Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

S.E (Electronics / Electronics & Telecommunication Engineering)

(Course 2019)

(w.e.f. June 2020)

Savitribai Phule Pune University, Pune
S.E. (Electronics / E&TC Engineering) 2019 Course
(With effect from Academic Year 2020-21)

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
207005	Engineering Mathematics III	04	-	01	30	70	25	-	-	125	04	-	01	05
204181	Electronic Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
204182	Digital Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
204183	Electrical Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
204184	Data structures	03	-	-	30	70	-	-	-	100	03	-	-	03
204185	Electronic Circuit Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
204186	Digital circuits Lab		02					50		50		01		01
204187	Electrical Circuit Lab	-	02	-	-	-	25	-	-	25	-	01	-	01
204188	Data Structures Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
204189	Electronic Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
204190	Mandatory Audit Course 3 [&]	-	-	-					-	-	-	-	-	-
Total		**16**	**10**	**01**	**150**	**350**	**75**	**100**	**25**	**700**	**16**	**05**	**01**	**22**

Savitribai Phule Pune University, Pune
S.E. (Electronics / E&TC Engineering) 2019 Course
(With effect from Academic Year 2020-21)

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
204191	Signals & Systems	03	-	01	30	70	25	-	-	125	03	-	01	04
204192	Control Systems	03	-		30	70		-	-	100	03	-	-	03
204193	Principles of Communication Systems	03	-	-	30	70	-	-	-	100	03	-	-	03
204194	Object Oriented Programming	03	-	-	30	70	-	-	-	100	03	-	-	03
204195	Signals & Control System Lab		02				50			50		01		01
204196	Principle of Communication Systems Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
204197	Object Oriented Programming Lab	-	02	-	-	-	-	-	50	50	-	01	-	01
204198	Data Analytics Lab		02				-		25	25		01		01
204199	Employability Skill Development	02	02	-	-	-	50	-	-	50	02	01	-	03
204200	Project Based Learning $^{\eta}$	-	04				50		-	50		02		02
204201	Mandatory Audit Course 4$^{\&}$	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		**14**	**14**	**01**	**120**	**280**	**175**	**50**	**75**	**700**	**14**	**07**	**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)

General Instructions

- PR/Tutorial/PBL 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.
- **Examination Scheme:** The theory examination shall be conducted in two phases for all the subjects.
  - Phase I as **In-Semester Examination** of 30 marks written theory examination based on Unit-1 and Unit-2 of course syllabus scheduled by university.
  - Phase II as **End-Semester Examination** of 70 marks written theory examination based on unit number 3, 4, 5, 6 of course syllabus scheduled by university.

- **Structure of Question Paper:**
  - Two units **(Unit1 and Unit 2)** will be covered for 30 Marks for **In-Semester Examination** Equal weightage will be given to both the units.

  - Four units **(Unit 3, Unit 4, Unit 5 and Unit 6)** shall have weightage of 70 Marks for **End-Semester Examination**. Marks weightage for the various units shall be as shown in Table below:

Sr. No.	Unit No.	In - Sem	End - Sem
1.	I	15	--
2.	II	15	--
3.	III	--	18
4.	IV	--	17
5.	V	--	18
6.	VI	--	17

  - Papers will have only one section and there will be two questions for In-sem and four questions for End-sem. For each question there will be alternate Question based on same unit and of the same marks.

  - Framing of questions should be according to Anderson / Bloom's Taxonomy and disseminated through the question papers with a mention of course outcomes as well.

- **Assessment**:

A. Theory:

  - In-sem assessment will be done at the centralized assessment programme (CAP) Centre of the College by the Expert who is appointed as an examiner for the courses as per 48(3) panel of Maharashtra Public University act 2016.

- End-sem assessment will be done at the CAP Centre designated by the University by the Expert who is appointed as an examiner for the subject as per 48(3) panel.

B. Term Work: Term Work is continuous assessment based on work done, submission of work in the form of report / journal, timely completion, attendance, and understanding. It should be assessed by subject teacher of the institute. At the end of the semester, the final grade for a Term Work shall be assigned based on the performance of the student and is to be submitted to the Savitribai Phule Pune University (SPPU). A student who fails in the Term Work on account of unsatisfactory performance shall be given F grade and on the account of inadequate attendance shall be given FX grade. Failing in a particular course Term Work shall not be the criteria for detention in the semester.

C. Practical / Oral: Practical / Oral is to be conducted and assessed jointly by internal and external examiners. The performance in the Practical / Oral examination shall be assessed by at least one pair of examiners appointed as examiners by the Savitribai Phule Pune University. The examiners will prepare the mark / grade sheet in the format as specified by the Savitribai Phule Pune University and authenticate it.

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.

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

207005: Engineering Mathematics - III

Teaching Scheme:	Credit	Examination Scheme:
Theory: 04 hrs. / week	**04 + 01 = 05**	**In-Sem (Theory): 30 Marks**
Tutorial: 01 hr. / week		**End Sem (Theory): 70 Marks**
		Term Work: 25 Marks

Prerequisite Courses, if any: 107001 - Engineering Mathematics - I

107008 - Engineering Mathematics - II

Companion Course, if any: --

Course Objectives:

- To make the students familiarize with concepts and techniques in Ordinary differential equations, Fourier Transform, Z-Transform, Numerical methods, Vector calculus and functions of a Complex variable.
- The aim is to equip them with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power, useful in their disciplines.

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

CO1: Solve higher order linear differential equation using appropriate techniques for modelling, analyzing of electrical circuits and control systems.

CO2: Apply concept of Fourier transform & Z-transform and its applications to continuous & discrete systems, signal & image processing and communication systems.

CO3: 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.

CO4: Perform vector differentiation & integration, analyze the vector fields and apply to electro-magnetic fields & wave theory.

CO5: Analyze Complex functions, Conformal mappings, Contour integration applicable to electrostatics, digital filters, signal and image processing.

Course Contents

Unit I	Linear Differential Equations (LDE) and Applications	(09 Hrs)

LDE of n^{th} order with constant coefficients, Complementary Function, Particular Integral, General method, Short methods, Method of variation of parameters, Cauchy's and Legendre's DE, Simultaneous and Symmetric simultaneous DE. Modeling of Electrical circuits.

Mapping of Course Outcomes for Unit I	**CO1: Solve higher order linear differential equation using appropriate techniques for modelling, analyzing of electrical circuits and control systems.**	
Unit II	**Transforms**	**(09 Hrs)**
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.		
Mapping of Course Outcomes for Unit II	**CO2: Apply concept of Fourier transform & Z-transform and its applications to continuous & discrete systems, signal & image processing and communication systems.**	
Unit III	**Numerical Methods**	**(09 Hrs)**
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 and Predictor-Corrector methods.		
Mapping of Course Outcomes for Unit III	**CO3: 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.**	
Unit IV	**Vector Differential Calculus**	**(09 Hrs)**
Physical interpretation of Vector differentiation, Vector differential operator, Gradient, Divergence and Curl, Directional derivative, Solenoidal, Irrotational and Conservative fields, Scalar potential, Vector identities.		
Mapping of Course Outcomes for Unit IV	**CO4: Perform vector differentiation & integration, analyze the vector fields and apply to electro- magnetic fields & wave theory.**	
Unit V	**Vector Integral Calculus & Applications**	**(10 Hrs)**
Line, Surface and Volume integrals, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem. Applications to problems in Electro-magnetic fields.		
Mapping of Course Outcomes for Unit V	**CO4: Perform vector differentiation & integration, analyze the vector fields and apply to electro- magnetic fields & wave theory.**	
Unit VI	**Complex Variables**	**(06 Hrs)**
Functions of a Complex variable, Analytic functions, Cauchy-Riemann equations, Conformal mapping, Bilinear transformation, Cauchy's integral theorem, Cauchy's integral formula and Residue theorem.		

Mapping of Course Outcomes for Unit VI	CO5: Analyze Complex functions, Conformal mappings, Contour integration applicable to electrostatics, digital filters, signal and image processing.

Learning Resources

Text Books:

1. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw Hill.
2. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publication, New Delhi.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India,10th Edition.
2. M.D. Greenberg, "Advanced Engineering Mathematics", Pearson Education, 2nd Edition.
3. Peter. V and O'Neil, "Advanced Engineering Mathematics", Cengage Learning,7th Edition.
4. S.L. Ross, "Differential Equations", Wiley India, 3rd Edition.
5. S. C. Chapra and R. P. Canale, "Numerical Methods for Engineers", McGraw-Hill, 7th Edition.
6. J. W. Brown and R. V. Churchill, "Complex Variables and Applications", McGraw-Hill Inc, 8th Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"Transform Calculus And its applications in differential equations"**
   https://nptel.ac.in/courses/111/105/111105123/
2. NPTEL Course on **"Numerical Methods"**
   https://nptel.ac.in/courses/111/107/111107105/
3. NPTEL Course on **"Integral & Vector Calculus"**
   https://nptel.ac.in/courses/111/105/111105122/
4. NPTEL Course on **"Complex Analysis"**
   https://nptel.ac.in/courses/111/103/111103070/

Virtual LAB Link:

1. **Numerical Methods:**
   http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/index.php

Guidelines for Tutorial and Term Work

i) Tutorial shall be engaged in three batches per division.
ii) Term work shall be based on continuous assessment of six assignments (one per each unit) and performance in internal tests.
iii) Additional tutorials (Min. 2) are to be conducted using Virtual Lab.

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204181: Electronic Circuits

Teaching Scheme:	Credit	Examination Scheme:
Theory: 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: 204185 - 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.
- Voltage to current and current to voltage converters.
- 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: Explain internal schematic of Op-Amp and define its performance 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, DC Load line, AC equivalent ckt, Parameters, Parasitics.

