2	Python: types, expressions, strings, lists, tuples. Python memory model: names, mutable and immutable values List operations: slices etc Binary search	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 3	Inductive function definitions: numerical and structural induction ,Elementary inductive sorting: selection and insertion sort, In-place sorting.	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 4	Basic algorithmic analysis: input size, asymptotic, complexity () notation ,Arrays vs lists ,Merge sort ,Quicksort, Stable sorting. Dictionaries More on Python functions: optional arguments, default values, Passing functions as arguments	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 5	Higher order functions on lists: map, list comprehension. Exception handling ,Basic input/output ,Handling files , String processing	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 6	Backtracking: N Queens, recording all solutions, Scope in Python: local, global, nonlocal names, Nested functions, Data structures: stack, queue, Heaps.	CO2 CO3	Chalk and talk PowerPoint Presentations

	Week 7	Abstract data types, Classes and objects in Python ,"Linked" lists: find, insert, delete ,	CO2 CO3 CO5	Chalk and talk PowerPoint Presentations
	Week 8	Binary search trees: find, insert, delete , Height-balanced binary search trees	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 9	Array computing and curve plotting, vectors and higher-dimensional arrays, matrices,	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 10	numPy, sciPy and Matplotlib, Plotting using PyLab, Chat Application,	CO2 CO5	Chalk and talk PowerPoint Presentations
	Week 11	Graphics and GUI Programming – Drawing using Turtle, Tkinter.	CO4 CO5	Chalk and talk PowerPoint Presentations
	Week 12	Python Pandas - Data alignment, aggregation, summarization, computation and analysis with Pandas.	CO4 CO5	Chalk and talk PowerPoint Presentations
	Week 13	Scientific computation using Python - Statistical data analysis, image processing	C05	Chalk and talk PowerPoint Presentations
	Week 14	Revision		

Program map for B.Tech (Electronics & Communication Engineering)



Name of Institute: **Institute of Technology & Engineering**
Name of Faculty: **Dr. Vrushank Shah**

Course code: EC0524
Course name: Digital Signal Processing
Pre-requisites: Signals & Systems
Credit points: 5
Offered Semester: 5th

Course coordinator (weeks 01 - 14)
Full name: Dr. Vrushank Shah
Department with siting location: Electronics & Communication Engineering
Telephone: 9898331721

Email: vrushankshah.ec@indusuni.ac.in
Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Course lecturer (weeks 01 - 14)
Full name: Dr. Vrushank Shah
Department with siting location: Electronics & Communication Engineering
Telephone: 9898331721
Email:vrushankshah.ec@indusuni.ac.in
Consultation times: 09.00 AM – 10.00 AM (Working Saturdays)

Students will be contacted throughout the session via mail with important information relating to this course.

Course Objectives

By participating in and understanding all facets of this course a student will:

1. To study about discrete time systems and to learn about FFT algorithm
2. To study the design techniques for FIR and IIR digital filters
3. To study the finite word length effects in signal processing
4. To understand the architecture of a digital signal processor and some programming issues in fixed-point digital signal processor in real-time implementation

Course Outcomes (CO)

1. To apply DFT for the analysis of digital signals & systems
2. Design FIR and IIR filters by hand to meet specific magnitude and phase requirements.

3. Design and implement digital filters by hand and by using Matlab.
4. Use computers and MATLAB to create, analyze and process signals, and to simulate and analyze systems sound and image synthesis and analysis, to plot and interpret magnitude and phase of LTI system frequency responses.
5. To choose digital signal processing algorithms to implement communication systems. apply DSP programming tools and use them for applications

