Faculty of Engineering

Savitribai Phule Pune University

Syllabus

of

Second Engineering

(Electronics & Computer Engineering)

(2019 Course)

(with effect from June 2021)

Savitribai Phule Pune University, Pune
S.E. (Electronics & Computer Engineering) 2020 Course
(With effect from Academic Year 2021-22)

Semester-III

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
	Engineering Mathematics III	04	-	01	30	70	25	-	-	125	04	--	01	05
	Electronic Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
	Digital Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
	Data structures & Algorithms	03	-	-	30	70	-	-	-	100	03	-	-	03
	Computer Organization	03	-	-	30	70	-	-	-	100	03	-	-	03
	Electronic Circuit Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
	Digital circuits Lab		02					50		50		01		01
	Data Structure and Algorithm Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
	Computer Organization Lab	-	02	-	-	-	25	-	-	25	-	01	-	01
	Electronic Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
	Mandatory Audit Course 3 &	-	-	-					-	-	-	-	-	-
	Total	**16**	**10**	**01**	**150**	**350**	**75**	**100**	25	**700**	**-**		-	
										Total Credit	**16**	**05**	**01**	**22**

Savitribai Phule Pune University, Pune
S.E. (Electronics & Computer Engineering) 2020 Course
(With effect from Academic Year 2021-22)

Semester-IV

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
	Signals & Systems	03	-	01	30	70	25	-	-	125	03	--	01	04
	Principles of Programming Language	03	-		30	70		-	-	100	03	-	-	03
	Principles of Communication System	03	-	-	30	70	-	-	-	100	03	-	-	03
	Object Oriented Programming	03	-	-	30	70	-	-	-	100	03	-	-	03
	System Programming & Operating Systems	03	-	-	30	70	-	-	-	100	03	-	-	03
	Signals & System Lab	-	02	-	-	-	25	-	-	50	-	01	-	01
	Communication Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
	Object Oriented Programming Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
	Employability Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
	Project Based Learning $^{\eta}$	-	04	-	-	-	50	-	-	50	-	02	-	02
	Mandatory Audit Course 4$^{\&}$	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	15	14	01	150	350	125	50	25	700	-	-	-	-
										Total Credit	**15**	**06**	**01**	**22**

Abbreviations:

In-Sem: In semester End-sem: End semester TH : Theory TW : Term Work

PR : Practical OR : Oral TUT : Tutorial

Note: Interested students of S.E. (Electronics/E&TC) can opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

Instructions:

- PR/Tutorial must be conducted in three batches per division.

- Minimum number of required Experiments/Assignments in PR/ Tutorial shall be carried out as mentioned in the syllabi of respective subjects.
- Assessment of tutorial work has to be carried out as term-work examination. Term-work Examination at second year of engineering course **shall be internal continuous assessment only.**

- **η:** Project based learning (PBL) requires continuous mentoring by faculty throughout the semester for successful completion of the tasks selected by the students per batch. While assigning the teaching workload of 2 Hrs/week/batch needs to be considered for the faculty involved. The Batch needs to be divided into sub-groups of 5 to 6 students. Assignments / activities / models/ projects etc. under project based learning is carried throughout semester and Credit for PBL has to be awarded on the basis of internal continuous assessment and evaluation at the end of semester.

- **&:** Audit course is mandatory but non-credit course. Assessment has to be conducted at the end of Sem III & IV respectively for award of grade at college level. Grade awarded for audit course shall not be calculated for grade point & CGPA.

Guidelines for Instructor's Manual

- The instructor's manual is to be developed as a hands-on resource and reference.
- Copy of Curriculum, Conduction & Assessment guidelines, List of Experiments to be attached.

Guidelines for Laboratory Conduction

- Students are not allowed to touch any equipment or other materials in the laboratory until they are instructed by Teacher or Technician.
- All the experiments mentioned in the syllabus are compulsory.
- Use of open source software and recent version is to be encouraged.
- In addition to these, faculty member has to get it done a mini-project based on the concepts learned.

Guidelines for Student's Lab Journal

- The laboratory assignments/experiments are to be submitted by student in the form of journal.
- Journal consists of Certificate, table of contents, and handwritten write-up for each experiment.
- Each experiment should consist of:
  - ✓ Title.
  - ✓ Objectives.
  - ✓ Problem Statement, Outcomes
  - ✓ Hardware / Software (If any) requirements.
  - ✓ Concept.
  - ✓ Experimental procedure / Setup.
  - ✓ Observation table
  - ✓ Conclusion.

Guidelines for Lab Assessment

- Continuous assessment of laboratory work is done based on overall performance.
- Each lab assignment/ experiment assessment will assign grade / marks based on parameters with appropriate weightage.
- Suggested parameters for overall assessment as well as each lab assignment / experiment assessment include:
  - ✓ Timely completion.
  - ✓ Performance.
  - ✓ Punctuality and neatness.
- The parameters for assessment are to be known to the students at the beginning of the course.

Engineering Mathematics -III
Credits: Th – 04 ,Tut-01

Teaching Scheme:
Theory : 04 hr/week
Tutorial: 01 hr/week

Examination Scheme:
In-Sem : 30 Marks
End-Sem : 70 Marks
Term Work : 25 Marks

Prerequisites: - Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Vector algebra, Algebra of complex numbers.

Course Objectives:
After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

- Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
- Transforms such as Fourier transform, Z-transform and applications to Communication systems and Signal processing.
- Vector differentiation and integration required in Electro-Magnetics and Wave theory.
- Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:
On completion of the course, student will be able to:

1. Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
2. Solve problems related to Fourier transform, Z-transform and applications to Communication systems and Signal processing.
3. Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
4. Perform vector differentiation and integration, analyze the vector fields and apply to Electro-Magnetic fields.
5. Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Course Contents

Unit I: Linear Differential Equations (LDE) and Applications (09 Hours)

LDE of n^{th} order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous & Symmetric simultaneous DE. Modeling of Electrical circuits.

Unit II: Transforms **(09 Hours)**

Fourier Transform (**FT**): Complex exponential form of Fourier series, Fourier integral theorem, Fourier Sine & Cosine integrals, Fourier transform, Fourier Sine and Cosine transforms and their inverses.

Z - Transform **(ZT):** Introduction, Definition, Standard properties, ZT of standard sequences and their inverses. Solution of difference equations.

Unit III: Numerical Methods **(09 Hours)**

Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation.

Numerical Integration: Trapezoidal and Simpson's rules, Bound of truncation error,

Solution of Ordinary differential equations: Euler's, Modified Euler's, Runge-Kutta 4^{th} order methods.

Unit IV: Vector Differential Calculus **(09 Hours)**

Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.

Unit V: Vector Integral Calculus and Applications **(09 Hours)**

Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Electro-magnetic fields.

Unit VI : Complex Variables **(09 Hours)**

Functions of Complex variables, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula, Laurent's series, Residue theorem.

Text Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 9e, Wiley India.
2. Peter V. O'Neil, "Advanced Engineering Mathematics", 7e, Cengage Learning.

Reference Books:

1. M. D. Greenberg, “Advanced Engineering Mathematics”, 2e, Pearson Education.
2. Wylie C.R. & Barrett L.C. , “Advanced Engineering Mathematics”, McGraw-Hill, Inc.
3. B. S. Grewal, “Higher Engineering Mathematics” Khanna Publication, Delhi.
4. P. N. Wartikar & J. N. Wartikar, “Applied Mathematics”, Volumes I and II, Pune VidyarthiGrihaPrakashan,.
5. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw-Hill.
6. Thomas L. Harman, James
7. Dabney and Norman Richert, “Advanced Engineering Mathematics with MATLAB”, 2e, Brooks/Cole, Thomson Learning.

Guidelines for Tutorial and Term Work:

i) Tutorial shall be engaged in four batches (batch size of 20 students maximum) per division.

ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.

Savitribai Phule Pune University **Second Year of Electronics & Computer Engineering (2020 Course)** **XXXXXX: Electronic Circuits**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**
Prerequisite Courses, if any: 104010 - Basic Electronics Engineering		
Companion Course, if any: XXXXXX - Electronic Circuits Laboratory		
Course Objectives: To make the students understand • Semiconductor device MOSFET, its characteristics, parameters & applications. • Concepts of feedbacks in amplifiers & oscillators. • Operational amplifier, concept, parameters & applications. • ADC, DAC as an interface between analog & digital domains. • Concepts, characteristics & applications of PLL.		

Course Outcomes: On completion of the course, learner will be able to –

CO1: Assimilate the physics, characteristics and parameters of MOSFET towards its application as amplifier.

CO2: Design MOSFET amplifiers, with and without feedback, & MOSFET oscillators, for given specifications.

CO3: Analyze and assess the performance of linear and switching regulators, with their variants, towards applications in regulated power supplies.

CO4: Explore and deploy basic configurations of Op-amp with negative feedback, with focus on relevant parameters.

CO5: Design, Build and test Op-amp based analog signal processing and conditioning circuits towards various real time applications.

CO6: Understand and compare the principles of various data conversion techniques and PLL with their applications.

Course Contents

Unit I	MOSFET & its Analysis	(08 Hrs)

Enhancement MOSFET: Construction, Characteristics, AC equivalent ckt, Parameters, Parasitics, Body effect, Sub-threshold conduction, W/L ratio. Common source amplifier & analysis, Load line, Source follower.

Mapping of Course Outcomes for Unit I	CO1: Assimilate the physics, characteristics and parameters of MOSFET towards its application as amplifier.

Unit II	MOSFET Circuits	(06 Hrs)

MOSFET as switch, resistor/diode. Current sink & source, Current mirror. Four types of feedback amplifiers, Effects of feedback, Voltage series & current series feedback amplifiers. Barkhausen criterion, Wein bridge & phase shift oscillator.

Mapping of Course Outcomes for Unit II	CO2: Design MOSFET amplifiers, with and without feedback, & MOSFET oscillators, for given specifications.

Unit III	Voltage Regulators	(06 Hrs)

Three terminal voltage regulator (317): Block diagram, typical ckts, Current boosting. Low Dropout Regulator (LDO).

SMPS: Block diagram, Types, typical ckts.

Mapping of Course Outcomes for Unit III	CO3: Analyze and assess the performance of linear and switching regulators, with their variants, towards applications in regulated power supplies.