Non ideal characteristics: Finite output resistance, Body effect, Sub-threshold conduction, breakdown effects, temperature effect, effect of W/L ratio, Common source amplifier & analysis, Source follower: circuit diagram, comparison with common source, Frequency response for amplifier

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, CMOS inverter, resistor & diode. Current sink & source, Current mirror. Four types of feedback amplifiers, Effects of feedback, Voltage series & current series feedback amplifiers and analysis, 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 regulators (317 & 337): Block diagram of linear voltage regulator, IC 317 and IC337, Features and specifications, typical circuits, current boosting, Low Dropout Regulator (LDO). **SMPS:** Block diagram, Types, features and specifications, typical circuits buck and boost converter.		
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 input Balanced output mode - AC analysis (using r parameters) & DC analysis, Level shifter, Op amp parameters, Current mirror, Op-amp characteristics (AC & DC). Voltage series & voltage shunt feedback amplifiers, Effect on R_i, R_o, gain & bandwidth.		
Mapping of Course Outcomes for Unit IV	**CO4: Explain internal schematic of Op-Amp and define its performance parameters.**	
Unit V	**Op-Amp Applications**	**(08 Hrs)**
Inverting amplifier, non-inverting amplifier, Voltage follower, Summing amplifier, Differential amplifier, Practical integrator, Practical differentiator, Instrumentation amplifier, Comparator, Schmitt trigger, Square & triangular wave generator.		
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)**
Voltage to Current, Current to Voltage converters. **DAC & ADC:** Resistor weighted and R-2R DAC, SAR, Flash and dual slope ADC Types / Techniques, Characteristics, block diagrams, Circuits, 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", Mc Graw Hill, 3rd Edition.

2. Ramakant Gaikwad, "Op Amps & Linear Integrated Circuits", Pearson Education.

Reference Books:

1. Millman Halkias, "Integrated Electronics".

2. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford, 2nd Edition.

3. Salivahan and Kanchana Bhaskaran, "Linear Integrated Circuits", Tata McGraw Hill.

MOOC / NPTEL Courses:

1. NPTEL Course **"Analog Electronic Circuits"**
https://nptel.ac.in/courses/108/105/108105158/

2. NPTEL Course on **"Analog Circuits"**
https://nptel.ac.in/courses/108/101/108101094/

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204182: Digital Circuits

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

Prerequisite Courses, if any: --

Companion Course, if any: 204186 - 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	(05 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, Data sheet specifications.

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 flop, Conversion of flip flops, Typical data sheet specifications of Flip flop application of Flip flops.

Registers, Shift registers, Counters (ring counters, twisted ring counters), ripple counters, Mod-n counters, up/down counters, synchronous counters, lock out, Clock Skew, Clock jitter. Effect on synchronous designs, Sequence Generators.

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, features and typical specifications 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", Tata McGraw Hill Publication, 3rd Edition.
2. Thomas Floyd, "Digital Electronics", 11th Edition.
3. M. Morris Mano, "Digital Logic and Computer Design", Prentice Hall of India, 4th Edition.
4. Taub and Schilling, "Digital Principles and Applications," TMH.

Reference Books:

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

MOOC / NPTEL Courses:

1. NPTEL Course **"Digital Circuits"**
   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 Electronic Circuits"**
   https://nptel.ac.in/courses/108/105/108105132/

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204183: Electrical Circuits

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

Prerequisite Courses, if any: 103004 - Basic Electrical Engineering

Companion Course, if any: 204187 - Electrical Circuits Laboratory

Course Objectives:

- To analyze simple DC and AC circuits with circuit simplification techniques.
- To formulate and analyze driven and source free RL and RC circuits.
- To formulate & determine network parameters for given network.
- To understand the constructional details, characteristics, features and application areas of various types of electric motors.

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

CO1: Analyze the simple DC and AC circuit with circuit simplification techniques.

CO2: Formulate and analyze driven and source free RL and RC circuits.

CO3: Formulate & determine network parameters for given network and analyze the given network using Laplace Transform to find the network transfer function.

CO4: Explain construction, working and applications of DC Machines / Single Phase & Three Phase AC Motors.

CO5: Explain construction, working and applications of special purpose motors & understand motors used in electrical vehicles.

CO6: Analyze and select a suitable motor for different applications.

Course Contents		
Unit I	**Basic Circuit analysis & Simplification Techniques**	**(08 Hrs)**
Kirchhoff's Current and Voltage Laws, Independent and Dependent sources and their interconnection, power calculations. **Network Analysis:** Mesh, Super mesh, Node and Super Node analysis. Source transformation and source shifting. **Network Theorems:** Superposition, Thevenin's, Norton's and Maximum Power Transfer. **(Analysis of simple DC circuits using all above techniques & Analysis of simple AC circuits using only Mesh analysis)**		
Mapping of Course Outcomes for Unit I	**CO1: Analyze the simple DC and AC circuit with circuit simplification techniques.**	
Unit II	**Transient Analysis of Basic RL, RC and RLC Circuits**	**(07 Hrs)**
Initial conditions, Driven RL and RC circuits, source free RL and RC circuits, properties of exponential response, Natural and Forced response of RL and RC circuits. Introduction to driven & Source free series RLC circuit. Over damped and Under damped series RLC circuit.		
Mapping of Course Outcomes for Unit II	**CO2: Formulate and analyze driven and source free RL and RC circuits.**	
Unit III	**Two Port Network Parameters and Functions**	**(07 Hrs)**
Terminal characteristics of network, Z, Y, h, ABCD Parameters; Reciprocity and Symmetry conditions, Applications of the parameters. Application of Laplace Transforms to circuit analysis, network functions for one port and two port networks, poles and zeros of network functions and network stability.		
Mapping of Course Outcomes for Unit III	**CO3: Formulate & determine network parameters for given network and analyze the given network using Laplace Transform to find the network transfer function.**	
Unit IV	**DC Machines**	**(08 Hrs)**
Construction, working principle, derivation of emf equation, types, voltage equation of DC generator. Working principle, derivation of Torque equation, types, voltage equation & speed equation of DC Motor. Basic characteristics & different methods of speed control of DC Shunt and Series motor, Power flow diagram of DC motor, Numericals on speed & torque. Need of starter, three point & four point starters for DC shunt motor, applications of DC Motors. **Permanent Magnet DC motors (PMDC):** Construction, Working and applications.		
Mapping of Course Outcomes for Unit IV	**CO4: Explain construction, working and applications of DC Machines / Single Phase & Three Phase AC Motors.** **CO6: Analyze and select a suitable motor for different applications.**	

Unit V	AC Motors (Single phase & Three phase)	(08 Hrs)
Three phase Induction motors: Construction, working principle, types, concept of slip, effect of slip on rotor parameters, derivation of torque equation, condition for maximum torque, torque ratios, Torque-slip characteristics, Power flow diagram with numerical. **Single phase Induction motor:** Construction, working principle, types and applications **Necessity of starters**: Study of DOL & Star-Delta starters, speed control using V/f method, Applications.		
Mapping of Course Outcomes for Unit V	**CO4: Explain construction, working and applications of DC Machines / Single Phase & Three Phase AC Motors.** **CO6: Analyze and select a suitable motor for different applications.**	
Unit VI	**Special Purpose Motors**	**(06 Hrs)**
BLDC Motor: Types, Construction, working principle, Bipolar control circuit, torque-speed characteristics and applications. **Stepper Motor:** Types, Construction, working principle, different modes of operation, control circuit, applications. Introduction to Electric vehicle, block diagram, case study of any one electric vehicle with respect to specifications of motor, battery and controller.		
Mapping of Course Outcomes for Unit VI	**CO5: Explain construction, working and applications of special purpose motors & understand motors used in electrical vehicles.** **CO6: Analyze and select a suitable motor for different applications.**	

Learning Resources

Text Books:

1. Ravish R Singh, "Network Analysis & Synthesis", McGraw-Hill Education.
2. B.L. Theraja, A.K. Theraja, "Electrical Technology", Vol II, AC & DC Machines, S. Chand

Reference Books:

1. I.J Nagarath and D.P Kothari, "Electrical Machines",Tata McGraw-Hill Publication 4th Edition.
2. William H. Hayt, Jack E. Kimmerly and Steven M. Durbin, "Electrical Circuit Analysis", Tata McGraw Hill publication, 7th Edition.
3. V K Mehta and Rohit Mehta, "Principles of Electrical Machines", S Chand Publications.
4. A K Babu, "Electric & Hybrid Vehicle", Khanna Publishing.

MOOC / NPTEL Courses:

1. NPTEL Course **"Basic Electrical Circuits"**
   https://nptel.ac.in/courses/117/106/117106108/
2. NPTEL Course **"Electrical Machines - I"**
   https://nptel.ac.in/courses/108/105/108105017/
3. NPTEL Course **"Electrical Machines - II"**
   https://nptel.ac.in/courses/108/105/108105131/

Other:

1. Application Note of Microchip AN885 on BLDC Motor Fundamentals.

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204184: Data Structures

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

Prerequisite Courses, if any: 110005 - Programming and Problem Solving

Companion Course, if any: 204188 - Data Structures Laboratory

Course Objectives:

To learn basic concepts of C Programming language.

- To learn different sorting and searching algorithms and their analysis.
- To learn linear data structures: Stack and Queue, Linked List and their applications.
- To learn nonlinear data structures: Tree, Graph and their applications.
- To study the systematic ways of solving problem, various methods of organizing large amount of data.
- To solve problems using data structures such as binary tree, binary search tree, and graph and writing programs.

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

CO1: Solve mathematical problems using C programming language.

CO2: Implement sorting and searching algorithms and calculate their complexity.

CO3: Develop applications of stack and queue using array.

CO4: Demonstrate applicability of Linked List.

CO5: Demonstrate applicability of nonlinear data structures - Binary Tree with respect to its time complexity.

CO6: 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: Solve mathematical problems 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 calculate their complexity.**	
Unit III	**Stack and Queue**	**(07 Hrs)**
Stack: Concept, Basic Stack operations, Array representation of stack, Stack as ADT, Stack Applications: Reversing data, Arithmetic expressions conversion and evaluation. **Queue:** Concept, Queue operations, Array representation of queue, Queue as ADT, Circular queue, Priority Queue, Applications of queue: Categorizing data, Simulation of queue.		
Mapping of Course Outcomes for Unit III	**CO3: Develop applications of stack and queue using array.**	
Unit IV	**Linked List**	**(07 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 Linked List.**	
Unit V	**Trees**	**(07 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: Demonstrate applicability of nonlinear data structures - Binary Tree with respect to its time complexity.**

Unit VI	**Graphs**	**(07 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 and Dijkstra's Shortest Path Algorithm.