Course Outline

Unit No.	Topics
1	**INTRODUCTION:** Signals, systems and signal processing, concept of frequency in continuous and discrete time signals , Periodic Sampling & Frequency domain representation of sampling, Reconstructions of band limited signals from its samples, general applications of DSP Discrete-Time **Signals and systems:** Discrete-Time Signals, Discrete-Time Systems, LTI Systems, Properties of LTI Systems, Linear Constant Co-efficient Difference equations, linear convolution and its properties, Frequency domain representation of Discrete-Time Signals & Systems. Representation of sequences by discrete time Fourier Transform, (DTFT), Properties of discrete time Fourier Transform, and correlation of signals, Fourier Transform Theorems.
2	**THE Z-TRANSFORM AND ITS APPLICATION TO THE ANALYSIS OF LTI SYSTEMS** Properties of ROC for Z-transform, Inverse Z-transform, Frequency response of LTI system, System functions for systems with linear constant-coefficient Difference equations, Freq. response of rational system functions relationship between magnitude & phase, All pass systems, inverse systems, Minimum/Maximum phase systems, systems with linear phase **Structures of Discrete-Time Systems:** Block Diagram representation of Linear Constant-Coefficient Difference equations, Structures of IIR Systems, Basic Structures for FIR Systems
3	**DISCRETE- FOURIER TRANSFORM (DFT) Discrete Fourier Transform (DFT):** Relationship between the DTFT and DFT and their inverses, DFT properties, Linear and circular convolution, Linear filtering methods based on DFT. **FAST FOURIER TRANSFORM[F.F.T]** Direct computation of DFT, DIT & DIF - FFT using radix 2 – Butterfly structure. Decimation in Time[D.I.T] , Decimation in frequency[D.I.F], Introduction to basic butterfly computation in radix-4 FFT algorithm, Goertzel algorithm and Chirp-Z Transform algorithm, Effect of Quantisation in DFT
4	**IIR FILTER DESIGN Analog filter design** – Butterworth and Chebyshev approximations; Discrete time IIR filter from analog filter, IIR filter design by impulse invariance, bilinear transformation, Approximation of derivatives-(HPF,BPF,BRF) filter design using frequency translation, Warping, prewarping - Frequency transformation. **FIR FILTER DESIGN** Linear phase FIR filter, Filter design using windowing techniques, Frequency sampling techniques, Finite word length effects in digital Filters

	Architecture of DSP Processors: Harward architecture, pipelining, Multiplier-accumulator (MAC) hardware, Architectures of fixed and floating point (TMSC6000) DSP processors.
Text books:	John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth edition, Pearson education / Prentice Hall, 2007
Reference Books/Notes	1. Alan V.Oppenheim, Ronald W. Schafer & Hohn. R.Back, "Discrete Time Signal Processing", Pearson Education, 2nd edition, 2005, ISBN 13: 9780131988422 2. Sanjit K. Mitra, "Digital Signal Processing -A Computer Based Approach", Third Edition, Tata Mc Graw Hill, 2007, ISBN 13: 9780077366766

Method of delivery

1. Chalk and talk
2. PowerPoint Presentations
3. Self-study material
4. NPTEL notes

Study time

3 hours per week Lectures, 2 hours tutorial and 2 Hours practical per week

CO-PO Mapping (PO: Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	√	√	√		√				√			
CO2	√	√	√		√				√			
CO3	√	√	√		√				√			
CO4	√	√	√		√				√		√	
CO5	√	√	√		√						√	

Blooms Taxonomy and Knowledge retention (For reference)

(Blooms taxonomy has been given for reference)