Unit IV	Operational Amplifier	(08 Hrs)

Block diagram, Differential amplifier analysis for dual i/p balanced o/p mode (using r parameters), Level shifter, Op amp parameters, Current mirror, Op-amp characteristics (AC & DC).		
Mapping of Course Outcomes for Unit IV	**CO4: Explore and deploy basic configurations of Op-amp with negative feedback, with focus on relevant parameters.**	
Unit V	**Op-Amp Applications**	**(10 Hrs)**
Inverting amplifier, Non inverting amplifier **[Study the effect on R_i, R_o, gain & bandwidth]**, Voltage follower, Summing amplifier, Differential amplifier, Practical integrator, Practical differentiator, Instrumentation amplifier, Comparator, Schmitt trigger, Square & triangular wave generator, Precision rectifiers. **[More emphasis on applications]**		
Mapping of Course Outcomes for Unit V	**CO5: Design, Build and test Op-amp based analog signal processing and conditioning circuits towards various real time applications.**	
Unit VI	**Converters & PLL**	**(06 Hrs)**
DAC & ADC: Types / Techniques, Characteristics, block diagrams, Ckts, Specifications, Merits, Demerits, Comparisons. **PLL:** Block Diagram, Characteristics, phase detectors, Details of PLL IC 565 Applications, Typical circuits.		
Mapping of Course Outcomes for Unit VI	**CO6: Understand and compare the principles of various data conversion techniques and PLL with their applications.**	

Learning Resources

Text Books:

1. Donald Neaman, "Electronic Circuits – Analysis and Design" Third edition, Mc Graw Hill.
2. Ramakant Gaikwad, "Op amps & Linear Integrated Circuits", Pearson Education.

Reference Books:

1. Millman Halkias, " Integrated Electronics".
2. Phillip E. Allen, Douglas R. Holberg, "CMOS Analog Circuit Design", Second Edition, Oxford.
3. Salivahan and Kanchana Bhaskaran, "Linear Integrated Circuits", Tata McGraw Hill.

MOOC / NPTEL Courses:

1. NPTEL Course **"Analog Electronic Circuits"** by Prof. Pradip Kumar Mandal (IIT Kharakpur) https://nptel.ac.in/courses/108/105/108105158/
2. NPTEL Course on **"Analog Circuits"** by Prof. Jayanta Mukherjee (IIT Bombay) https://nptel.ac.in/courses/108/101/108101094/

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Digital Circuits

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any: XXXXXX - Digital Circuits Laboratory

Course Objectives: To make the students understand

- The fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
- Boolean algebra, Karnaugh maps and its application to the design and characterization of digital circuits.
- To analyze logic processes and implement logical operations using combinational logic circuits.
- The principles of logic design and use of simple memory devices, flip-flops, and sequential circuits.
- Concepts of sequential circuits and to analyze sequential systems in terms of state machines.
- System design approach using programmable logic devices.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Identify and prevent various hazards and timing problems in a digital design.

CO2: Use the basic logic gates and various reduction techniques of digital logic circuit.

CO3: Analyze, design and implement combinational logic circuits.

CO4: Analyze, design and implement sequential circuits

CO5: Differentiate between Mealy and Moore machines.

CO6: Analyze digital system design using PLD

Course Contents

Unit I	Digital Logic Families	(04 Hrs)

Classification and Characteristics of digital Logic Families: -Speed, power dissipation, figure of merit, fan in, fan out, current, voltage, noise immunity, operating temperatures and power supply requirements. TTL logic. Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic: CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL.

Mapping of Course Outcomes for Unit I	CO1: Identify and prevent various hazards and timing problems in a digital design.

Unit II	**Combinational Logic Design**	**(08 Hrs)**
Definition of combinational logic, canonical forms, Standard representations for logic functions, k-map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don't care conditions, Design Examples: Arithmetic Circuits, BCD - to – 7 segment decoder, Code converters. Introduction to Quine- McCluskey method, Quine McCluskey using don't care terms, Reduced prime implicants Tables.		
Mapping of Course Outcomes for Unit II	**CO2: Use the basic logic gates and various reduction techniques of digital logic circuit.**	
Unit III	**Combinational Circuits**	**(06 Hrs)**
Adders and their use as subtractor, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Multiplexers and their use in combinational logic designs, multiplexer trees, De-multiplexers and their use in combinational logic designs, Decoders, Demultiplexer trees.		
Mapping of Course Outcomes for Unit III	**CO3: Analyze, design and implement combinational logic circuits.**	
Unit IV	**Sequential Logic Design**	**(08 Hrs)**
1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, hold and setup time and metastability. Excitation Table for flip flops. Conversion of flip flops. Application of Flip flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence Generators, ripple counters, up/down counters, synchronous counters, lock out, Clock Skew, Clock jitter. Effect on synchronous designs.		
Mapping of Course Outcomes for Unit IV	**CO4: Analyze, design and implement sequential circuits**	
Unit V	**State Machines**	**(07 Hrs)**
Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector. Introduction to Algorithmic state machines- construction of ASM chart and realization for sequential circuits		
Mapping of Course Outcomes for Unit V	**CO5: Differentiate between Mealy and Moore machines.**	
Unit VI	**Programmable Logic Devices**	**(08 Hrs)**

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, General Architecture of FPGA and CPLD. Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM ROM, EPROM, EEPROM, NVRAM, SRAM, and DRAM. Designing combinational circuits using PLDs.

Mapping of Course Outcomes for Unit VI	**CO6: Analyze digital system design using PLD**

Learning Resources

Text Books:

1. R.P. Jain, "Modern digital electronics" , 3rd edition , 12th reprint Tata McGraw Hill Publication,2007**.**
2. Thomas Floyd, "Digital Electronics", 11th Edition.
3. M. Morris Mano, "Digital Logic and Computer Design" 4the dition,Prentice Hall of India, 2013.
4. Taub and Schilling, "Digital Principles and Applications," TMH.

Reference Books:

1. Anand Kumar, "Fundamentals of Digital Circuits" 1st edition, Prentice Hall of India, 2001
2. J. F. Wakerly, "Digital Design- Principles and Practices," 3rd Edition, Pearson
3. M. M. Mano, "Digital Design," Prentice Hall India.

MOOC / NPTEL Courses:

1. NPTEL Course **"Digital Circuits"** by Prof. Santanu Chattopadhay (IIT Kharakpur) https://nptel.ac.in/courses/108/105/ 108105113/
2. NPTEL Course **"Digital Circuits & Systems"** https://nptel.ac.in/courses/117/106/117106086/
3. NPTEL Course **"Digital Circuits"** by Prof. Goutam Saha (IIT Kharakpur) https://nptel.ac.in/courses/108/105/108105132/

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Data Structure and Algorithm

Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any:

Companion Course, if any: XXXXXX - Data Structure Laboratory

Course Objectives:

- To learn basic concepts of C Programming language
- To learn different sorting and searching algorithms and its analysis
- To learn linear data structures : Stack and Queue, Link List and applications.
- To learn Non linear data structures : Tree , Graph and applications.
- To study the systematic way of solving problems, various methods of organizing large amounts of data.
- To solve problems using data structures such as binary trees, binary search trees, and graphs and writing programs

Course Outcomes: On completion of the course, learner will be able to –

CO1: Develop programs using C programming language.

CO2: Implement sorting and searching algorithms and calculates it complexity.

CO3: Develop applications of stacks and queues using array.

CO4: Demonstrate applicability of linear data structures.

CO5: Design height balanced Binary Tree and analyze its time complexity.

CO6: Demonstrate applicability of Non linear data structures with real time application.

CO7: Design height balanced Binary Tree and analyze its time complexity.

CO8: Apply the knowledge of graph for solving the problems of spanning tree and shortest path algorithm.

Course Contents

Unit I	Introduction to C Programming	(08 Hrs)

C Fundamentals: Constants, Variables and Keywords in C, Operators, Bitwise Operations, Decision Control and Looping Statements.

Arrays & Pointers: Arrays, Functions, Recursive Functions, Pointers, String Manipulations, Structures, Union, Enumeration, MACROS.

File Handling: File Operations- Open, Close, Read, Write And Append

Mapping of Course Outcomes for Unit I	CO1: Develop programs using C programming language.

Unit II	Searching and Sorting Algorithms	(06 Hrs)

Algorithms: Analysis of Iterative and Recursive algorithms, Space & Time complexity, Asymptotic notation- Big-O, Theta and Omega notations. **Searching methods:** Linear, Binary and Fibonacci Search. **Sorting methods:** Bubble, Insertion, Selection, Merge, and Quick Sort.		
Mapping of Course Outcomes for Unit II	**CO2: Implement sorting and searching algorithms and calculates it complexity.**	
Unit III	**Stack and Queues**	**(06 Hrs)**
Stacks: Concept, Basic Stack operations, Array representation of stacks, Stack as ADT, Stack Applications: Reversing data, Arithmetic expressions conversion and evaluation. **Queues:** Concept, Queue operations, Array representation of queues, Queue as ADT, Circular queue, Priory Queue, Application of queues: Categorizing data, Simulation of queues.		
Mapping of Course Outcomes for Unit III	**CO3: Develop applications of stacks and queues using array**	
Unit IV	**Linked List**	**(06 Hrs)**
Concept of linked organization, Singly Linked List, Stack using linked list, Queue using linked list, Doubly Linked List, Circular Linked List, Linked list as ADT. Representation and manipulations of polynomials using linked list, comparison of sequential and linked organization.		
Mapping of Course Outcomes for Unit IV	**CO4: Demonstrate applicability of linear data structures.**	
Unit V	**Trees**	**(06 Hrs)**
Introduction to trees: Basic Tree Concepts. **Binary Trees:** Concept & Terminologies, Representation of Binary Tree in memory, Traversing a binary tree. Binary Search Trees (BST): Basic Concepts, BST operations, Concept of Threaded Binary Search Tree **AVL Tree:** Basic concepts and rotations of a Tree.		
Mapping of Course Outcomes for Unit V	**CO5: Design height balanced Binary Tree and analyze its time complexity.** **CO6: Demonstrate applicability of Non linear data structures with real time application.** **CO7: Design height balanced Binary Tree and analyze its time complexity.**	
Unit VI	**Graphs**	**(06 Hrs)**

Graph: Basic Concepts & terminology.

Representation of graphs: Adjacency matrix, Adjacency list.

Operations on graph: Traversing a graph.

Spanning trees: Minimum Spanning tree- Kruskal's Algorithm, Prim's Algorithm. Dijkstra's Shortest Path Algorithm

Mapping of Course Outcomes for Unit VI	**CO8: Apply the knowledge of graph for solving the problems of spanning tree and shortest path algorithm.**

Learning Resources

Text Books:

1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Books Source.

2. Richard. F. Gilberg& Behrouz A. Forouzan, Data Structures A Pseudocode Approach with C, Cengage Learning, second edition.

Reference Books:

1. Seymour Lipschutz, Data Structure with C, Schaum's Outlines, Tata McGrawHill.

2. E Balgurusamy – Programming in ANSI C, Tata McGraw-Hill, Third Edition.

3. Yedidyah Langsam, Moshe J Augenstein, Aaron M Tenenbaum – Data structures using C and C++ - PHI Publications, 2nd Edition.