Mapping of Course Outcomes for Unit VI	**CO6: Apply the knowledge of graph for solving the problems of spanning tree and shortest path algorithm.**

Learning Resources

Text Books:

1. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Books Source,2nd Edition

2. Richard. F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C," Cengage Learning, 2nd Edition.

Reference Books:

1. E Balgurusamy, "Programming in ANSI C", Tata McGraw-Hill, 3rd Edition.

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

3. Reema Thareja, "Data Structures using C", Oxford University Press, 2nd Edition.

MOOC / NPTEL Courses:

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

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

2. NPTEL Course "**Data Structures & Algorithms**"

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

Savitribai Phule Pune University Second Year of Electronics / E & Tc Engineering (2019 Course) 204185: Electronic Circuits Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 50 Marks**
Prerequisite Courses, if any: -		
Companion Course, if any: 204181 - 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: Compulsory	
6.	To measure following Op- amp parameters & compare with specifications given in data sheet. **[Any two Practical Op-Amp can be used for comparison. e.g. LM741, OP07, LF351, LF356, TI071, TI072]** 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 2 or 3-bit R-2R ladder DAC.
9.	To design, build & test Square and triangular waveform generator using Op-Amp (LF351/6)
Group C: [Any 2 to be performed]	
11.	To design, build & test Schmitt trigger using Op-Amp (LF356, TI071)
12.	To design, build & test three Op amp Instrumentation amplifier for typical application.
13.	To design, build & test 2-bit flash ADC.

14.	To build & test PLL ckt.

Note:

- One practical from each Group should be performed as simulation practical (using any available tool).
- Additional (min.2) practicals are to be performed using Virtual Lab.

Virtual LAB Links:

1. **Integrated Circuits:**
   http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/electronerds/index.html

2. **Basic Electronics Virtual Lab:**
   http://vlabs.iitkgp.ernet.in/be/

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204186: Digital Circuits Lab

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

Prerequisite Courses, if any: --

Companion Course, if any: 204182 - 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-bit Comparator. 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):** (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.

Virtual LAB Links:

1. Digital Logic Design:
http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/index.html

2. Digital Electronics:
http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/cool_developers/index.html

3. Digital Logic Design using Gates:
http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/index.html

4. Digital Applications:
http://vlabs.iitb.ac.in/vlabs-dev/labs/digital_application/index.html

5. Digital Electronics Circuits Lab:

http://vlabs.iitkgp.ernet.in/dec/

6. Digital Logic Design Lab:

http://cse15-iiith.vlabs.ac.in/

7. Hybrid Electronics:

http://he-coep.vlabs.ac.in/

Note: Additional (min.2) practicals are to be performed using Virtual Lab.

Savitribai Phule Pune University **Second Year of Electronics / E & Tc Engineering (2019 Course)** **204187: Electrical Circuits Lab**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Term Work: 25 Marks**
Prerequisite Courses, if any: --		
Companion Course, if any: 204183 - Electrical Circuits		

List of Laboratory Experiments

Group A: Tutorial Assignments

- Tutorials must be conducted batch wise.
- Batch size should not be more than 20 students.
- The main objective of this tutorial is to focus on the outcomes defined in the theory syllabus by solving the following assignment based on paper work.

1 (a)	**Determine the following using KVL, KCL, node, loop analysis and circuit simplification techniques:** 1. Currents through various given branches. 2. Voltages across the given branches. 3. Power absorbed or delivered by a given component. **(Analysis of simple DC circuits using all above techniques & Analysis of simple AC circuits using Mesh and Nodal analysis is expected)** **Verifying the results using appropriate simulator is expected:** https://www.falstad.com/circuit/ **OR** https://www.tinkercad.com/dashboard?type=circuits&collection=designs **OR** http://vlab.amrita.edu/?sub=1&brch=75 **OR any other equivalent**

1 (b)	**Determine the following using Network Theorems. One problem statement on each theorem.** 1. Currents through various given branches. 2. Voltages across the given branches. 3. Power absorbed or delivered by a given component. **(Analysis of simple DC circuits using all theorems is expected)** **Verifying the results using appropriate simulator is expected:** https://www.falstad.com/circuit/ **OR** https://www.tinkercad.com/dashboard?type=circuits&collection=designs **OR** http://vlab.amrita.edu/?sub=1&brch=75 **OR any other equivalent**
2 (a)	Formulate differential equation for RL and RC circuits and solve for current and voltages by determining initial conditions for driven and source free conditions.
2(b)	Carry out the transient analysis and determine the voltage, current expressions for a given network involving RL, RC, RLC. (One problem statement on each combination, source free and driven RL, RC, series RLC network) **Verifying the results using appropriate simulator is expected:** https://www.falstad.com/circuit/ **OR** https://www.tinkercad.com/dashboard?type=circuits&collection=designs **OR** http://vlab.amrita.edu/?sub=1&brch=75 **OR any other equivalent**
3 (a)	Determine the Z, Y, h, ABCD parameters for a given network. **Verifying the results using appropriate simulator is expected:** https://www.falstad.com/circuit/ **OR** https://www.tinkercad.com/dashboard?type=circuits&collection=designs
3 (b)	Analyze the given network using Laplace Transform and find the network transfer function.
Group B: Lab Practicals	
4.	To study speed control of DC shunt motor using armature voltage and field current control method. Measure RPM and plot graph of speed versus armature voltage and field current. **Virtual Lab Link:** http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/index.php

5.	To study No-load test and blocked rotor test on 3-phase induction motor. **Virtual Lab Link:** http://vem-iitg.vlabs.ac.in/
6.	Torque- speed characteristic of 3 phase induction motor
7.	To Study BLDC Motor Drive.
8.	To study operating modes of stepper motor.
Group C: Industrial Visit / Case study	
9.	Industrial visit to electric motor manufacturing company / electric vehicle company / Power generation station. **OR** Case study of any one electric vehicle with respect to specifications of motor, battery and controller.

Virtual LAB Links:

1. **Analog Signal, Network and Measurement Virtual Lab:**
   http://vlabs.iitkgp.ernet.in/asnm/
2. **Electric Circuits Lab:**
   http://vlab.amrita.edu/?sub=1&brch=75
3. **Electrical Machines Lab:**
   http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/index.php
4. **Electrical Machines Lab:**
   http://em-coep.vlabs.ac.in/

Note: Additional (min.2) practicals are to be performed using Virtual Lab

Savitribai Phule Pune University **Second Year of Electronics / E & Tc Engineering (2019 Course)** **204188: Data Structures Lab**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Oral: 25 Marks**
Prerequisite Courses, if any: 110005 - Programming and Problem Solving		
Companion Course, if any: 204184 - Data Structures		

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 traversal.
6.	Implement Graph using adjacency Matrix with BFS & DFS traversal.
Group B: [Any 3 to be performed] **Write a C program to:**	
7.	Implement stack and queue using linked list.
8.	Implement assignment 2 using files.
9.	Add two polynomials using linked list.
10.	Reverse a doubly linked list.
11.	Evaluate postfix expression (input will be postfix expression).
12.	Reverse and Sort stack using recursion.
13.	Implement inorder tree traversal without recursion.
14.	To find inorder predecessor and successor of a given key in BST.
15.	Implement Quicksort.
Group C: [Any 1 to be performed] **Write a C program to:**	
16.	Implement merge sort for doubly linked list.

17.	Construct a tree from given in order 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 Prim'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 assignment, the respective group will present it during the practical slot.
  - Distribution of work in a group during presentation may contain:
    - Algorithm / Flowchart
    - Program Explanation
    - Applications

Virtual LAB Links:

1. **Data Structures - I:**
   https://ds1-iiith.vlabs.ac.in/data-structures-1/
2. **Data Structures - II:**
   https://ds2-iiith.vlabs.ac.in/data-structures-2/
3. **Data Structures Lab:**
   http://cse01-iiith.vlabs.ac.in/
4. **Computer Programming Lab:**
   http://cse02-iiith.vlabs.ac.in/

Note: Additional (min.2) practicals are to be performed using Virtual Lab.

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204189: Electronic Skill Development Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 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 and 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 McGraw Hill

2. Simon Monk “Hacking Electronics”, McGraw Hill

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 / E & Tc Engineering (2019 Course) 204190: Mandatory Audit Course - 3		
Teaching Scheme:	**Credit**	**Examination Scheme:**
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List of Courses to be opted (Any one) under Mandatory Audit Course 3

- Technical English For Engineers
- Ecology and Environment
- Ecology and Society
- German I
- Science, Technology and Society
- Introduction to Japanese Language and Culture

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory 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 the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

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:

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 www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

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.
- 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, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204191: Signals & Systems

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 hrs. / week **Tutorial: 01 hr. / week**	**03 + 01 = 04**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks** **Term Work: 25 Marks**

Prerequisite Courses, if any: --

Companion Course, if any: 204195 - Signal & Control 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 and 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", Wiley India, 2nd Edition.
2. M.J. Roberts "Signal and Systems", Tata McGraw Hill 2007.

Reference Books:

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

MOOC / NPTEL Courses:

1. NPTEL Course **"Principles of Signals & System"**

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

2. Lecture Series on, **"Signals & Systems"**

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

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204192: Control Systems

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

Prerequisite Courses, if any: --

Companion Course, if any: 204195 - Signal & Control Systems Lab

Course Objectives:

- To Introduce elements of control system and their modeling using various Techniques.
- To get acquainted with the methods for analyzing the time response and Stability of System
- To Introduce and analyze the frequency response and Stability of System
- To Introduce concept of root locus, Bode plots, Nyquist plots.
- To Introduce State Variable Analysis method.
- To get acquainted with Concepts of PID controllers and IoT based Industrial Automation.

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

CO1: Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.

CO2: Determine the (absolute) stability of a closed-loop control system.

CO3: Perform time domain analysis of control systems required for stability analysis.

CO4: Perform frequency domain analysis of control systems required for stability analysis.

CO5: Apply root-locus, Frequency Plots technique to analyze control systems.

CO6: Express and solve system equations in state variable form.

CO7: Differentiate between various digital controllers and understand the role of the controllers in Industrial automation.