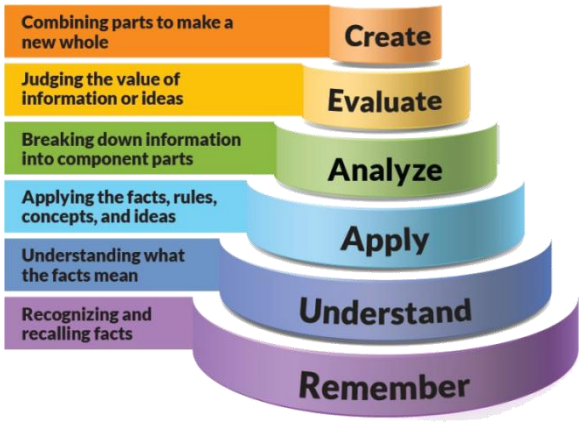


Figure 1: Blooms Taxonomy

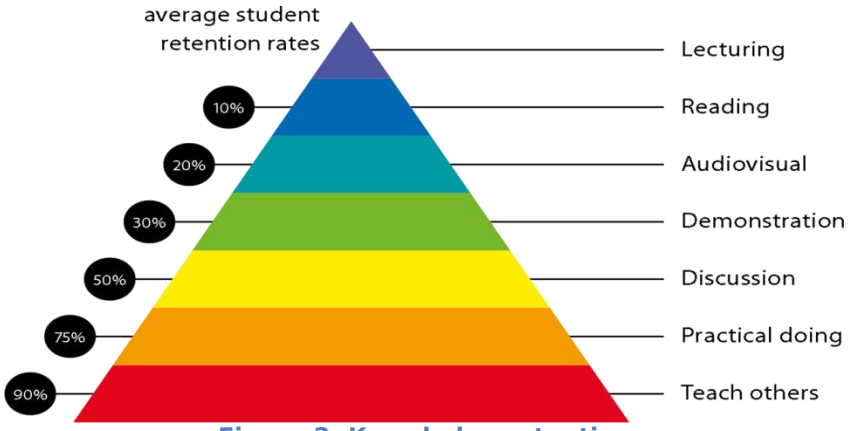


Figure 2: Knowledge retention

Graduate Qualities and Capabilities covered

(Qualities graduates harness crediting this Course)

General Graduate Qualities	Specific Department of Graduate Capabilities
Informed Have a sound knowledge of an area of study or profession and understand its current issues, locally and internationally. Know how to apply this knowledge. Understand how an area of study has developed and how it relates to other areas.	**1 Professional knowledge, grounding & awareness**
Independent learners Engage with new ideas and ways of thinking and critically analyze issues. Seek to extend knowledge through ongoing research, enquiry and reflection. Find and evaluate information, using a variety of	**2 Information literacy, gathering & processing**

sources and technologies. Acknowledge the work and ideas of others.	
Problem solvers Take on challenges and opportunities. Apply creative, logical and critical thinking skills to respond effectively. Make and implement decisions. Be flexible, thorough, innovative and aim for high standards.	**4 Problem solving skills**
Effective communicators Articulate ideas and convey them effectively using a range of media. Work collaboratively and engage with people in different settings. Recognize how culture can shape communication.	**5 Written communication** **6 Oral communication** **7 Teamwork**
Responsible Understand how decisions can affect others and make ethically informed choices. Appreciate and respect diversity. Act with integrity as part of local, national, global and professional communities.	**10 Sustainability, societal & environmental impact**

Practical work : Not Applicable

Lecture/tutorial times

(Give lecture times in the format below)

The University norms states that it is the responsibility of students to attend all lectures, tutorials, seminars and practical work as stipulated in the course outline. Minimum attendance requirement as per university norms is compulsory for being eligible for semester examinations.

Details of referencing system to be used in written work

1. Text Books and Reference Books
2. Online Resources

Text books

Mention in syllabus

Additional Materials

1. https://nptel.ac.in/courses/117102060/
2. https://in.mathworks.com/solutions/dsp.html

ASSESSMENT GUIDELINES

Your final course mark will be calculated from the following:

1. Theory CIE 60 marks:
a. Midsem exam: 40 Marks
b. Assignment: 10 Marks
c. Quiz: 10 Marks

2. Practical CIE 60 marks:
a. Experiment Performance 30 Marks
b. File work + Skill Test 20 Marks
c. Internal Viva 10 Marks

SUPPLEMENTARY ASSESSMENT

Students who receive an overall mark less than 40% in internal component or less than 40% in the end semester will be considered for supplementary assessment in the respective components (i.e internal component or end semester) of semester concerned. Students must make themselves available during the supplementary examination period to take up the respective components (internal component or end semester) and need to obtain the required minimum 40% marks to clear the concerned components.