4. Reema Thareja, "Data Structures using C", Second Edition, Oxford University Press, 2014

MOOC / NPTEL:

1. NPTEL Course **"Programming & Data Structure"**

https://nptel.ac.in/courses/106/105/106105085/

2. NPTEL Course "Data Structure & Algorithms"

https://nptel.ac.in/courses/106/102/106102064/

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Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Computer Organization

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any: Fundamentals of Programming Languages-I & II
Basics of Electronics Engineering

Companion Course, if any: XXXXXX - Computer Organization Lab

Course Objectives:

- To understand the structure, function and characteristics of computer systems.
- To understand the design of the various functional units and components of digital computers.
- To identify the elements of modern instructions sets and explain their impact on processor design.
- To explain the function of each element of a memory hierarchy, identify and compare different methods for computer I/O.
- To compare simple computer architectures and organizations based on established performance metrics.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Demonstrate computer architecture concepts related to design of modern processors, memories and I/Os.

CO2: Analyze the principles of computer architecture using examples drawn from commercially available computers.

CO3: Evaluate various design alternatives in processor organization.

Course Contents		
Unit I	**Computer Evolution & Performance**	**(07 Hrs)**
Computer Organization and Architecture, Structure and Function, Evolution (a brief history) of computers, Designing for Performance, Evolution of Intel processor architecture- 4 bit to 64 bit, performance assessment. **A top level view of Computer function and interconnection:** Computer Components, Computer Function, Interconnection structure, bus interconnection. **Computer Arithmetic:** The Arithmetic and Logic Unit, addition and subtraction of signed numbers, design of adder and fast adder, carry look ahead addition, multiplication of positive numbers, signed operand multiplication, booths algorithm, fast multiplication, integer division. **Floating point representation and operations :** IEEE standard, arithmetic operations, guard bits and truncation.		
Mapping of Course Outcomes for Unit I	**CO1: Demonstrate computer architecture concepts related to design of modern processors, memories and I/Os.**	
Unit II	**Computer Memory System**	**(07 Hrs)**
Characteristics of memory system, The memory hierarchy. **Cache Memory:** Cache memory principles, Elements of cache design- cache address, size, mapping functions, replacement algorithms, write policy, line size, number of cache, one level and two level cache, performance characteristics of two level cache- locality & operations. **Internal Memory:** Semiconductor main memory, advanced DRAM organization. **External Memory:** Hard Disk organization, RAID- level 1 to level 6. **Case Study-** Pentium IV cache organization.		
Mapping of Course Outcomes for Unit II	**CO1: Demonstrate computer architecture concepts related to design of modern processors, memories and I/Os.**	
Unit III	**Input Output System**	**(07 Hrs)**
External devices, **I/O modules** - Module function and I/O module structure. **Programmed I/O:** overview, I/O commands, I/O instructions, Interrupt driven I/O- interrupt processing, design issues. **Direct Memory Access:** Drawbacks of programmed and interrupt driven I/O, DMA functions, **Case Study: DMA Controller** Intel 8237A-study in brief, I/O channels and processors- evolution and characteristics. **Case Study:** Study of Programmable Interrupt Controller Intel 82C59A in brief.		

Mapping of Course Outcomes for Unit III	**CO2: Analyze the principles of computer architecture using examples drawn from commercially available computers.**	
Unit IV	**Instruction sets**	**(07 Hrs)**
Characteristics and Functions: Machine instruction characteristics, types of operands. **Types of operations:** Data transfer, arithmetic, logical, conversion, input-output, system control, and transfer of control. **Addressing modes and Formats:** Addressing modes- immediate, direct, indirect, register, register indirect, displacement and stack **Instruction Formats:** instruction length, allocation of bits, variable length instructions. **Case Study:** Study above mention functionalities in 8086.		
Mapping of Course Outcomes for Unit IV	**CO2: Analyze the principles of computer architecture using examples drawn from commercially available computers.**	
Unit V	**Processor Organization**	**(07 Hrs)**
Processor organization, Register organization- user visible registers, control and status registers, **Instruction Cycle-** The machine cycle and Data flow. **Instruction Pipelining-** Pipelining Strategy, pipeline performance, pipeline hazards, dealing with branches. **Instruction level parallelism and superscalar processors -** Super scalar verses super pipelined, constraints. **Design Issues-** instruction level and machine parallelism, Instruction issue policy, register renaming, machine parallelism, branch prediction, superscalar execution and implementation. **Case studies-** Register organization of microprocessor 8086, Pipelining in Pentium, Pentium IV.		
Mapping of Course Outcomes for Unit V	**CO3: Evaluate various design alternatives in processor organization.**	
Unit VI	**Basic Processing Unit**	**(07 Hrs)**
Fundamental Concepts: Register transfer, performing arithmetic or logic operations, fetching a word from memory, storing a word in memory, Execution of a complete instruction- branch instructions. **Hardwired control**, M**icro-programmed control:** Micro instructions, micro program sequencing, wide branch addressing, microinstruction with next address field, pre-fetching microinstructions and emulation.		
Mapping of Course Outcomes for Unit VI	**CO3: Evaluate various design alternatives in processor organization.**	

Learning Resources

Text Books:

1. W. Stallings, "Computer Organization and Architecture: Designing for performance", Pearson Education/ Prentice Hall of India, 2003 7th Edition.
2. Zaky S, Hamacher, "Computer Organization", McGraw-Hill Publications, 2001, 5th Edition.

Reference Books:

1. John P Hays, "Computer Architecture and Organization", McGraw-Hill Publication, 1998, , 3rd Edition.
2. Miles Murdocca and Vincent Heuring, "Computer Architecture and Organization- an integrated approach", Wiley India Pvt. Ltd, 2nd Edition.
3. A. Tanenbaum, "Structured Computer Organization", Prentice Hall of India, 1991, 4th Edition
4. Patterson and Hennessy, "Computer Organization and Design", Morgan Kaufmann Publishers In, 4th Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"Computer Organization"**

https://nptel.ac.in/courses/106/106/106106092/

2. NPTEL Course **"Computer Architecture & Organization"**

https://nptel.ac.in/courses/106/105/106105163/

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Electronic Circuits Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 hrs. / week	01	PRACTICAL: 50 Marks

Prerequisite Courses, if any:

Companion Course, if any: XXXXXX - Electronic Circuits

List of Laboratory Experiments

Group A [Any 4 to be performed]

1.	To design, build single stage CS amplifier & verify dc operating point.
2.	To build & test single stage CS amplifier, plot frequency response. Calculate A_v, R_i, R_o & bandwidth.
3.	To implement current series feedback amplifier & measure R_{if}, R_{of}, A_{vf} & bandwidth.
4.	To implement MOSFET amplifier based Wein bridge oscillator.

5.	To design & implement an adjustable voltage regulator using three terminal voltage regulator IC.
Group B [Any 8 to be performed]	
6.	To measure following Op- amp parameters & compare with specifications given in data sheet. **[Any two Practical Op-Amp can be used for comparison. eg.LM741, OP07, LF351, LF356]** a) Input bias current b) Input offset current c) Input offset voltage d) Slew rate e) CMRR
7.	To design, build & test integrator using Op-amp for given frequency f_a.
8.	To design, build & test three Op amp Instrumentation amplifier for typical application.
9.	To design, build & test Square and triangular waveform generator using Op-Amp (LF351/6)
10.	To build & test Op amp precision half & full wave rectifiers.
11.	To design, build & test Schmitt trigger using Op-Amp (LF356)
12.	To design, build & test 2 or 3 bit R-2R ladder DAC.
13.	To design & implement 4 bit R-2R ladder DAC.
14.	To build & test PLL ckt.

Note: Min. of 1 practical from Group A and min. of 2 practicals from Group B are to be performed as Simulation practical in addition to above mentioned practicals and compare the results of simulated practicals with the corresponding hardware practical.

Savitribai Phule Pune University **Second Year of Electronics & Computer Engineering (2020 Course)** **XXXXXX: Digital Circuits Lab**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
PR: 02 hrs. / week	**01**	**PRACTICAL: 50 Marks**
Prerequisite Courses, if any:		
Companion Course, if any: XXXXXX - Digital Circuits		

List of Laboratory Experiments	
1.	**Study of IC-74LS153 as a Multiplexer:** (Refer Data-Sheet). a. Design and Implement 8:1 MUX using IC-74LS153 & Verify its Truth Table. b. Design & Implement the given 4 variable function using IC74LS153. Verify its Truth- Table
2.	**Study of IC-74LS138 as a Demultiplexer / Decoder:** (Refer Data-Sheet) a. Design and Implement full adder and subtractor function using IC-74LS138. b. Design & Implement 3-bit code converter using IC-74LS138.(Gray to Binary/Binary to Gray)
3.	**Study of IC-74LS83 as a BCD adder:** (Refer Data-Sheet). a. Design and Implement 1 digit BCD adder usingIC-74LS83 b. Design and Implement 4-bit Binary sub tractor using IC-74LS83.
4.	**Study of IC-74LS85 as a magnitude comparator:** (Refer Data-Sheet) a. Design and Implement 4-bitComparator. b. Design and Implement 8-bit Comparator
5.	Study of Counters: a. Design and Implement 4-bit counter using JK- Flip flop
6.	**Study of Counter ICs (74LS90/74LS93):** (Refer Data-Sheet) a. Design and Implement MOD-N and MOD-NN using IC-74LS90 and draw Timing diagram. b. Design and Implement MOD-N and MOD-NN using IC-74LS93 and draw Timing diagram.
7.	Study of synchronous counter: a. Design & Implement 4-bit Up/down Counter and MOD-N Up/down Counter using IC74HC191/ IC74HC193. Draw Timing Diagram.
8.	Verify four voltage and current parameters for TTL and CMOS (IC 74LSXX, 74HCXX), (Refer Data-Sheet).
9.	**Study of Shift Register:** Design and Implement 4-bit right shift and left shift register using D-flip flop.
10.	**Study of Shift Register (74HC194/74LS95):** a. Design and Implement Pulse train generator using IC-74HC194/IC74LS95 (Use right shift/ left shift). b. Design and Implement 4-bit Ring Counter/ Twisted ring Counter using shift registers IC 74HC194/IC74LS95.
11.	**Study of Counter ICs (74LS90/74LS93):** (ReferData-Sheet) a. Design and Implement MOD-N and MOD-NN using IC-74LS90 and draw Timing diagram. b. Design and Implement MOD-N and MOD-NN using IC-74LS93 and draw Timing diagram.

Savitribai Phule Pune University Second Year of Electronics & Computer Engineering (2020 Course) XXXXXX: Data Structure and Algorithm Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
PR: 02 hrs. / week	**01**	**ORAL: 25 Marks**
Prerequisite Courses, if any:		
Companion Course, if any: XXXXXX - Data Structure and Algorithm		

List of Laboratory Experiments

Group A: Compulsory

Write a C program to:

1.	Perform following String operations with and without pointers to arrays (without using the library functions): a. substring b. palindrome c. compare d. copy e. reverse
2.	Implement Database Management using array of structures with operations Create, Display, Modify, Append, Search and Sort. (For any database like Employee or Bank database with and without pointers to structures)
3.	Implement Stack and Queue using arrays.
4.	Create a singly linked list with options: a. Insert (at front, at end, in the middle), b. Delete (at front, at end, in the middle), c. Display, d. Display Reverse, e. Revert the SLL
5.	Implement Binary search tree with operations Create, search, and recursive traversals.
6.	Implement Graph using adjacency Matrix with BFS & DFS traversals.