Course Contents

Unit I	Introduction to Control Systems & its modelling	(06 Hrs)
Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems, Block diagram reduction Techniques, Signal flow graph.		
Mapping of Course Outcomes for Unit I	**CO1: Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.**	
Unit II	**Time domain analysis**	**(06 Hrs)**
Time domain analysis: transient response and steady state response, standard test inputs for time domain analysis, order and type of a system, transient analysis of first and second order systems, time domain specifications of second order under damped system from its step response, Steady state error and static error constants.		
Mapping of Course Outcomes for Unit II	**CO2: Determine the (absolute) stability of a closed-loop control system.**	
Unit III	**Stability analysis**	**(08 Hrs)**
Characteristic equation of a system, concept of pole and zero, response of various pole locations in s-plane, concept of stability absolute stability, relative stability, stability of system from pole locations, Routh Hurwit stability criterion, Root locus: definition, magnitude and angle conditions, construction of root locus, concept of dominant poles, effect of addition of pole and zero on root locus. Application of root locus for stability analysis.		
Mapping of Course Outcomes for Unit III	**CO3: Perform time domain analysis of control systems required for stability analysis.**	
Unit IV	**Frequency domain analysis**	**(08 Hrs)**
Frequency response and frequency domain specifications, correlation between time domain and frequency domain specifications, polar plot, Nyquist stability criterion and construction of Nyquist plot, Bode plot, determination of frequency domain specifications and stability analysis using Nyquist plot and Bode plot.		
Mapping of Course Outcomes for Unit IV	**CO4: Perform frequency domain analysis of control systems required for stability analysis.** **CO5: Apply root-locus, Frequency Plots technique to analyze control systems.**	
Unit V	**State space representation**	**(06 Hrs)**

State space advantages and representation, Transfer function from State space, physical variable form, phase variable forms: controllable canonical form, observable canonical form, Solution of homogeneous state equations, state transition matrix and its properties, computation of state transition matrix by Laplace transform method only.

Mapping of Course Outcomes for Unit V	**CO6: Express and solve system equations in state variable form.**

Unit VI	**Controllers and Digital Control Systems**	**(06 Hrs)**

Concept of Controller, Basic ON-OFF Controller, Concept of Dead Zone, Introduction to P, I, D, PI, PD and PID controller, OFFSET of Controller, Integral Reset, PID Characteristics. Concept of Zeigler-Nicholas method.

Concept of Industrial Automation, Need of IoT based Industrial Automation.

Mapping of Course Outcomes for Unit VI	**CO7: Differentiate between various digital controllers and understand the role of the controllers in industrial automation.**

Learning Resources

Text Books:

1. N. J. Nagrath and M. Gopal, "Control System Engineering", New Age International Publishers, 5th Edition.
2. K. Ogata, "Modern Control Engineering", Prentice Hall India Learning Private Limited; 5th Edition.

Reference Books:

1. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition.
2. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition.
3. Schaum's Outline Series, "Feedback and Control Systems" Tata McGraw-Hill.
4. John J. D'Azzo and Constantine H. Houpis, "Linear Control System Analysis and Design", Tata McGraw-Hill, Inc.
5. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley.

MOOC / NPTEL Courses:

1. NPTEL Course **"Control System"**

   https://nptel.ac.in/courses/107/106/107106081/

2. NPTEL Course **"Control System Design"**

   https://nptel.ac.in/courses/115/108/115108104/

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204193: Principles of Communication Systems

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

Prerequisite Courses, if any: --

Companion Course, if any: 204191 - Signals & Systems
204196 - Principles of Communication Systems 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", McGraw-Hill, 4th Edition.
2. B P Lathi, Zhi Ding, "Modern Analog and Digital Communication System", Oxford University Press, 4th Edition.

Reference Books:

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

MOOC / NPTEL Course:

1. NPTEL Course **"Principles of Communication Systems-I"**

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

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204194: Object Oriented Programming

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

Prerequisite Courses, if any: --

Companion Course, if any: 204197 - Object Oriented Programming 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 **"Programming in Java"**

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

2. NPTEL Course **"Programming in C++"**

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 / E & Tc Engineering (2019 Course) 204195: Signals & Control System Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Term Work: 50 Marks**
Prerequisite Courses, if any: --		
Companion Course, if any: 204192 - Signals & Systems 204193 - Control systems		

SIGNALS & SYSTEMS

Note:- Attempt any six exercises from group A, eight exercises from group B and perform additional (min.3) tutorials using Virtual Lab.

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 program 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 program 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.

CONTROL SYSTEMS

Group B	
1.	Numerical on Black diagram reduction technique, Signal Flow Graphs (at least 4 numericals)
2.	Computation of transfer function of Electric Circuits, Mechanical Circuits for concept understanding with their analogy Force-Voltage and Force Current.
3.	Standard input signals and time response analysis of First Order and Second order Systems for step input. Underdamped, Critically damped and Overdamped case.
4.	Stability analysis for any given system with Characteristic Equation given (Software Simulation).
5.	Computation and Software / Simulation of root locus for given G(s)H(s). Comment on time domain specifications and stability of the system.
6.	Computation and analysis of frequency response analysis u Bode Plot for given G(s) H(s). Comment on Gain Margin, Phase Margin and Stability of the system.
7.	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

8.	Compute correlation time domain and frequency domain with examples (at least 4 numericals).
9.	Computation of State Model from Transfer function and Compute Transfer Function from state model solve at least 4/5 numericals.
10.	Derivation of Properties and solve numerical on state transition matrix.
11.	Observe the effect of P, PI, PD and PID controller on the step response of a feedback control system. Comment on effect of Controller mode Time domain specifications/ analysis.

Virtual LAB Link:

1. **Signals and Systems Labotratory:**
   http://ssl-iitg.vlabs.ac.in/

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204196: Principles of Communication Systems Lab

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

Prerequisite Courses, if any: --

Companion Course, if any: 204193 - Principles of Communication Systems

List of Laboratory Experiments

Group A: Hardware Practicals

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 [Any 3 to be performed]	
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.

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204197: Object Oriented Programming Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 hrs. / week	**01**	**Oral: 50 Marks**

Prerequisite Courses, if any: --

Companion Course, if any: 204194 - Object Oriented Programming

List of Laboratory Experiments

Group A: [Any Four to be performed]	
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 to be performed]	
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.

Virtual LAB Links:

1. **Object Oriented Programming with C++:**
   http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/index.php

2. **Problem Solving Lab:**
   http://ps-iiith.vlabs.ac.in/

Note: Additional (min.2) practicals are to be performed using Virtual Lab.

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204198: Data Analytics Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 hrs. / week	01	Oral: 25 Marks

Prerequisite Courses, if any: 110005 - Programming and Problem Solving

Companion Course, if any: --

Course Objectives:

- To introduce to students fundamentals of data science.
- To introduce to students various Python packages related to data science.
- To make student write Python programs related to data sequences using NumPy and Pandas.
- To make student write Python programs related to data frames using NumPy and Pandas.

Guidelines for Instructor's Manual

This course introduces student to the basics of the Python programming environment for preliminary data science applications. The course also introduces data manipulation and cleaning techniques using the popular Python Pandas and Scikit-learn library and introduces the abstraction of the Series and Data Frame as the central data structures for data analysis.

Design minimum ten lab assignments based on the syllabus. The focus shall be on to make student take tabular data, clean it, manipulate it, and run basic inferential statistical analyses. It is preferred to use some real life data (of small size) for validation of the assignments.

Guidelines for Laboratory Conduction

During each lab experiment the following activities will be carried out:

- The instructor will explain the aims & objectives of the assignments.
- The instructor will explain the topics required to carry out the experiment.
- The students will do the hands on as per the Lab manual & Web resources provided.
- The students will show the results to the instructor.

Note: If required, the teacher can conduct (additional) one lecture per week to explain theoretical aspects of data science and to demonstrate Python data science library functions.

Guidelines for Student's Lab Journal

The student's Lab Journal can be assignments submitted in the form a soft copy/hard copy. In case of soft copy submission, the print out of only first page can be kept in the Journal. It should include following as applicable:

Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

Guidelines for Lab /TW Assessment

The oral examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.

List of Laboratory Experiments / Assignments

1.	**Introduction to data analytics and Python fundamentals:** • Understanding the Data. • Python Packages for Data Science. • Importing and Exporting Data in Python. • Getting Started Analyzing Data in Python. • Accessing Databases with Python.
2.	**Data Visualization in Python:** • **Matplotlib, Pandas, Seaborn**: Sactterplot, Barchart, Linechart, Histogram. • **Other Graphs**: Boxplot, Heatmap, Faceting, Pairplot.
3.	**Data Wrangling:** • Pre-processing Data in Python • Dealing with Missing Values in Python • Data Formatting in Python • Data Normalization in Python • Binning in Python • Turning categorical variables into quantitative variables in Python
4.	**Statistical Data Analysis:** • Probability. • Sampling & Sampling Distributions. • Hypothesis Testing.

5.	**Exploratory Data Analysis:** • Descriptive Statistics. • Group By in Python. • Correlation. • Correlation – Statistics. • Analysis of Variance ANOVA.
6.	**Model Development:** • Linear Regression and Multiple Linear Regression • Model Evaluation using Visualization • Polynomial Regression and Pipelines • Measures for In-Sample Evaluation • Prediction and Decision Making

Learning Resources

Reference Books:

1. Jake Vander Plas and O'Reilly, "Python Data Science Handbook: Essential Tools for Working with Data"
2. Wes McKinney and O'Reilly, "Python for Data Analysis", 2nd Edition.
3. Joel Grus and O'Reilly, "Data Science from Scratch: First Principles with Python".

Web resources:

1. https://swayam.gov.in/nd1_noc20_cs46/
2. https://www.coursera.org/learn/data-analysis-with-python
3. https://www.geeksforgeeks.org/python-for-data-science/
4. https://www.coursera.org/learn/python-data-analysis/home/welcome/
5. https://www.udemy.com/course/data-science-with-python-a-complete-guide-3-in-1/

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204199: Employbility Skills Development

Teaching Scheme:	Credit	Examination Scheme:
Theory: 02 hrs. / week **Practical: 02 hrs. / week**	**02 + 01 = 03**	**Term work: 50 Marks**

Prerequisite Courses, if any: --

Companion Course, if any: --

Course Objectives:

- Develop good communication skills – both oral as well as written.
- Encourage creative and critical thinking among students.
- Nurture collaborative behavior to work efficiently in groups.