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A report on the practical work is due the subsequent week after completion of the class by each group.

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Late assignments will not be accepted without supporting documentation. Late submission of the reports will result in a deduction of 10 % of the maximum mark per calendar day

Format

All assignments must be presented in a neat, legible format with all information sources correctly referenced. **Assignment material handed in throughout the session that is not neat and legible will not be marked and will be returned to the student.**

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Do not copy the work of other students.
Do not share your work with other students (except where required for a group activity or assessment)

.

Course schedule (subject to change)

(Mention quiz, assignment submission, breaks etc as well in the table under the Teaching Learning Activity Column)

	Week #	Topic & contents	CO Addressed	Teaching Learning Activity (TLA)
	Weeks 1	Signals, systems and signal processing, concept of frequency in continuous and discrete time signals	CO1 CO3	Chalk and talk PowerPoint Presentations
	Weeks 2	Periodic Sampling & Frequency domain representation of sampling, Reconstructions of band limited signals from its samples, general applications of DSP	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 3	Discrete-Time Signals, Discrete-Time Systems, LTI Systems, Properties of LTI Systems, Linear Constant Co-efficient Difference equations	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 4	linear convolution and its properties, Frequency domain representation of Discrete-Time Signals & Systems.	CO1 CO3	Chalk and talk PowerPoint Presentations
	Week 5	Representation of sequences by discrete time Fourier Transform, (DTFT), Properties of discrete time Fourier Transform, and correlation of signals, Fourier Transform Theorems.	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 6	Properties of ROC for Z-transform, Inverse Z-transform, Frequency response of LTI system, System functions for systems with linear constant-coefficient Difference equations	CO2 CO3	Chalk and talk PowerPoint Presentations

	Week 7	Freq. response of rational system functions relationship between magnitude & phase, All pass systems, inverse systems, Minimum/Maximum phase systems, systems with linear phase	CO2 CO3 CO5	Chalk and talk PowerPoint Presentations
	Week 8	Block Diagram representation of Linear Constant-Coefficient Difference equations, Structures of IIR Systems, Basic Structures for FIR Systems	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 9	Discrete Fourier Transform (DFT), Relationship between the DTFT and DFT and their inverses, DFT properties, Linear and circular convolution, Linear filtering methods based on DFT.	CO2 CO3	Chalk and talk PowerPoint Presentations
	Week 10	Direct computation of DFT, DIT & DIF - FFT using radix 2 – Butterfly structure. Decimation in Time[D.I.T] , Decimation in frequency [D.I.F], Introduction to basic butterfly computation in radix-4 FFT algorithm, Goertzel algorithm and Chirp-Z Transform algorithm, Effect of Quantisation in DFT	CO2 CO5	Chalk and talk PowerPoint Presentations
	Week 11	Analog filter design – Butterworth and Chebyshev approximations; Discrete time IIR filter from analog filter, IIR filter design by impulse invariance, bilinear transformation, Approximation of derivatives-(HPF,BPF,BRF) filter design using frequency translation, Warping, prewarping - Frequency transformation.	CO4 CO5	Chalk and talk PowerPoint Presentations
	Week 12	Linear phase FIR filter, Filter design using windowing techniques, Frequency sampling techniques, Finite word length effects in digital Filters	CO4 CO5	Chalk and talk PowerPoint Presentations
	Week 13	Harward architecture, pipelining, Multiplier-accumulator (MAC) hardware, Architectures of fixed and floating point (TMSC6000) DSP processors.	C05	Chalk and talk PowerPoint Presentations

	Week 14	Revision		

Program map for B.Tech (Electronics & Communication Engineering)