Group B: Perform (Any 4)

Write a C program to:

7.	Implement stack and Queue using Linked Lists.

8.	Implement assignment 2 using files
9.	Add two polynomials using linked lists.
10.	Reverse a doubly linked list
11.	Evaluate postfix expression (input will be postfix expression)
12.	Reverse and Sort stack using recursion.
13.	Implement In order tree traversal without recursion
14.	To find in order predecessor and successor of a given key in BST.
15.	Implement Quicksort

Group C: Perform (Any 2)

Write a C program to:

16.	Implement merge sort for doubly linked list.
17.	Construct a tree from given inorder and preorder traversal
18.	Implement Dijkstra's Algorithm
19.	Implement Circular Linked List with various operations
20.	Represent graph using adjacency list or matrix and generate minimum spanning tree using Prism's algorithm

Group assignment

- Make Group of **4 students** in a batch (Batch of 20)
- Group will select any one topic as group assignment
- After completing the mini-project the respective group will present it during the practical slot.
  - Distribution of work in a group during presentation may contain:
    - Algorithm / Flowchart
    - Program Explanation
    - Application

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXX: Computer Organization Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 hrs. / week	01	Term Work: 25 Marks

Prerequisite Courses, if any:

Companion Course, if any:

List of Laboratory Experiments	
1.	Study of basic architecture of 8086.
2.	Study the complete instruction set of 8086 and write the instructions of 8086 along with examples.
3.	Write an assembly language code using 8086 to implement data transfer instruction.
4.	Write an assembly language code using 8086 to store numbers in reverse order in memory location.
5.	Write an assembly language code using 8086 to implement arithmetic instruction.
6.	Write an assembly language code using 8086 to add two numbers using lxi instruction.
7.	Write an assembly language code using 8086 to add two 8 bit numbers stored in memory and also storing the carry.
8.	Write an assembly language code using 8086 to find the factorial of a number.
9.	Write an assembly language code using 8086 to implement logical instructions.

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Electronic Skill Development Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 hrs. / week	**01**	**TERM WORK: 25 Marks**

Prerequisite Courses, if any: Basic Electronics Engineering, Fundamentals of Programming, Open-source electronics platform based on easy-to-use hardware and software (preferably Arduino)

Companion Course, if any: Any one of the following:

1. Jeremy Blum PCB tutorials
2. OrCAD basic Tutorials

List of Assignments (Min. 10 has to be completed)	
Group A: Application of Electronics Principles in Practice	
1.	Electronic Components and Connections (Bread boarding)
2.	Introduction and applications using Arduino and micro python
3.	Using Sensors & Actuators and their interfacing with Arduino (Motor Driver with relays , Reversible motor, SSR)
4.	Wireless Connectivity to Arduino
Group B: Hardware Design, Fault Finding, Testing, Repair and Measuring	

5.	Drawing layout of PCB using PCB design software
6.	Single layer PCB design for a simple electronic Circuit
7.	Using test equipment for testing, fault finding & repair etc.
8.	Use of measuring equipment for measurement of signals.
9.	Using Simulation software for design & testing of electronic circuits.
Group C: Assembly, SMD Overview, Power Budgeting, Batteries (Lead Acid , LiPo), Solar	
10.	Assemble and utilize mechanical parts such as DC Motor, AC Motor, Stepper motor Solenoid, sensors etc., Connect assemble mechanical parts to form a working unit , Wire and form cables. industry standards
11.	Assemble and use various types of parts and surface mounted devise parts, Assemble parts to standard determined by IPC-A-610, Work to correct sequences and tolerances, Accurately solder components using lead free solder to comply with
12.	Calculation of Power budget for an electronic circuit.
13.	Study & Use of various types of Batteries.
14.	Study of various solar power generation systems.

Learning Resources

Reference Books:

1. R S Khandpur, “Printed Circuit Boards: Design – Fabrication and Assembly”, Tata McGrawHill

2. Simon Monk “Hacking Electronics”, McGrawHill

Web resources:

1. https://github.com/arduino/Arduino

2. https://spoken-tutorial.org/tutorialsearch/?search_foss=Arduino&search_language=English

3. https://worldskillsindia.co.in/worldskill/file/2019/Electronics.pdf

4. https://worldskills.org/what/projects/wsss/

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Mandatory Audit Course - 3

Teaching Scheme:	Credit	Examination Scheme:
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GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is manadatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Student can choose the audit course either from courses available on SWAYAM or NPTEL Portal. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

Selecting an Audit Course:

A) Using Swayam Platform:

With a view to providing access to the best quality learning resources across the country, the project **'Study Webs of Active Learning for Young Aspiring Minds' (SWAYAM)** has been started. SWAYAM provides an integrated platform and portal for online courses, using information and communication technology (ICT) and covering High School till all higher education subjects and skill sector courses to ensure that every student benefits from learning material through ICT.

- Student can select any of the course mentioned in the syllabus and has to register for the corresponding MOOC course available on the SWAYAM Platform as a Audit course.
- The duration of the course should not be more than 8 Weeks.
- Once the course is completed the student has to appear for the examination as per the guidelines on the SWAYAM portal.
- After clearing the examination successfully; student will be awarded with passing certificate a copy which he/she has to submit to concerned authority for getting the clearance of completing the Audit course.

B) Using NPTEL Platform:

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website https://swayam.gov.in/nc details/NPTEL.

- Student can select any of the course mentioned in the syllabus and has to register for the corresponding online course available on the NPTEL Platform as an Audit course.
- The duration of the course should not be more than 8 Weeks.
- Once the course is completed the student has to appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with passing certificate a copy which he/she has to submit to concerned authority for getting the clearance of completing the Audit course.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- After the completion of the course the students must undergo the examination as per the schedule on SWAYAM and NPTEL platforms.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments and course completion certificate; the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.
- Every student must compel that student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance.

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Signals & Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 hrs. / week TUTORIAL: 01hr. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any: XXXXX - Signal & Systems Lab

Course Objectives:

- To understand the mathematical representation of continuous and discrete time signals and systems.
- To classify signals and systems into different categories.
- To analyze Linear Time Invariant (LTI) systems in time and transform domains.
- To build basics for understanding of courses such as signal processing, control system and communication.
- To develop basis of probability and random variables.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Identify, classify basic signals and perform operations on signals.

CO2: Identify, Classify the systems based on their properties in terms of input output relation and in terms of impulse response and will be able to determine the convolution between to signals.

CO3: Analyze and resolve the signals in frequency domain using Fourier series and Fourier Transform.

CO4: Resolve the signals in complex frequency domain using Laplace Transform, and will be able to apply and analyze the LTI systems using Laplace Transforms.

CO5: Define and Describe the probability, random variables and random signals. Compute the probability of a given event, model, compute the CDF and PDF.

CO6: Compute the mean, mean square, variance and standard deviation for given random variables using PDF.

Course Contents		
Unit I	**Introduction to Signals & Systems**	**(07 Hrs)**
Signals: Introduction,Graphical, Functional, Tabular and Sequence representation of Continuous and Discrete time signals. Basics of Elementary signals: Unit step, Unit ramp, Unit parabolic, Impulse, Sinusoidal, Real exponential, Complex exponential, Rectangular pulse, Triangular, Signum, Sinc and Gaussian function. **Operations on signals**: time shifting, time reversal, time scaling, amplitude scaling, signal addition, subtraction, signal multiplication. Communication, control system and Signal processing examples. **Classification of signals:** Deterministic, Random, periodic , Non periodic, Energy , Power, Causal , Non- Causal, Even and odd signal. **Systems**: Introduction, Classification of Systems: Lumped Parameter and Distributed Parameter System, static and dynamic systems, Causal-non causal systems, Linear and Non- linear systems, time variant and time invariant systems, stable and unstable systems, invertible and non- invertible systems.		
Mapping of Course Outcomes for Unit I	**CO1: Identify, classify basic signals and perform operations on signals.**	
Unit II	**Time domain representation of LTI System**	**(07 Hrs)**
Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Computation of convolution sum. Properties of convolution. System interconnection, system properties in terms of impulse response, step response in terms of impulse response.		
Mapping of Course Outcomes for Unit II	**CO2: Identify, Classify the systems based on their properties in terms of input output relation and in terms of impulse response and will be able to determine the convolution between to signals.**	
Unit III	**Fourier Series**	**(07 Hrs)**
Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, orthogonality, basis functions, Amplitude and phase response, FS representation of CT signals using trigonometric and exponential Fourier series. Applications of Fourier series, properties of Fourier series and their physical significance, Gibbs phenomenon.		
Mapping of Course Outcomes for Unit III	**CO3: Analyze and resolve the signals in frequency domain using Fourier series and Fourier Transform.**	

Unit IV	Fourier Transform	(07 Hrs)
Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, Properties and their significance, Interplay between time and frequency domain using sinc and rectangular signals, Fourier Transform for periodic signals.		
Mapping of Course Outcomes for Unit IV	**CO3: Analyze and resolve the signals in frequency domain using Fourier series and Fourier Transform.**	
Unit V	**Laplace Transform**	**(07 Hrs)**
Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC, Properties of ROC, Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform and their significance, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, stability considerations in S domain, Application of Laplace transforms to the LTI system analysis.		
Mapping of Course Outcomes for Unit V	**CO4: Resolve the signals in complex frequency domain using Laplace Transform, and will be able to apply and analyze the LTI systems using Laplace Transforms.**	
Unit VI	**Probability and Random Variables**	**(07 Hrs)**
Probability: Experiment, sample space, event, probability, conditional probability and statistical independence, Bayes theorem, Uniform and Gaussian probability models. **Random variables:** Continuous and Discrete random variables, cumulative distributive function, Probability density function, properties of CDF and PDF. Statistical averages, mean, moments and expectations, standard deviation and variance.		
Mapping of Course Outcomes for Unit VI	**CO5: Define and Describe the probability, random variables and random signals. Compute the probability of a given event, model, compute the CDF and PDF.** **CO6: Compute the mean, mean square, variance and standard deviation for given random variables using PDF.**	

Learning Resources

Text Books:

1. Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India.
2. M.J. Roberts "Signal and Systems", Tata McGraw Hill 2007.

Reference Books:

1. Charles Phillips, "Signals, Systems and Transforms", 3rd Edition, Pearson Education.
2. Peyton Peebles, "Probability, Random Variable, Random Processes", 4th Edition, Tata Mc Graw Hill.
3. A. Nagoor Kanni "Signals and Systems", 2nd edition, Mc Graw Hill.