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

CO1: Define personal and career goals using introspective skills and SWOC assessment. Outline and evaluate short-term and long-term goals.

CO2: Develop effective communication skills (listening, reading, writing, and speaking), self- management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.

CO3: Be a part of a multi-cultural professional environment and work effectively by enhancing inter-personal relationships, conflict management and leadership skills.

CO4: Comprehend the importance of professional ethics, etiquettes & morals and demonstrate sensitivity towards it throughout certified career.

CO5: Develop practically deployable skill set involving critical thinking, effective presentations and leadership qualities to hone the opportunities of employability and excel in the professional environment.

Course Contents

Unit I	Understanding Self and Soft Skills	(04 Hrs)

Introduction to introspective methods, SWOC Analysis, Understanding the importance of soft skills, soft skill vs hard skill, interdisciplinary relevance, emotional quotient and emotional intelligence, personal and career goal setting, aligning aspirations with individual's skill sets, understanding self-esteem and critically evaluating oneself.

Mapping of Course Outcomes for Unit I	**CO1: Define personal and career goals using introspective skills and SWOC assessment. Outline and Evaluate short-term and long-term goals.**	
Unit II	**Communication Skills**	**(04 Hrs)**
Essentiality of good communication skills, Importance of feedback, Different types of communication, Barriers in communication and how to overcome these barriers, Significance of non-verbal messages as augmentation to verbal communication, Group Discussion, Listening Vs Hearing, Reading to comprehend, Learning to skim and scan to extract relevant information, Effective digital communication.		
Mapping of Course Outcomes for Unit II	**CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.**	
Unit III	**Language & Writing Skills**	**(04 Hrs)**
Fundamentals of English Grammar, improve Lexical resource, essential steps to improve spoken and written English, Business vocabulary, Writing - Email, Resume, Formal letter, Official Communication, Essay, Presentation – Planning, Organizing, Preparing and Delivering Professional presentation, Resume writing: Resume content, identification of carrier objective, characteristics of good resume, different formats of resume-chronological, Functional , Hybrid Effective letter and cover letter writing, Application writing, Report writing.		
Mapping of Course Outcomes for Unit III	**CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.**	
Unit IV	**Leadership Skills and Group Dynamics**	**(04 Hrs)**
Understanding Corporate Culture and Leadership skills, difference between a leader and a manager, Importance of resilience in a professional surrounding, Developing empathy and emotional intelligence, being assertive and confident, 4-Ds of decision making, Creative and solution-centric thinking, Resolving conflicts, Working cohesively as a team to achieve success, 5 Qualities of an Effective team - Positivity, respect for others, trust, goal-focused, supportiveness.		
Mapping of Course Outcomes for Unit IV	**CO3: Be a part of a multi-cultural professional environment and work effectively by enhancing inter- personal relationships, conflict management and leadership skills.**	

Unit V	Professionalism & Ethics	(04 Hrs)
Understanding ethics and morals, Importance of Professional Ethics, hindrances due to absence of Work ethics, Professional etiquette – Introductions, with colleagues, attire, events, dinning, telephone, travelling, netiquette, social media, writing. Stress as integral part of life, Identifying signs and sources of stress, Steps to cope with stress – open communication, positive thinking, Belief in oneself, ability to handle failure, Retrospective thinking for future learning, Organizing skills to enhance time management, Focusing on goals, smart work vs hard work, Prioritizing activities, Perils of procrastination, Daily evaluation of "to-do" list.		
Mapping of Course Outcomes for Unit V	**CO4: Comprehend the importance of professional ethics, etiquettes & morals and demonstrate sensitivity towards it throughout certified career.** **CO5: Develop practically deployable skill set involving critical thinking, effective presentations and leadership qualities to hone the opportunities of employability and excel in the professional environment.**	
Unit VI	**Quantitative Ability & Logical Reasoning**	**(04 Hrs)**
Numbers, HCF and LCM, Time and distance, Time and work, Clock, Simple interest and compound interest, Boats and steams, Number series, Ratio and proportion, probability, profit and loss, odd man out series, permutations, height and distance, square and cube rootmatching, selection, verbal reasoning, logical games, logical deductions, logical problems, cause and effect.		
Mapping of Course Outcomes for Unit VI	**CO2: Develop effective communication skills (listening, reading, writing, and speaking), self - management attributes, problem solving abilities and team working & building capabilities in order to fetch employment opportunities and further succeed in the workplace.**	

Learning Resources

Text Books:

1. R. S. Agarwal "Quantitative Aptitude for Competitive Examinations" S. Chand Publications.
2. R.Gajendra Singh Chauhan and Sangeeta Sharma, "Soft Skills-An integrated approach to maximize personality", Wiley Publication, ISBN: 987-81-265-5639-7

Reference Books:

1. Indrajit Bhattacharya, "An Approach to Communication Skills", Dhanpat Rai.

2. Simon Sweeney, "English for Business Communication", Cambridge University Press.

3. Sanjay Kumar and Pushpa Lata, "Communication Skills", Oxford University Press.

4. Atkinson and Hilgard's, "Introduction to Psychology", 14th Edition.

5. Kenneth G. Mcgee, "Heads Up: How to Anticipate Business Surprises & Seize Opportunities First", Harvard Business School Press, Boston, Massachusetts.

6. Krishnaswami, N. and Sriraman, "Creative English for Communication", Macmillan.

MOOC / NPTEL Courses:

1. NPTEL Course **"Developing Soft skills & Personality"**

   https://nptel.ac.in/courses/109/104/109104107/

2. NPTEL Course **"Communication Skills"**

   https://nptel.ac.in/courses/109/104/109104030/

3. NPTEL Course **"Effective Writing"**

   https://nptel.ac.in/courses/109/107/109107172/

4. NPTEL Course **"Interpersonal Skills"**

   https://nptel.ac.in/courses/109/107/109107155/

THEORY SESSIONS

Sr. No.	Topic to be covered	No. of Hours
1.	Soft Skills Vs Hard Skills	1
2.	Planning Career Goals – Short Term & Long Term	1
3.	Understanding SWOC Analysis	1
4.	Resume Writing	1
5.	Presentation Skills	1
6.	Interview Skills	1
7.	Writing Skills	1
8.	Corporate Business Etiquette	2
9.	Time & Stress Management	1
10.	Attitude	1
11.	Leadership Skills	1
12.	Creative & Lateral Thinking	1
13.	Problem Solving	1
14.	Team Dynamics	1
15.	Mental Arithmetic	2

16.	Number Sequence	2
17.	Speed Calculation	2
18.	Fundamentals of English Grammar	2
19.	Verbal Reasoning / Verbal Ability	1
	TOTAL HOURS	**24**

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 elaborating 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 must 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.

Virtual LAB Link:

1. Virtual English Communication Lab:
https://ve-iitg.vlabs.ac.in/

Note: Additional (min.3) tutorials are to be performed using Virtual Lab.

Savitribai Phule Pune University

Second Year of Electronics / E & Tc Engineering (2019 Course)

204200: Project Based Learning

Teaching Scheme:	Credit	Examination Scheme:
Practical: 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. 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.

PBL is an approach to design Electronic Systems Curricula for making electronics more appealing to students. Since electronics is an important grounding for other disciplines (computer science, signal processing, and communications), this approach proposes the development of multidisciplinary projects using the PBL strategy for increasing the attractiveness of the curriculum. Promoting electronics as grounding for other disciplines can be done by defining a new curriculum that includes practical courses (laboratories) in which the students develop whole systems involving multidisciplinary knowledge.

Course Objectives: On completion of the course, learner will be able to -

- To emphasize projectbased 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.

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 5 (five) to 6 (six) students in each class
2. A supervisor/mentor teacher assigned to 3-4 groups or one batch

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.

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 Articles:

1. John Larmer, John R. Mergendoller, and Suzie Boss, "Setting the Standard for Project Based Learning".
2. John Larmer and Suzie Boss, "Project Based Teaching: How to Create Rigorous and Engaging Learning Experiences".
3. Erin M. Murphy and Ross Cooper, "Hacking Project Based Learning: 10 Easy Steps to PBL and Inquiry". M. Krašna, "Project based learning (PBL) in the teachers' education,"39th International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO), Opatija, 2016, pp. 852-856, doi: 10.1109/MIPRO.2016.7522258.
4. J. Macias- Guarasa, J.M. Montero, R. San-Segundo, A. Araujo and O. Nieto-Taladriz, "A project based learning approach to design electronic systems curricula", IEEE transactions on Education, vol.49, no. 3, pp. 389-397, Aug. 2006, doi: 10.1109/TE.2006.879784

Web resources:

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

Savitribai Phule Pune University

Second Year of Electronics/E & Tc Engineering (2019 Course)

204201: Mandatory Audit Course - 4

Teaching Scheme:	Credit	Examination Scheme:
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List of Courses to be opted (Any one) under Mandatory Audit Course 4

- Enhancing Soft Skills and Personality
- Language & Mind
- Emotional Intelligence
- German II
- Human Behaviour
- Speaking Effectively

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory 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 the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

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:

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 www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per

the guidelines on the NPTEL portal.

- After clearing the examination successfully; student will be awarded with certificate.

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.
- 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, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.

Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

T.E (Electronics & Telecommunication Engineering)

(Course 2019)

(w.e.f. June 2021)

Savitribai Phule Pune University, Pune
T.E. (Electronics& Telecommunication Engineering) 2019 Course
(With effect from Academic Year 2021-22)

Semester-V

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
304181	Digital Communication	03	-	-	30	70	-	-	-	100	03	-	-	03
304182	Electromagnetic Field Theory	03	-	01	30	70	25	-	-	125	03	-	01	04
304183	Database Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304184	Microcontrollers	03	-	-	30	70	-	-	-	100	03	-	-	03
304185	Elective - I	03	-	-	30	70	-	-	-	100	03	-	-	03
304186	Digital Communication Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304187	Database Management Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
304188	Microcontroller Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304189	Elective I Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304190	Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
304191A	Mandatory Audit Course 5 &	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**10**	**01**	**150**	**350**	**50**	**125**	**25**	**700**	**-**		-	-
										Total Credit	**15**	**05**	**01**	**21**

Elective -I

1) Digital Signal Processing
2) Electronic Measurements
3) Fundamentals of JAVA Programming
4) Computer Networks

Savitribai Phule Pune University, Pune
T.E. (Electronics& Telecommunication Engineering) 2019 Course
(With effect from Academic Year 2021-22)

Semester-VI

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
304192	Cellular Networks	03	-	-	30	70	-	-	-	100	03	-	-	03
304193	Project Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304194	Power Devices & Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
304195	Elective-II	03	-	-	30	70	-	-	-	100	03	-	-	03
304196	Cellular Networks Lab	-	02	-	-	-	-	-	50	50	-	01	-	01
304197	Power Devices & Circuits Lab	-	02	-	-	-	-	50	-	50		01		01
304198	Elective-II Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304199	Internship**	-	-	-	-	-	100	-	-	100	-	-	04	04
304200	Mini Project	-	04	-	-	-	25	-	50	75	-	02	-	02
304191 B	Mandatory Audit Course 6 &	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**12**	**10**	**00**	**120**	**280**	**125**	**75**	**100**	**700**				
										Total Credit	**12**	**05**	**04**	**21**

Abbreviations:
In-Sem: In semester End-Sem: End semester TH: Theory TW : Term Work
PR: Practical OR: Oral TUT: Tutorial

Note: Students of T.E. (Electronics & Telecommunications) have to opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

Elective -II

1) Digital Image Processing
2) Sensors in Automation
3) Advanced JAVA Programming
4) Embedded Processors
5) Network Security

SEMESTER - V

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304181: Advanced Digital Communication

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

Prerequisite Courses, if any:

1. Principles of Communication Systems
2. Signals & Systems
3. Control Systems
4. Digital Circuits
5. Electronic Circuits.

Companion Course, if any: Digital Communication Lab

Course Objectives: To make the students understand

- To familiarize students with various digital modulation techniques used in digital communication systems.
- To equip students the students with tools required for performance analysis of digital communication systems.
- To introduce the students with the concept of information theory & coding techniques.

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

CO1: Apply the statistical theory for describing various signals in a communication system.

CO2: Understand and explain various digital modulation techniques used in digital communication systems and analyze their performance in presence of AWGN noise.

CO3: Describe and analyze the digital communication system with spread spectrum modulation.

CO4: Analyze a communication system using information theoretic approach.

CO5: Use error control coding techniques to improve performance of a digital communication system.

Course Contents

Unit I	Random Processes & Noise	(07 Hrs.)

Random Processes: Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation and Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density.

Mathematical Representation of Noise: Some Sources of Noise, Frequency-domain Representation of Noise, Superposition of Noises, Linear Filtering of Noise, Quadrature Components of Noise, Representation of Noise using Orthonormal Coordinates.

Mapping of Course Outcomes for Unit I	**CO1: Apply the statistical theory for describing various signals in a communication system.**

Unit II	Digital Modulation-I	(07 Hrs.)

Baseband Signal Receiver: Probability of Error, Optimal Receiver Design.

Digital Modulation: Generation, Reception, Signal Space Representation and Probability of Error Calculation for Binary Phase Shift Keying (BPSK), Binary Frequency Shift Keying (BFSK), Quadrature Phase Shift Keying (QPSK), M-ary Phase Shift Keying (MPSK).

Mapping of Course Outcomes for Unit II	**CO2: Understand and explain various digital modulation techniques used in digital communication systems and analyze their performance in presence of AWGN noise.**

Unit III	Digital Modulation-II	(07 Hrs.)

Generation, Reception, Signal Space Representation and Probability of Error Calculation for Quadrature Amplitude Shift Keying (QASK), M-ary FSK (MFSK), Minimum Shift Keying (MSK), Pulse Shaping to reduce Interchannel and Intersymbol Interference, some Issues in transmission and reception, Orthogonal Frequency Division Multiplexing (OFDM), Comparison of digital modulation systems.

Mapping of Course Outcomes for Unit III	**CO2: Understand and explain various digital modulation techniques used in digital communication systems and analyze their performance in presence of AWGN noise.**

Unit IV	Spread Spectrum Modulation	(06 Hrs.)

Use of Spread Spectrum , Direct Sequence (DS) Spread Spectrum, Spread Spectrum and Code Division Multiple Access (CDMA), Ranging Using DS Spread Spectrum , Frequency Hopping (FH) Spread Spectrum, **Pseudorandom (PN) Sequences:** Generation and Characteristics, Synchronization in Spread Spectrum Systems

Mapping of Course Outcomes for Unit IV	**CO3: Describe and analyze the digital communication system with spread spectrum modulation.**

Unit V	Information Theoretic Approach to Communication System	(07 Hrs.)
Introduction to information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding, Discrete memory less channel, Mutual information, Channel capacity, Channel coding theorem, Differential entropy and mutual Information for continuous ensembles, Information Capacity theorem.		
Mapping of Course Outcomes for Unit V	**CO4: Analyse a communication system using information theoretic approach.**	
Unit VI	**Error-Control Coding**	**(06 Hrs)**
Linear Block Codes: Coding, Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding. Cyclic Codes: Coding & Decoding, Convolutional Codes: Coding & Decoding, Introduction to Turbo Codes & LDPC Codes.		
Mapping of Course Outcomes for Unit VI	**CO5: Use error control coding techniques to improve performance of a digital communication system.**	

Learning Resources

Text Books:

1. Taub, Schilling and Saha, "Principles of Communication Systems", McGraw-Hill, 4th Edition.
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", Pearson Education, 2nd Edition.
2. Wayne Tomasi, "Electronic Communications System", Pearson Education, 5th Edition.
3. A.B Carlson, P B Crully, J C Rutledge, "Communication Systems", Tata McGraw Hill Publication, 5th Edition.
4. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th Edition.
5. Simon Haykin, "Digital Communication Systems", John Wiley & Sons, 4th Edition.

MOOC / NPTEL Courses:

1. NPTEL Course on **"Digital Communications"**

Link of the Course: **https://nptel.ac.in/courses/108/102/108102096/**

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304182: Electromagnetic Field Theory

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 hrs. / week **Tutorial: 01 hr. / week**	**03 + 01 = 04**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks** **Term Work: 25 Marks**

Prerequisite Courses, if any:

1. Vectors, Vector Calculus
2. Coordinate Geometry, Cartesian, Cylindrical, Spherical
3. Engineering Mathematics III

Companion Course, if any: Electromagnetic Field Theory Tutorials

Course Objectives:

- Provide the foundation and rudiments of Electromagnetic theory essential to subsequent courses of radiation, microwave and wireless communications.
- Expose the students to basic laws of electro statics, magneto statics leading to the Maxwell Equations for static and dynamic fields.
- Extend these laws to Uniform Plane waves, transmission line theory and some of the case studies of applications of engineering electromagnetic field theory.
- The main focus will be on the physical interpretation of all the mathematical formulations and extend these concepts to real time applications in the field Electronics and Telecommunication Engineering.

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

CO1: Apply the basic electromagnetic principles and determine the fields (E & H) due to the given source.

CO2: Apply boundary conditions to the boundaries between various media to interpret behavior of the fields on either sides.

CO3: State, Identify and Apply Maxwell's equations (integral and differential forms) in both the forms (Static, time-varying or Time-harmonic field) for various sources, Calculate the time average power density using Poynting Theorem, Retarded magnetic vector potential.

CO4: Formulate, Interpret and solve simple uniform plane wave (Helmholtz Equations) equations, and analyze the incident/reflected/transmitted waves at normal incidence.

CO5: Interpret and Apply the transmission line equation to transmission line problems with load impedance to determine input and output voltage/current at any point on the Transmission line, Find input/load impedance, input/load admittance, reflection coefficient, SWR, Vmax/Vmin, length of transmission line using Smith Chart.

CO6: Carry out a detailed study, interpret the relevance and applications of Electromagnetics.

Course Contents		
Unit I	**Electrostatics**	**(08 Hrs.)**
Review of 3D Coordinate Geometry, Vector Calculus, Physical significance of Gradient, Divergence, Curl, Electric field intensity(E), Displacement Flux Density(D), Gauss's law, Electric potential(V), Potential Gradient, E/D/V due to uniform sources (point charge, infinite line charge, infinite surface charge) , Maxwell Equations for Electrostatics, Current, Current Density, physical interpretation. **Application Case Study:** Electrostatic Discharge, Cathode Ray Oscilloscope.		
Mapping of Course Outcomes for Unit I	**CO1: Apply the basic electromagnetic principles and determine the fields (E & H) due to the given source.** **CO6: Carry out a detailed study, interpret the relevance and applications of Electromagnetics.**	
Unit II	**Magneto statics**	**(06 Hrs)**
Lorentz force, magnetic field intensity (H), Magnetic Flux Density(B), – Biot–Savart's Law – Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Maxwell Equations for Magneto Statics, physical interpretation. **Application Case Study:** Lightning, Magnetic Resonance Imaging (MRI).		
Mapping of Course Outcomes for Unit II	**CO1: Apply the basic electromagnetic principles and determine the fields (E & H) due to the given source.** **CO6: Carry out a detailed study, interpret the relevance and applications of Electromagnetics.**	
Unit III	**Boundary Conditions**	**(06 Hrs)**
Electric Dipole, Dielectric Polarization, Properties of Conductors, Dielectric Materials, Boundary conditions (dielectric-dielectric, conductor –dielectric), significance and applications of Poisson's and Laplace's equations - Capacitance, Energy density. Magnetization, magnetic materials, Boundary conditions for Magnetic Fields, Magnetic force, Torque. **Application Case Study:** RF MEMS, Magnetic Levitation, Electromagnetic Pump.		
Mapping of Course Outcomes for Unit III	**CO2: Apply boundary conditions to the boundaries between various media to interpret behavior of the fields on either sides.** **CO6: Carry out a detailed study, interpret the relevance and applications of Electromagnetics.**	