MOOC / NPTEL Courses:

1. NPTEL Course **"Principles of Signals & System"**, by Prof. Aditya.K. Jagannath (IIT Kanpur)

https://nptel.ac.in/courses/108/104/108104100/

2. Lecture Series on, **"Signals & Systems"**, by Prof. K.S. Venkatesh (IIT Kanpur)

http://www.nptelvideos.in/2012/12/signals-and-system.html

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXX: Principles of Programming Language

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any: XXXXX – Principles of Programming Language Lab

Course Objectives:

- To learn principles of programming language
- To understand structural, computational and logical implications regarding programming languages
- To explore main programming paradigms.
- To understand and apply Object Oriented Programming (OOP) principles using C++ and Java

Course Outcomes: On completion of the course, learner will be able to –

CO1: To analyze the strengths and weaknesses of programming languages for effective and efficient program development.

CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.

CO3: To grasp different programming paradigms

CO4: To use the programming paradigms effectively in application development.

Course Contents		
Unit I	**Programming Language Syntax & semantics**	**(07 Hrs)**
Software development process, language and software development environments, language and software design methods, languages and computer architecture, programming language qualities, languages and reliability, languages and maintainability, languages and efficiency, a brief historical perspective and early high level languages, a bird's eye view of programming language concepts. **Syntax and semantics:** Language definition, syntax, abstract syntax, concrete syntax, and pragmatics, semantics, an introduction to formal semantics, languages, language processing, interpretation, translation, the concept of binding, variables, name and scope, Type, l-value, r-value, reference and unnamed variables, routines, generic routines, aliasing and overloading, an abstract semantic processor, run time structure.		
Mapping of Course Outcomes for Unit I	**CO1: To analyze the strengths and weaknesses of programming languages for effective and efficient program development.** **CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.**	
Unit II	**Structuring Data, Computations and Programming**	**(07 Hrs)**
Structuring of Data- Built in and primitive types, Data aggregates and type constructors, Cartesian product, Finite mapping User -defined types and abstract data types, Type systems, Static versus dynamic program checking, Strong typing and type checking, Type compatibility, Type conversions, Types and subtypes, Generic types, monomorphic versus polymorphic type systems, **Structuring of Computations:** Structuring the computation, Expressions and statements, Conditional execution and iteration, Routines, Style issues: side effects and aliasing, Exceptions,		
Mapping of Course Outcomes for Unit II	**CO1: To analyze the strengths and weaknesses of programming languages for effective and efficient program development.** **CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.**	
Unit III	**Structuring of a Program**	**(07 Hrs)**

Software design method, Concepts in support of modularity, Encapsulation, Interface and implementation, Separate and independent compilation, Libraries of modules, Language features for programming in the large, Program organization, Grouping of units, Encapsulation, Interface and implementation, Abstract data types, classes, and modules, Generic units, Generic data structures, Generic algorithms, Generic modules, Higher levels of genericity.

Programming paradigms: Introduction to programming paradigms, Introduction to four main Programming paradigms- procedural, object oriented, functional, and logic & rule based.

Mapping of Course Outcomes for Unit III	**CO1: To analyze the strengths and weaknesses of programming languages for effective and efficient program development.** **CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.**

Unit IV	**Java as Object Oriented Programming Language**	**(07 Hrs)**

Java History, Java Features, Java and Internet, Java and Word Wide Web, Web Browsers, Java Virtual Machine.

Data Types and Size: (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type).

Arrays: One dimensional array, multi-dimensional array, alternative array declaration statements.

Control Statements Revision of identical selection Statements in brief (if, else if, Nested if, Switch, Nested Switch), Iterative Statements For Each version of For Loop, Declaring Loop Control Variables Inside the for loop, Using comma in for loop), Jump Statements (Labeled Break and Labeled Continue).

String Handling: String class methods.

Mapping of Course Outcomes for Unit IV	**CO2: To inculcate the principles underlying the programming languages enabling to learn new programming languages.** **CO3: To grasp different programming paradigms**

Unit V	**Inheritance, Polymorphism and Encapsulation in Java**	**(07 Hrs)**

Classes and Methods: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable -length arguments.

Inheritances: member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class.

Packages and Interfaces: defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.

Mapping of Course Outcomes for Unit V	**CO3: To grasp different programming paradigms**

Unit VI	**Exception handling in Java**	**(07 Hrs)**

Fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception sub classes).

Managing I/O: Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, Print Writer class,

Applet: Applet Fundamental, Applet Architecture, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Difference between Applet and Application Program.

Mapping of Course Outcomes for Unit VI	**CO3: To grasp different programming paradigms.** **CO4: To use the programming paradigms effectively in application development.**

Learning Resources

Text Books:

1. Carlo Ghezzi, Mehdi Jazayeri, “Programming Language Concepts”,3rd Ed, Wiley Publication.
2. Herbert Schildt, "The Complete Reference Java", 9th Ed, TMH,

Reference Books:

1. Sebesta R., "Concepts of Programming Languages", 4th Edition, Pearson Education.
2. Deugo, “Java Gems”, Cambridge University Press.
3. T. W. Pratt, M. V. Zelkowitz, "Programming Languages Design and Implementation‖, 4th Ed, PHI

MOOC / NPTEL Courses:

1. NPTEL Course **"Principles of Programming Language"**

https://nptel.ac.in/courses/106/102/106102067/

2. NPTEL Course **"Programming in Java"**

https://nptel.ac.in/courses/106/105/106105191/

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Object Oriented Programming

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any: XXXXXX - OOP Lab

Course Objectives:

- Make the students familiar with basic concepts and techniques of object oriented programming in C++ To acquaint the students with the fundamental principles of modulation process and different amplitude and angle modulation systems.
- Develop an ability to write programs in C++ for problem solving.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Describe the principles of object oriented programming.

CO2: Apply the concepts of data encapsulation, inheritance in C++.

CO3: Understand Operator overloading and friend functions in C++.

CO4: Apply the concepts of classes, methods inheritance and polymorphism to write programs C++.

CO5: Apply Templates, Namespaces and Exception Handling concepts to write programs in C++.

CO6: Describe and use of File handling in C++.

Course Contents

Unit I	Foundation of Object Oriented Programming	(08 Hrs)

Introduction to procedural, modular, object-oriented and generic programming techniques, Limitations of procedural programming, Need of object-oriented programming, fundamentals of object-oriented programming: objects, classes, data members, methods, messages, data encapsulation, data abstraction and information hiding, inheritance, polymorphism. Inline functions, Function overloading, call by value and call by reference, return by reference, functions with default arguments, this pointer, illustrative Simple C++ Programs. Dynamic initialization of variables, memory management operators, Member dereferencing operators, operator precedence, typecast operators, Scope resolution operators, arrays.		
Mapping of Course Outcomes for Unit I	**CO1: Describe the principles of object oriented programming.**	
Unit II	**Classes & Objects**	**(06 Hrs)**
Defining class, Defining member functions, static data members, static member functions, private data members, public member functions, arrays of objects, objects as function arguments. Constructors and Destructors: types of constructors, handling of multiple constructors, destructors. (**Complex Class & String Class**)		
Mapping of Course Outcomes for Unit II	**CO2: Apply the concepts of data encapsulation, inheritance in C++.**	
Unit III	**Operator Overloading**	**(06 Hrs)**
Fundamentals of Operator Overloading, Restrictions on Operators Overloading, Operator Functions as Class Members vs. as Friend Functions, Overloading Unary Operators, Overloading Binary Operators, Overloading of operators using friend functions.		
Mapping of Course Outcomes for Unit III	**CO3: Understand Operator overloading and friend functions in C++.**	
Unit IV	**Inheritance & Polymorphism**	**(06 Hrs)**
Introduction to inheritance, base and derived classes, friend classes, types of inheritance, hybrid inheritance, member access control, static class, multiple inheritance, ambiguity, virtual base class, Introduction to polymorphism, pointers to objects, virtual functions, pure virtual functions, abstract base class, Polymorphic class, virtual destructors, early and late binding, container classes, Contained classes, Singleton class.		
Mapping of Course Outcomes for Unit IV	**CO4: Apply the concepts of classes, methods inheritance and polymorphism to write programs C++.**	
Unit V	**Templates, Namespaces and Exception handling**	**(06 Hrs)**

Templates: Introduction, Function template and class template, function overloading vs. function templates

Namespaces: Introduction, Rules of namespaces

Exception handling: Introduction, basics of exception handling, exception handling mechanism, throwing and catching mechanism, specifying exceptions, Multiple Exceptions, Exceptions with arguments C++ streams, stream classes, unformatted I/O, formatted I/O and I/O manipulators.

Mapping of Course Outcomes for Unit V	**CO5: Apply Templates, Namespaces and Exception Handling concepts to write programs in C++.**

Unit VI	**Working with files**	**(06 Hrs)**

Introduction, classes for file Stream Operations, opening and closing files, detecting End_Of_File (EOF), modes f File Opening, file pointers and manipulators, updating file, error handling during file operations.

Mapping of Course Outcomes for Unit VI	**CO6: Describe and use of File handling in C++.**

Learning Resources

Text Books:

1. E Balagurusamy, "Programming with C++", Tata McGraw Hill, 3rd Edition.

2. Herbert Schildt , "The Complete Reference C++", 4th Edition.

Reference Books:

1. Robert Lafore, "Object Oriented Programming in C++", Sams Publishing, 4th Edition.

2. Matt Weisfeld, "The Object-Oriented Thought Process", Pearson Education.

MOOC / NPTEL Courses:

1. NPTEL Course **"Prgramming in Java",** by Prof. Debasis Samanta (IIT Kharakpur)

https://nptel.ac.in/courses/106/105/106105191/

2. NPTEL Course **"Prgramming in C++",** by Prof. Pratha Pritam (IIT Kharakpur)

https://nptel.ac.in/courses/106/105/106105151/

Other Resources:

1. Bjarne Stroustrup, "A Tour of C++"

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Principles of Communication Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any: XXXXXX - Signals & Systems
XXXXXX- Communications Lab

Course Objectives:

- To equip/ familiarize students with basic mathematical tools for time and frequency domain analysis of communication signal and systems.
- To acquaint the students with the fundamental principles of modulation process and different amplitude and angle modulation systems.
- To introduce the students with the concept of Sampling theorem and pulse modulation techniques PAM, PWM, PPM.
- To impart pre-requisites of digital communication systems and explore digital representation techniques like PCM, DPCM, DM and ADM.
- To highlight the issues in baseband digital transmission such as data representation, synchronization, multiplexing and ISI.

Course Outcomes: On completion of the course, learner will be able to –

CO1: To compute & compare the bandwidth and transmission power requirements by analyzing time and frequency domain spectra of signal required for modulation schemes under study.

CO2: Describe and analyze the techniques of generation, transmission and reception of Amplitude Modulation Systems.

CO3: Explain generation and detection of FM systems and compare with AM systems.

CO4: Exhibit the importance of Sampling Theorem and correlate with Pulse Modulation technique (PAM, PWM, and PPM).

CO5: Characterize the quantization process and elaborate digital representation techniques (PCM, DPCM, DM and ADM).

CO6: Illustrate waveform coding, multiplexing and synchronization techniques and articulate their importance in baseband digital transmission.

Course Contents		
Unit I	**Signals & spectra**	**(08 Hrs)**
Introduction to Communication System, Analog and Digital messages, regenerative repeaters, Signal Bandwidth & Power. Size & classification of signal, exponential fourier series, concept of negative frequencies. Fourier transform and properties, Frequency shifting, Concept of baseband and bandpass signals, Signal transmission through LTI system. Signal energy & Energy Spectral density. Signal power & Power Spectral Density, Input and output PSD, PSD of modulated signal.		
Mapping of Course Outcomes for Unit I	**CO1: To compute & compare the bandwidth and transmission power requirements by analyzing time and frequency domain spectra of signal required for modulation schemes under study.**	
Unit II	**AM transmission & reception for signal tone**	**(08 Hrs)**
Need for frequency translation, Amplitude modulation (DSB-C), Double sideband Suppressed carrier (DSB-SC) modulation, Single sideband modulation (SSB), Vestigial Sideband modulation (VSB),Spectrum and Bandwidth of AM, DSB-SC, SSB & VSB, Calculation of modulation index for AM wave, Modulation index for more than one modulating signals, Power and power efficiency, AM reception		
Mapping of Course Outcomes for Unit II	**CO2: Describe and analyze the techniques of generation, transmission and reception of Amplitude Modulation Systems.**	
Unit III	**FM transmission & reception for signal tone**	**(08 Hrs)**
Phase Modulation (PM) and Frequency Modulation (FM), Relationship between Phase and Frequency Modulation, Modulation Index, Spectrum of FM (single tone): Feature of Bessel Coefficient, Power of FM signal, Bandwidth of tone modulated FM signal, modulation index : AM vs. FM, Spectrum of constant Bandwidth' FM, Narrowband and Wideband FM. **FM modulators and demodulators:** FM generation by Armstrong's Indirect method, frequency multiplication and application to FM, FM demodulator.		
Mapping of Course Outcomes for Unit III	**CO3: Explain generation and detection of FM systems and compare with AM systems.**	

Unit IV	Pulse Modulation	(06 Hrs)
Need of analog to digital conversion, sampling theorem for low pass signal in time domain, and Nyquist criteria, Types of sampling- natural and flat top. Pulse amplitude modulation & concept of TDM: Channel bandwidth for PAM, equalization, Signal Recovery through holding. Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM): Generation & Detection.		
Mapping of Course Outcomes for Unit IV	**CO4: Exhibit the importance of Sampling Theorem and correlate with Pulse Modulation techniques (PAM, PWM, and PPM)**	
Unit V	**Digital Representation of Analog Signals**	**(06 Hrs)**
Quantization of Signals: Quantization error, Uniform & Non-Uniform types of Quantization, Mid-rise & Mid-tread Quantizer, Companding, A-law & μ-law, Pulse Code Modulation system– Generation & Reconstruction, Differential Pulse code modulation, Delta Modulation, Adaptive Delta Modulation.		
Mapping of Course Outcomes for Unit V	**CO5: Characterize the quantization process and elaborate digital representation techniques (PCM, DPCM, DM and ADM).**	
Unit VI	**Baseband Digital Transmission**	**(06 Hrs)**
Line codes: Properties and spectrum **Digital Multiplexing and hierarchies:** T1, AT&T, E1, CCITT, Scrambling & Unscrambling. **Synchronization:** Carrier Synchronization, Bit Synchronization and Frame Synchronization. Intersymbol Interference, Equalization.		
Mapping of Course Outcomes for Unit VI	**CO6: Illustrate waveform coding, multiplexing and synchronization techniques and articulate their importance in baseband digital transmission.**	

Learning Resources

Text Books:

1. Taub , Schilling and Saha, “Principles of Communication Systems”, 4th Edition, McGraw-Hill.
2. B P Lathi, Zhi Ding, “Modern Analog and Digital Communication System”, Oxford University Press, 4th Edition.

Reference Books:

1. Bernard Sklar, Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications", 2nd Edition, Pearson Education
2. Wayne Tomasi, " Electronic Communications System", 5th Edition , Pearson Education
3. A.B Carlson, P B Crully, J C Rutledge, ―Communication Systems‖, 5th Edition, Tata McGraw Hill Publication.
4. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons.

MOOC / NPTEL Courses:

1. NPTEL Course **"Principles of Communication Systems-I",** by Prof. Aditya.K. Jagannath

https://nptel.ac.in/courses/108/104/108104091/

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: System Programming & Operating Systems

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives: To make the students understand

- To understand system software concepts, like the use and implementation of assembler, macros, linker, loaders and compiler.
- To get acquainted with software tools for program development.
- To explore memory allocation methods, input output devices and file system w. r. t. various operating system.
- To study and implement various processes scheduling techniques and dead lock avoidance schemes in operating system.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Demonstrate the knowledge of Systems Programming and Operating Systems.

CO2: Formulate the Problem and develop the solution for same.

CO3: Compare and analyse the different implementation approach of system programming operating system abstractions.

CO4: Interpret various OS functions used in Linux / Ubuntu

Course Contents

Unit I	Introduction to System Programming	(07 Hrs)

Introduction: Components of System Software, Language Processing Activities, Fundamentals of Language Processing.

Assemblers: Elements of Assembly language programming. Simple assembler scheme, Structure of an assembler, Design of single and two pass assembler.

Macro Processors: Macro Definition and call, Macro expansion, Nested Macro Calls, Advanced Macro Facilities, Design of a two-pass macro-processor.

Mapping of Course Outcomes for Unit I	CO1: Demonstrate the knowledge of Systems Programming and Operating Systems.

Unit II	Compilers, Loaders and Linkers	(07 Hrs)

Compilers: Basic compilers function, Phases of compilation, memory allocation, compilation of expression, Compilation of expressions, compilation of control structures, Code of optimization.

Loaders: Loader Schemes: Compile and go, General Loader Scheme, Absolute loaders, subroutine linkages, relocating loaders, direct linking loaders, Design of an absolute loader.

Linkers: Relocation and linking concepts, Design of linker, self relocating programs, Static and dynamic linker.

Mapping of Course Outcomes for Unit II	CO1: Demonstrate the knowledge of Systems Programming and Operating Systems.

Unit III	Introduction to Operating System & Process Management	(07 Hrs)

Introduction to OS : Architecture, Goals & Structures of O.S, Basic functions, Interaction of O. S. & hardware architecture, System calls, Batch, multiprogramming. Multitasking, time sharing, parallel, distributed & real -time O.S.

Process Management: Concept, Process states, Process control, Threads.

Scheduling: Types of scheduling, Scheduling algorithms.

Mapping of Course Outcomes for Unit III	CO1: Demonstrate the knowledge of Systems Programming and Operating Systems. CO2: Formulate the Problem and develop the solution for same.

Unit IV	**Concurrency Control**	**(07 Hrs)**
Concurrency: Interprocess communication, Mutual Exclusion, Semaphores, Classical Problems of Synchronization: Readers-Writers, Producer Consumer, and Dining Philosopher problem. **Deadlock:**Principles of deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection.		
Mapping of Course Outcomes for Unit IV	**CO1: Demonstrate the knowledge of Systems Programming and Operating Systems.** **CO3: Compare and analyse the different implementation approach of system programming operating system abstractions.**	
Unit V	**Memory Management**	**(07 Hrs)**
Basics of memory management, Swapping, Memory Allocation, Paging, Segmentation ,Virtual memory, Demand Paging, Page replacement, Page replacement algorithms – Optimal FIFO, LRU, LRU approximation, Allocation of frames		
Mapping of Course Outcomes for Unit V	**CO3: Compare and analyse the different implementation approach of system programming operating system abstractions.**	
Unit VI	**Input Output File system**	**(07 Hrs)**
I/O management & Disk scheduling: I/O Devices, Organization of I/O functions, Operating System Design issues, I/O Buffering, Disk Scheduling (FCFS), RAID, Disk Cache. **File Management:** Concepts, File Organization, File Directories, File Sharing, Record Blocking, Allocation methods, Free Space management		
Mapping of Course Outcomes for Unit VI	**CO6: Understand and compare the principles of various data conversion techniques and PLL with their applications.**	

Learning Resources

Text Books:

1. Dhamdhere D., "Systems Programming and Operating Systems", 2nd Edition, 'TMH
2. Siberschatz A, Galvin P.B, Gagne G, “Operating System Concepts”, John Wiley.
3. J. J. Donovan, ―Systems Programming‖, McGraw Hill

Reference Books:

1. Stalling William, "Operating Systems", Pearson Education, fifth edition.

2. Adam Hoover, “System Programming with C and UNIX”, Pearson Education

3. Leland L. Beck, “System Software,” Pearson Editions.

4. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, PHI.

MOOC / NPTEL Courses:

1. NPTEL course on, "Operating Systems"

https://nptel.ac.in/courses/106/108/106108101/

Savitribai Phule Pune University **Second Year of Electronics & Computer Engineering (2020 Course)** **XXXXXX: Signals & System Lab**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
PR: 02 hrs. / week	**01**	**Term Work: 25 Marks**
Prerequisite Courses, if any:		
Companion Course, if any: XXXXXX - Signals & Systems		

LIST OF ASSIGNMENTS / TUTORIALS

Group A	
1.	Generate and plot the following signals in time domain and also sketch its amplitude and phase spectrum. Verify the result: • Impulse • Unit Step • Exponential • Unit ramp • Sinc • Rectangular
2 (a)	Write the codes to plot the following signals also simulate the signals: (a) $\sin(200\pi t)$ (b) $\sin(200\pi t + \frac{\pi}{6})$ (c) $\sin(200\pi t - \frac{\pi}{6})$ (d) $\cos(200\pi t)$ (e) $\cos(200\pi t + \frac{\pi}{4})$ (f) $\cos(200\pi t - \frac{\pi}{6})$
2 (b)	Develop codes to simulate, and plot the results for an exponential signal: $x(t) = k\, e^{-at} u(t)$ for the cases: (a) $k = 1$, and $a = 0.35$ (b) $k = 1.2$ and $a = -0.45$
3.	**Sampling & Aliasing** Consider various human voice / speech (probably your voice both male and female) or music signals. Try different sampling rates and observe the effect of aliasing.