Unit IV	Time Varying Electromagnetic Fields: Maxwell Equations	(06 Hrs)
Scalar and Vector Magnetic Potential, Poisson's and Laplace Equations, Faraday's law, Translational and motional emf, Displacement current density, Continuity Equation, Time varying Maxwell's equations - point form, integral form, Power and Poynting theorem, concept of Retarded magnetic vector potential, **Application Case Study:** Memristor, Electric Motors, Generators.		
Mapping of Course Outcomes for Unit IV	**CO3: State, Identify and Apply Maxwell's equations (integral and differential forms) in both the forms (Static, time-varying or Time-harmonic field) for various sources, Calculate the time average power density using Poynting Theorem, Retarded magnetic vector potential.** **CO6: Carry out a detailed study, interpret the relevance and applications of Electromagnetics**	
Unit V	**Uniform Plane Waves**	**(6 Hrs)**
Maxwell's equation using phasor notations, Electromagnetic wave equations (Helmholtz equation), Relation between E and H, depth of penetration, concept of polarization, Reflection by perfect conductor-normal incidence, reflection by perfect dielectric- normal incidence, Snell's law. **Application Case Study:** Comparison of Circuit Theory at low frequency and Field theory at High frequencies, Antenna Radiation Mechanism, Propagation of EM energy.		
Mapping of Course Outcomes for Unit V	**CO4: Formulate, Interpret and solve simple uniform plane wave (Helmholtz Equations) equations, and analyze the incident/reflected/transmitted waves at normal incidence.** **CO6: Carry out a detailed study, interpret the relevance and applications of Electromagnetics.**	
Unit VI	**Transmission Line Theory**	**(06 Hrs)**
Line parameters, skin effect, general solution, physical significance of the equations, wavelength, velocity of propagation, the distortion less line, Reflection on a line not terminated in Z0, reflection coefficient, open and short circuited lines, reflection coefficient and reflection loss, standing waves; nodes; standing wave ratio, Input impedance of dissipation less line, Smith Chart and its applications in solving the transmission line parameters. **Application Case Study:** Coaxial Cable, Twisted Pair, Microwave Waveguides		

Mapping of Course Outcomes for Unit VI	**CO5: Interpret and Apply the transmission line equation to transmission line problems with load impedance to determine input and output voltage/current at any point on the Transmission line, Find input/load impedance, input/load admittance, reflection coefficient, SWR, Vmax/Vmin, length of transmission line using Smith Chart.** **CO6: Carry out a detailed study, interpret the relevance and applications of Electromagnetics.**

Learning Resources

Text Books:

1. M.N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", Oxford University Press, India, 2015 (Asian adaptation of 'M.N.O. Sadiku, Elements of Electromagnetics, Sixth International Edition, Oxford University Press'), 6th Edition.
2. William H. Hayt and John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, 8th Revised Edition.

Reference Books:

1. Kraus and Fleish, "Electromagnetics with Applications", McGraw Hill International Editions, 5th Edition.
2. Jordan and Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 1964.

MOOC / NPTEL Courses:

1. NPTEL Course "Transmission Lines and EM Waves -Video course" Prof. R.K. Shevgaonkar
   Link of the Course: https://nptel.ac.in/courses/117/101/117101056/

2. NPTEL Course on "Electromagnetic theory - Video course" Dr. Pradeep Kumar K
   Link of the Course: https://nptel.ac.in/courses/108/104/108104087/

3. David Staelin. 6.013 Electromagnetics and Applications. Spring 2009. Massachusetts Institute of Technology: MIT Open Course Ware
   Link:https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013-electromagnetics-and-applications-spring-2009/index.htm#

List of Tutorials to be carried out

At least 5 Assignments should be conducted using Virtual Electromagnetic Lab, https://www.ee.iitb.ac.in/course/~vel/	
1.	Vector analysis, Electric field Intensity(E): Due to Q, ρ_L, ρ_S
2.	Gauss's Law, Electric flux Density(D) & Electrical Potential (V) : Due to Q, ρ_L, ρ_S,
3.	Electrostatic Boundary Conditions: dielectric-dielectric, conductor –dielectric
4.	Poisson's and Laplace's Equation: Capacitance, Energy density.
5.	Magnetic field Intensity (H)- Biot-Savart: Due to I dL, K dS, J dV, and Ampere's circuital law
6.	Magnetic Boundary Conditions, Inductance, Force, Torque, Energy density.
7.	Faradays Law, Maxwell's Equations
8.	Poynting Theorem, Retarded Magnetic Potential
9.	Transmission line: Primary & Secondary Constants , V & I
10	Reflection Coefficient, SWR, etc using Smith Chart
11	Uniform Plane Waves: Wave parameters, Incidence/Reflection /transmission of UPW.
12	All-important derivations
13	Case Study of EMF Applications to real life and wireless communication

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304183: Database Management

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

Prerequisite Courses, if any:

1. Data Structures

Companion Course, if any: Database Management Lab

Course Objectives:

- To understand fundamental concepts of database from its design to its implementation.
- To analyze database requirements and determine the entities involved in the system and with one another.
- To manipulate database using SQL Query to create, update and manage Database.
- Be familiar with the basic issues of transaction processing and concurrency control.
- To learn and understand Parallel Databases and its Architectures.
- To learn and understand Distributed Databases and its applications.

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

CO1: Ability to implement the underlying concepts of a database system.

CO2: Design and implement a database schema for a given problem-domain using data model.

CO3: Formulate, using SQL/DML/DDL commands, solutions to a wide range of query and update problems.

CO4: Implement transactions, concurrency control, and be able to do Database recovery.

CO5: Able to understand various Parallel Database Architectures and its applications.

CO6: Able to understand various Distributed Databases and its applications.

Course Contents

Unit I	Introduction to DBMS	(07 Hrs.)

Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, Data Abstraction and Database System Structure.

Relational Model: Structure of relational databases, Domains, Relations, Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus.

Entity-Relationship model: Basic Concepts, Entity Set, Relationship Sets and Weak Entity Sets, Mapping Cardinalities, Keys, E-R diagrams, Design Issues, Extended E-R Features, Converting E-R & EER diagram into tables.

Mapping of Course Outcomes for Unit I	**CO1: Ability to implement the underlying concepts of a database system.**

Unit II	Relational Database Design	(06 Hrs.)
Basic concepts, CODD's Rules, Relational Integrity: Domain, Referential Integrities, Enterprise Constraints, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, 4NF and BCNF.		
Mapping of Course Outcomes for Unit II	**CO2: Design and implement a database schema for a given problem-domain using data model.**	
Unit III	**Basics of SQL**	**(07 Hrs.)**
DDL, DML, DCL, Structure: Creation, Alteration, Defining constraints – Primary key, Foreign key, Unique key, Not null, Check, IN operator, Functions - Aggregate Functions, Built-in Functions –Numeric, Date, String Functions, Set operations, sub-queries, correlated subqueries, Use of group by, having, order by, join and its types, Exist, Any, All, view and its types. **Transaction control commands**: Commit, Rollback, Save-point PL/SQL Concepts: Cursors, Stored Procedures, Stored Function, Database Triggers.		
Mapping of Course Outcomes for Unit III	**CO3: Formulate, using SQL/DML/DDL commands, solutions to a wide range of query and update problems.**	
Unit IV	**Database Transactions Management**	**(07 Hrs.)**
Basic concepts of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Need, Locking Methods, Deadlock handling and Time-stamp based Protocols.		
Mapping of Course Outcomes for Unit IV	**CO4: Implement transactions, concurrency control, and be able to do Database recovery.**	
Unit V	**Parallel Databases**	**(06 Hrs.)**
Introduction to Database Architectures: Multi-user DBMS Architectures, Case study- Oracle Architecture. **Parallel Databases:** Performance Parameters for Parallel Databases, Types of Parallel Database Architecture, Evaluating Parallel Query in Parallel Databases and Virtualization on Multicore processors.		
Mapping of Course Outcomes for Unit V	**CO5: Able to understand various Parallel Database Architectures and applications.**	
Unit VI	**Distributed Databases**	**(07 Hrs.)**
Distributed Databases: Distributed Database Management System, Factors Encouraging DDBMS, Advantages of Distributed Databases, Types of Distributed Databases, Architecture of Distributed Databases, Distributed Database Design, Distributed Data Storage, and Distributed Transaction: Basics, Failure modes, Commit Protocols, Concurrency Control in Distributed Database.		
Mapping of Course Outcomes for Unit VI	**CO6: Able to understand various Distributed Databases and its applications.**	

Learning Resources

Text Books:

1. A. Silberschatz, H.F. Korth and S. Sudarshan , “Database System Concepts”, McGraw Hill, 6th Edition.
2. C.J. Date, A. Kannan, S. Swamynathan “An introduction to Database Systems”, Pearson, 8th Edition.

Reference Books:

1. Martin Gruber, “Understanding SQL”, Sybex Publications.
2. Ivan Bayross, “SQL- PL/SQL”, BPB Publications, 4th Edition.
3. S.K. Singh, “Database Systems: Concepts, Design and Application”, Pearson, Education, 2nd Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **“Database Management System”**

   Link of the Course: https://nptel.ac.in/courses/106/106/106106220/

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304184: Microcontroller

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

Prerequisite Courses, if any:

1. Digital Logic Design
2. Electronic Components and Hardware
3. Basics of C Language.

Companion Course, if any: Microcontroller Lab

Course Objectives: During the course study students will be able to

- Understand architecture and features of 8051 and PIC18FXX Microcontroller.
- Learn interfacing of real-world peripheral devices with microcontroller.
- Explore different features of PIC 18FXXXX Microcontroller with Architecture.
- Use concepts of timers and interrupts of PIC 18FXXXX in programming.
- Design and develop microcontroller based embedded application.
- Demonstrate real life applications using PIC 18FXXXX.

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

CO1: Understand the fundamentals of microcontroller and programming.

CO2: Interface various electronic components with microcontrollers.

CO3: Analyze the features of PIC 18F XXXX.

CO4: Describe the programming details in peripheral support.

CO5: Develop interfacing models according to applications.

CO6: Evaluate the serial communication details and interfaces.

Course Contents

Unit I	Introduction to Microcontroller Architecture	(06 Hrs.)

Difference between microprocessor and microcontroller Introduction to the Microcontroller classification, Feature and block diagram of 8051 and explanation, Program Status Word (PSW), 8051. Overview of Instruction set, memory organization, Interrupt structure, timers and its modes, Serial communication: concept of baud rate, Data transmission and reception using Serial port. Sample programs of data transfer, Delay using Timer (0&1) and interrupt, Data transmission and reception using Serial port. I/O Port Programming, All programs in C language.