4.	**Real time speech signal and Spectral analysis** The speech signal has frequency components in the audio frequency range 300 Hz to 3400 Hz of the electromagnetic spectrum. Record the male and female voice speech Signal. Write a programme to record the speech signals and sketch it in time domain, its amplitude spectrum and phase spectrum.
5.	The music signal has frequency components in the audio frequency range 20 Hz to 20000 Hz of the electromagnetic spectrum. Record or use the recorded music samples of different instruments (at least four) and Write a programme to record the music signal and sketch it in time domain, its amplitude spectrum and phase spectrum. Also comment on the result.
6.	Find the convolution integral of Unit step and exponential signals and write a program to sketch the out response of the system. Also verify the commutative property of convolution integral.
7.	Take any one periodic signal and find its fourier series coefficients using exponential or trigonometric FS method. Write a program to find its Fourier series coefficients. Also using FS coefficients, reconstruct the signal. Observe the effect of Gibb's phenomenon.
Group B	
8.	Software / Hardware implementation of step response for First order and Second Order Systems for under damped and Critically Damped system.
9.	Stability analysis for any given system with Characteristic Equation given (Software Simulation).
10.	Hardware/Software / Simulation of root locus for given G(s)H(s). Comment on time domain specifications and stability of the system.
11.	Software implementation/Simulation frequency response analysis using Bode Plot for given G(s) H(s). Comment on Gain Margin, Phase Margin and Stability of the system.
12.	Software implementation/Simulation frequency response analysis using Nyquist Plot for given G(s) H(s). Comment on Gain Margin, Phase Margin and Stability of the system.

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Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Communication Lab

Teaching Scheme:	Credit	Examination Scheme:
PR: 02 hrs. / week	**01**	**PRACTICAL: 50 Marks**

Prerequisite Courses, if any:
Companion Course, if any: XXXXXX – Principles of Communication system

List of Laboratory Experiments	
Group A	
1.	AM Generation (DSB-FC): Calculation of modulation index by graphical method, Power of AM Wave for different modulating signal and Observe Spectrum.
2.	Frequency modulator & demodulator using Varicap/Varactor Diode and NE 566 VCO, IC 565 (PLL based detection), calculation of modulation index & BW of FM.
3.	Verification of Sampling Theorem, PAM Techniques, (Flat top & Natural sampling), reconstruction of original signal, Observe Aliasing Effect in frequency domain.
4.	Generation and Detection of PWM using IC 555
5.	Study of PCM
6.	Study of Companded PCM
7.	**Study of DM:** Generation and detection
8.	**Study of ADM:** Generation and detection
9.	Study of line codes (NRZ, RZ, POLAR RZ, BIPOLAR (AMI), MANCHESTER) & their spectral analysis.
Group B - Simulation Practicals	
10.	Simulation of T1/E1 system using suitable software.
11.	Simulation program to study effect of ISI and noise in baseband communication system.
12.	Simulation program to calculate Signal to noise ratio for PCM system & DM system.
13.	Verify Sampling Theorem using simulation.
14.	Demonstrate Scrambling and descrambling operation either using hardware or any simulation tool.

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Second Year of Electronics & Computer Engineering (2020 Course)XXXXXX:

Object Oriented Programming Lab

Teaching Scheme:	**Credit**	**Examination Scheme:**
PR: 02 hrs. / week	**01**	**ORAL: 25 Marks**

Prerequisite Courses, if any:
Companion Course, if any: XXXXXX - Object Oriented Programming

List of Laboratory Experiments	
Group A (Any Four)	
1.	Write a program in C++ to sort the numbers in an array using separate functions for read, display, sort and swap. The objective of this assignment is to learn the concepts of input, output, functions, call by reference in C++.
2.	Write a C++ program that illustrates the concept of Function over loading.
3.	Write a program in C++ to perform following operations on complex numbers Add, Subtract, Multiply, Divide, Complex conjugate. Design the class for complex number representation and the operations to be performed. The objective of this assignment is to learn the concepts classes and objects.
4.	Write a program in C++ to implement Stack. Design the class for stack and the operations to be performed on stack. Use Constructors and destructors. The objective of this assignment is to learn the concepts classes and objects, constructors and destructors.
5.	Write a program in C++ to overload unary operators for complex class.
Group B (Any Seven)	
6.	Write a program in C++ to perform following operations on complex numbers Add, Subtract, Multiply, Divide. Use operator overloading for these operations. The objective of this assignment is to learn the concepts operator overloading.
7.	Write a program in C++ to implement string class. Write constructors, destructor, Accepts function and Display function.
8.	Write a program in C++ to implement string class. Write constructors, destructor, Accepts function and Display function. To overload = operator so as call copy constructor.
9.	Write a program in C++ to implement containment concept using Employee, B Date, & String Classes.
10.	Write a program in C++ to Read and Display the information of Employee Using Multiple Inheritance. Use Basic Info and Department Info as a base classes of Employee class.
11.	Write a C++ program that illustrates run time polymorphism by using virtual functions.
12.	Write a C++ program which use try and catch for exception handling.
13.	Write a C++ program which to implement class and function template.
14.	Write a C++ program which to demonstrate use of namespace in the program.
15.	Write a C++ program which copies the contents of one file to another.

Savitribai Phule Pune University Second Year of Electronics & Computer Engineering (2020 Course) XXXXXX: Employbility Skills Development		
Teaching Scheme:	**Credit**	**Examination Scheme:**
PR: 02 hrs. / week	**01**	**TERM WORK: 25 Marks**

Guidelines for Conduction of Employability Skills Development Lab

- The teacher may design specific assignments that can highlight the learning outcomes of each unit.
- Each activity conducted in the lab should begin with a brief introduction of the topic, purpose of the activity from a professional point of view and end with the learning outcomes as feedback from students.
- Most of the lab sessions can be designed to be inclusive; allowing students to learn skills experientially; which will benefit them in the professional environment.
- Every student must be given sufficient opportunity to participate in each activity and constructive feedback from the instructor / facilitator at the end of the activity should learn towards encouraging students to work on improving their skills.
- Activities should be designed to respect cultural, emotional and social standing of students. Some of the activities can be designed to cater to enhancement of multiple skills – For eg – Team Building Activity can highlight ‘open communication’, ‘group discussion’, ‘respecting perspectives’, ‘leadership skills’, ‘focus on goals’ which can help students improve their inherent interpersonal skills.

Guidelines for Student’s Lab Journal and TW Assessment

- Each student should have a Lab Workbook (sample can be provided if required) which outlines each lab activity conducted.
- The student must respond by writing out their learning outcomes and laborating the activities performed in the lab.
- Continuous assessment of laboratory work is to be done based on overall performance and lab assignments and performance of student.

- Each lab assignment assessment will be assigned grade/marks based on parameters with appropriate weightage.
- Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, punctuality, neatness, enthusiasm, participation and contribution in various activities-SWOC analysis, presentations, team activity, event management, group discussion, group exercises and interpersonal skills and similar other activities/assignments

List of Laboratory Sessions

1.	**Introduction of Self / SWOC Analysis:** a. Explain how to introduce oneself in a professional manner and presenting oneself positively Name | Academic Profile | Achievements | Career Aspirations | Personal Information (hobbies, family, social) b. Focus on introspection and become aware of one's Strengths, Weakness, Opportunities and Challenges Students can write down their SWOC in a matrix and the teacher can discuss the gist personally
2.	**Career Goals and Planning:** • Make students understand the difference between a job and a career. Elaborate steps on how to plan a career. ➢ Students can choose a career and they should write down what skills, knowledge, steps are need to be successful in that particular career and how they can get the right opportunity • Explain to students how to plan short term and long term goals. ➢ Think and write down their short term goals and long terms goals. Teacher can read and discuss (provide basic counselling) about the choices written
3.	**Group Discussion:** • The class can be divided into groups of 8 – 10 students in each group for a discussion lasting 10 minutes ➢ Topics can be topical and non-controversial. After each group finishes its discussion, the teacher can give critical feedback including areas of

	improvement. The teacher should act as a moderator / observer only
4.	**Team Building Activities:** • The class can be divided into groups of 4-5 students in each group and an activity can be given to each group ➢ The activities chosen for each team should be competitive and should involve every student in the team. The activities can be conducted indoors or outdoors depending on infrastructure.
5.	**Public Speaking - (Choose any 2):** • **Prepared Speech** ➢ Topics are shared with students and they will be given 10 minutes to prepare and 3 minutes to deliver followed by Q&A from audience. Teacher can evaluate each student based on content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively • **Extempore Speech** ➢ Various topics are laid out in front of the audience and each student is to pick one topic and speak about the topic for 5 minutes followed by Q&A from audience. Teacher can evaluate each student based on ability to think on his/her feet, content, communication skills, logical and cohesive presentation of topic, perspective of student, ability to handle questions and respond positively • **Reviewing an Editorial article** ➢ Either using e-paper / printed copy, students have to select a recent editorial (that is non-controversial), read it and explain to the audience what the editor's perspective is and what the student's perspective is • **Book Review** Each student will orally present to the audience his/her review of a book that he/she has recently read
6.	**Mock Interviews:** • Every student has to undergo this session and the teacher should seek the

	assistance of another faculty member / TPO Officer to act as interview panel. Students will be informed beforehand about the job profile that they are appearing the interview for and they have to come prepared with a printed copy of their resume, formally dressed. Questions will include technical as well as HR. Faculty can choose to give problems that students have to solve using their technical skills. Students will be graded on the basis of their technical knowledge, ability to answer questions well, presentation of self, body language and verbal skills
7.	**Listening and Reading Skills:** • Listening Worksheets to be distributed among students ➢ Each student can be given specifically designed worksheets that contain blanks / matching / MCQs that are designed to an audio (chosen by the faculty). Students have to listen to the audio (only once) and complete the worksheet as the audio plays. This will help reiterate active listening as well as deriving information (listening to information between the lines)Reading Comprehension Worksheets to be distributed among students • Teacher can choose reading passages from non-technical domains, design worksheets with questions for students to answer. This will enhance students' reading skills by learning how to skim and scan for information.
8.	**Writing Skills (Choose any 2):** • **Letter / Email Writing** ➢ After explaining to the students the highlights of effective writing, students can be asked to write (using digital platforms / paper-based) letter to an organization with the following subject matter i. requesting opportunity to present his/her product ii. complaining about a faulty product / service iii. apologizing on behalf of one's team for the error that occurred iv. providing explanation for a false accusation by a client • **Report Writing** ➢ After describing various formats to write report and explaining how to write a report, each student should be asked to write a report (digital / paper-based) on any of the following topics ▪ Industrial visit ▪ Project participated in ▪ Business / Research Proposal • **Resume Writing**

	➢ The teacher should conduct a brief session outlining the importance of a CV / Resume and students can write / type out their own resumes ▪ Share various professional formats ▪ Focus on highlighting individual strengths ▪ Develop personalized professional goals / statement at the beginning of the resume
9.	**Lateral and Creative Thinking:** • Every student needs to step out of the linear thinking and develop lateral and creative thinking. Teacher can develop creative activities in the classroom / lab that will help students enhance their creative thinking. Some of the suggested activities ➢ Each group (3-4 students) can be given random unrelated items and they will be given 20 mins to come up with creative ideas on how the objects can be used for activities / purposes other than its intended one ➢ Each student is given a random line and he/she has to spin a fictional story and tell it to the class (3 minutes). Each story should have a beginning, middle and end ➢ Each group (3-4 students) can be given a fictional / hypothetical dangerous situation and they have to find a solution to that problem. They can present it to the other teams who will then get the opportunity to pick flaws in the ideas
10.	**Presentation Skills:** Every student will have to choose a topic of his/her choice and make a 5-minute presentation using audio-video aids / PPT. The topic can either be technical or non-technical. Focus and evaluation of each presentation should be the depth of knowledge about the topic, originality of perspective on the topic, well-researched or not, verbal and non-verbal skills and ability to answer questions effectively. Plagiarism should be discredit and students should be warned about it.
11.	**Expert Lecture :** Highlighting the need to manage stress and time, experts from the fields of health and fitness, counselling, training, medical or corporate HR can be invited to deliver a participatory session that focus on helping students to cope with parental, social, peer and career pressures

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Project Based Learning

Teaching Scheme:	Credit	Examination Scheme:
TH: 04 hrs. / week	02	TERM WORK: 50 Marks

Preamble:

The main stream engineering education follows traditional classroom teaching, in which the major focus is mainly on the lecturer and the student has very little (if any) choice on the learning process. This traditional approach no doubt has been effective for years; however rapid development in engineering and technology requires adopting a teaching approach that would assist students not only in developing a core set of industry relevant skills, but also enable them to adapt to changes in their professional career. Today the employers' demands are: Communication skills, Ability to work in Interdisciplinary teams, Analytical skills, Management skills. This consideration concludes that Project-Based Learning (PBL) is the best way to fulfill industry needs.

Course Objectives:

- To emphasize project based learning activities that are long-term, interdisciplinary and student-centric.
- To inculcate independent and group learning by solving real world problem with the help of available resources.
- To be able to develop application based on the fundamentals of electronics and communication engineering by possibly the integration of previously acquired knowledge.
- To get practical experience in all steps in the life cycle of the development of electronic systems: specification, design, implementation, and testing
- To be able to select and utilize appropriate hardware and software tools to design and analyze the proposed system.
- To provide every student the opportunity to get involved either individually or as a group so as to develop team skills and learn professionalism.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Identify the real world problem (possibly of interdisciplinary nature) through a rigorous literature survey and formulate/set relevant aim and objectives.

CO2: Contribute to society through proposed solution by strictly following professional ethics and safety measures.

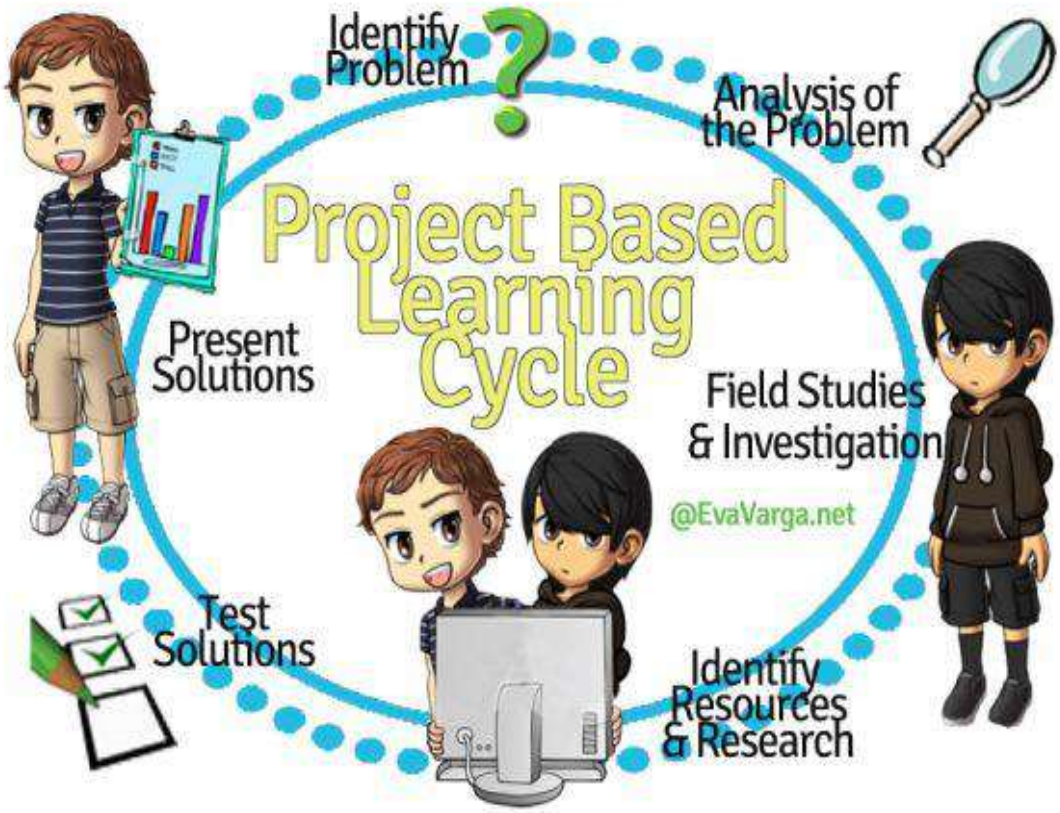
CO3: Propose a suitable solution based on the fundamentals of electronics and communication engineering by possibly the integration of previously acquired knowledge.

CO4: Analyze the results and arrive at valid conclusion.

CO5: Use of technology in proposed work and demonstrate learning in oral and written form.

CO6: Develop ability to work as an individual and as a team member.

Working Cycle:



Group Structure:

Working in supervisor/mentor –monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

1. Create groups of 4 (four) to 5 (Five) students in each class
2. A supervisor/mentor teacher assigned to individual groups

Project Selection:

Survey through journals, patents or field visit (A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific), check the physibility of solution, analyze the problem, design and find the values of components.

There are no commonly shared criteria for what constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity.

The problem-based project oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students' wondering within different disciplines and professional environments. As stated in the preamble as electronics is an important grounding for other disciplines (computer science, signal processing, and communications), the project topic can be Interdisciplinary in nature. However the chosen problem must involve the application of electronics and communication engineering fundamentals. Out of the total developed system setup, the project must involve minimum 40% electronic components. Although in a genuine case 100% software based project topic may be allowed.

Tools for testing:

Recommended to use tools like DSO, PCB Manufacturing Equipment's, Scilab / Matlab, Multisim, Eagle etc.

Ethical Practices, team work and project management:

Use IEEE standards for project manufacturing, respect the time of others, attend the reviews, poster presentation and model exhibitions, strictly follow the deadline of project completion, comply with all legislation requirements that govern workplace health and safety practices.

Effective Documentation:

In order to make our engineering graduates capable to prepare effective documentation, it is required for the students to learn the effective writing skills. The PBL final report is expected to consist of the Literature Survey, Problem Statement, Aim and Objectives, System Block Diagram, System Implementation Details, Discussion and Analysis of Results, Conclusion, System Limitations and Future Scope. Many freely available software tools (for instance Medley (Elsevier), Grammerly) are expected to be used during the preparation of PBL synopsis and final report. It is expected that the PBL guides/mentors shall teach students about utilizing valid sources of information (such as reference papers, books, magazines, etc) related to their PBL topic.

Evaluation & Continuous Assessment:

The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness. Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary. During process of monitoring and continuous assessment and evaluation the individual and team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor /mentor and authorities. Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services. Supervisor/mentor and Students must actively participate in assessment and evaluation processes.

It is recommended that the all activities are required to be recorded and regularly. A regular assessment of PBL work is required to be maintained at the department in PBL log book by students. It is expected that the PBL log book must include following:

1. Weekly monitoring by the PBL guide,
2. Assessment sheet for PBL work review by PBL guide and PBL Evaluation Committee (PEC).

The PEC structure shall consist of Head of the department, 1/2 senior faculties of the department and one industry expert (optional).

Continuous Assessment Sheet (CAS) is to be maintained by the department. Recommended parameters for assessment, evaluation and weightage:

1. Idea Inception (kind of survey). (10%)
2. Outcome (Participation/ publication, copyright, patent, product in market). (50%)
3. Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents). (15%)
4. Attended reviews, poster presentation and model exhibition. (10%)
5. Demonstration (Poster Presentation, Model Exhibition etc). (10%).
6. Awareness /Consideration of - Environment/ Social /Ethics/ Safety measures/Legal aspects. (5%)

Learning Resources

Reference Books / Research Arcticles:

1. Setting the Standard for Project Based Learning, Book by John Larmer, John R. Mergendoller, and Suzie Boss
2. Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences, Book by John Larmer and Suzie Boss
3. Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry in the, Book by Erin M. Murphy and Ross Cooper.
4. M. Krašna, "Project based learning (PBL) in the teachers' education," 2016 39th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, 2016, pp. 852-856, doi: 10.1109/MIPRO.2016.7522258.

Web resources:

- Project-Based Learning, Edutopia, March 14, 2016.
- What is PBL? Buck Institute for Education.
- www.schoology.com
- www.howstuffworks.com
- www.wikipedia.org

Savitribai Phule Pune University

Second Year of Electronics & Computer Engineering (2020 Course)

XXXXXX: Mandatory Audit Course - 4

Teaching Scheme:	Credit	Examination Scheme:
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GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is manadatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in each semester is provided in curriculum. Student can choose the audit course either from courses available on SWAYAM or NPTEL Portal. Evaluation of audit course will be done at institute level. Method of conduction and method of assessment for audit courses is suggested.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

Selecting an Audit Course:

C) Using Swayam Platform:

With a view to providing access to the best quality learning resources across the country, the project **'Study Webs of Active Learning for Young Aspiring Minds' (SWAYAM)** has been started. SWAYAM provides an integrated platform and portal for online courses, using information and communication technology (ICT) and covering High School till all higher education subjects and skill sector courses to ensure that every student benefits from learning material through ICT.

- Student can select any of the course mentioned in the syllabus and has to register for the corresponding MOOC course available on the SWAYAM Platform as a Audit course.
- The duration of the course should not be more than 8 Weeks.
- Once the course is completed the student has to appear for the examination as per the guidelines on the SWAYAM portal.
- After clearing the examination successfully; student will be awarded with

passing certificate a copy which he/she has to submit to concerned authority for getting the clearance of completing the Audit course.

D) Using NPTEL Platform:

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website https://swayam.gov.in/nc details/NPTEL.

- Student can select any of the course mentioned in the syllabus and has to register for the corresponding online course available on the NPTEL Platform as an Audit course.
- The duration of the course should not be more than 8 Weeks.
- Once the course is completed the student has to appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with passing certificate a copy which he/she has to submit to concerned authority for getting the clearance of completing the Audit course.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute has to maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- After the completion of the course the students must undergo the examination as per the schedule on SWAYAM and NPTEL platforms.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments and course completion certificate; the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.
- Every student must compel that student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in-semester performance.