Mapping of Course Outcomes for Unit I	CO1: Understand the fundamentals of microcontroller and programming

Unit II	IO Port Interfacing-I	(06 Hrs.)
Pin diagram and its functioning Port structure, I/O Port Programming, I/O Interfacing Requirements, **Interfacing of:** LEDS, Keys, 7-segment multiplexed display, DAC 0808, ADC 0809 Stepper motor, Relay, Buzzer, Opto-isolators. **Design of Data acquisition System (DAS):** All programs in embedded C language.		
Mapping of Course Outcomes for Unit II	**CO2: Interface various electronic components with microcontrollers**	
Unit III	**PIC 18F XXXX Microcontroller Architecture**	**(06 Hrs.)**
Comparison of PIC family, Criteria for Choosing Microcontroller, features, PIC18FXXXX architecture with generalized block diagram. MCU, Program and Data memory organization, Bank selection using Bank Select Register, Pin out diagram, Reset operations, Watch Dog Timers, Configuration registers and oscillator options (CONFIG), Power down modes, Overview of instruction set.		
Mapping of Course Outcomes for Unit III	**CO3: Analyze the features of PIC18F XXXX**	
Unit IV	**Peripheral Support in PIC 18FXXXX**	**(06 Hrs.)**
Brief Summary of peripheral support, Timers and its Programing (mode 0 &1), Interrupt Structure of PIC18FXXXX with SFR, PORTB change Interrupts, use of timers with interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP, Block diagram of in-built ADC with Control registers, Sensor interfacing using ADC: All programs in embedded C.		
Mapping of Course Outcomes for Unit IV	**CO4: Describe the programming details in peripheral support**	
Unit V	**Real Word Interfacing With 18FXXXX**	**(06 Hrs.)**
Port structure with programming, Interfacing of LED, LCD and Key board, Motion Detectors, Gas sensors, IR sensors, Design of PIC test Board and debugging. **Home protection System:** All programs in embedded C.		
Mapping of Course Outcomes for Unit V	**CO5: Develop interfacing models according to applications**	
Unit VI	**Serial Port Programming interfacing with 18FXXXX**	**(06 Hrs.)**
Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, SPI, MSSP structure (SPI & I2C), USART (Receiver and Transmitter), interfacing of RTC (DS1307) with I2C and EEPROM with SPI. Design of Traffic Light Controller; All programs in embedded C.		
Mapping of Course Outcomes for Unit VI	**CO6: Evaluate the serial communication details and interfaces**	

Learning Resources

Text Books:

1. Mahumad Ali Mazadi, Janice Gillispie Mazadi, Rolin D McKinlay, "The 8051 Microcontroller & Embedded Systems (Using Assembly and C)", PHI, 2nd Edition.
2. Mahumad Ali Mazadi, Rolin D McKinlay and Danny Causey, "PIC Microcontroller & Embedded System", Pearson Education, 3rd Edition.

Reference Books:

1. Kenneth J. Ayala, 'The 8051 Microcontroller Architecture, Programming and Applications', Cengage Learning, 3rd Edition.
2. Ajay Deshmukh, "Microcontrollers Theory and Applications", TATA McGraw Hill, 4th Edition.
3. Peatman, John B, "Design with PIC Microcontroller", Pearson Education PTE, 1st Edition.
4. Data Sheet of PIC 18FXXXX series.

MOOC / NPTEL Courses:

1. NPTEL Course **"Microcontroller and Applications"**

   Link of the Course: **https://nptel.ac.in/courses/117/104/117104072/**

   https://nptel.ac.in/courses/108/105/108105102/

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304185 (A): Digital Signal Processing (Elective - I)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any:
1. Signals & Systems

Companion Course, if any: Digital Signal Processing Lab

Course Objectives:

- Understand the sampling, aliasing and block schematic of digital signal processing.
- Introduction to Z transform for stability and causality analysis of systems.
- Introduction of DFT, FFT for analysis of DT signals.
- Design and implementation of IIR digital filters.
- Design and implementation of FIR digital filters.
- Apply DSP algorithms/techniques.

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

CO1: Interpret and process discrete/ digital signals and represent DSP system.

CO2: Analyze the digital systems using the Z-transform techniques.

CO3: Implement efficient transform and its application to analyze DT signals.

CO4: Design and implement IIR filters.

CO5: Design and implement FIR filters.

CO6: Apply DSP techniques for speech/ biomedical/ image signal processing.

Course Contents

Unit I	DSP Preliminaries	(06 Hrs.)

Discretization of Analog Signals: Sampling theorem in time domain, recovery of analog signals, and analytical treatment with examples, mapping between analog frequencies to digital frequency, Concept of Up-sampling and Down-sampling in signal processing, Representation of signals as vectors, concept of Basis function and orthogonality, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing, Introduction to DSP processor (TMS 320 XX 6713). **(Only the block schematic of the DSP processor along with brief discussion of three architectures: Von Neumann , Harvard and Super Harvard Architecture)**

Mapping of Course Outcomes for Unit I	**CO1: Interpret and process discrete/ digital signals and represent DSP system.**

Unit II	Z-Transform	(06 Hrs.)
Need for Z-transform, relation between Laplace transform and Z transform, relation between Fourier transform and Z transform, Properties of Z Transform **(without proof)**, Concept of ROC and Properties of ROC, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform using Partial Fraction Expansion (PFE) method (for causal, anti-causal and non-causal systems), Solution of difference equations using Z transform.		
Mapping of Course Outcomes for Unit II	**CO2: Analyze the digital systems using the Z-transform techniques.**	
Unit III	**Transforms (DFT-FFT)**	**(08 Hrs.)**
Frequency domain sampling, DFT, Properties of DFT**(with proof of only circular convolution property)**, Circular convolution, Computation of linear convolution using circular convolution, FFT, Decimation in Time (DIT) and Decimation in Frequency(DIF) using Radix-2 FFT algorithm for 4 point and 8 point sequences, DFT & FFT computation complexity for 4 point and 8 point sequences, Linear filtering (Block convolution or Long sequence convolution) using overlap add and overlap save method.		
Mapping of Course Outcomes for Unit III	**CO3: Implement efficient transform and its application to analyze DT signals.**	
Unit IV	**IIR Filter Design**	**(06 Hrs.)**
Concept of analog filter design, IIR filter design by approximation of backward derivatives, IIR filter design by impulse invariance method, Bilinear transformation method, warping effect. Butterworth filter design, Characteristics of Butterworth filters and Chebyshev filters, IIR filter realization using direct form, cascade form and parallel form, Finite word length effect in IIR filter design.		
Mapping of Course Outcomes for Unit IV	**CO4: Design and implement IIR filters.**	
Unit V	**FIR Filter Design**	**(06 Hrs.)**
Windowing techniques: Gibbs phenomenon, characteristics and comparison of different window functions, **Linear phase conditions:** impulse and phase and group delays, Design of linear phase FIR filter using windows: Rect, Hanning, Hamming, Blackmann & Kaiser, Magnitude and Phase response of Digital filters, Frequency response of Linear phase FIR filters, FIR filter realization using Direct Form, Cascade and linear phase structure.		
Mapping of Course Outcomes for Unit V	**CO5: Design and implement FIR filters.**	

Unit VI	Introduction to 1D & 2D Signal Processing	(06 Hrs.)

Dimensionality of signals, Introduction of 1D signals

Speech: Basics of speech signal and its features, LTI representation of speech signal, Estimation of fundamental frequency, identification of voiced and unvoiced speech and noise removal

Biomedical Signal: Basics of ECG and its features, Spectral Analysis using FFT, Artifacts suppression, Algorithms for R peak detection

Fundamentals of image processing: Representation of digital image, Spatial and Temporal resolution, 2D convolution for feature extraction.

Mapping of Course Outcomes for Unit VI	CO6: Apply DSP techniques for speech/ biomedical/ image signal Processing.

Learning Resources

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Prentice Hall, 4th Edition.
2. Dr. Shaila Apte , "Digital Signal Processing", Wiley India Publication, 2nd Edition.
3. S. Salivahanan, C. Gnanapriya , "Digital Signal Processing", McGraw Hill, 2nd Edition.

Reference Books:

1. Ifeachor E.C, Jervis B. W, "Digital Signal Processing : Practical approach", Pearson Publication, 2nd Edition.
2. Li Tan , "Digital Signal Processing : Fundamentals and Applications", Academic Press, 3rd Edition.
3. Schaum's Outline of "Theory and Problems of Digital Signal Processing", 2nd Edition.
4. Oppenheim, Schafer , "Discrete-time Signal Processing", Pearson Education, 1st Edition.
5. K.A. Navas, R. Jayadevan , "Lab Primer through MATLAB", PHI, Eastern Economy Edition.

MOOC / NPTEL Courses:

1. NPTEL Course on "**Digital Signal Processing**"

   Link of the Course: https://nptel.ac.in/courses/117/102/117102060/

2. NPTEL Course on "**Digital Signal Processing**"

   Link of the Course: https://nptel.ac.in/courses/108/105/108105055/

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304185 (B): Electronic Measurements (Elective - I)

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

Prerequisite Courses, if any:
1. Basic Electronics Engineering
2. Electronic Skill Development Lab

Companion Course, if any: Electronic Measurements Lab

Course Objectives: To make the students understand

- Fundamental principles of measurement systems.
- Basic electronics measuring instruments and analyzers.
- Use of different types of Signal Generators.
- Working principle and use of different types of Oscilloscopes.
- Use of other display devices, recorders and timer/counter.
- Advanced measurement systems.

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

CO1: Understand the metrics for the measurement system

CO2: Select and use the instruments for measurement & analysis of basic electronic parameters

CO3: Identify and use the different signal generators for specific applications

CO4: Understand the principles of different Oscilloscopes for specific applications

CO5: Identify the use of other display devices, recorders and timer/counter in measurement systems

CO6: Use the advanced measurement systems for electronics parameter measurement

Course Contents

Unit I	Basics of Measurements	(06 Hrs.)

Units Systems, Standards, Measurement system characteristics (static and dynamic), Statistical metrics in measurement systems, probability of errors, Calibration of measurement system.

Mapping of Course Outcomes for Unit I	CO1: Understand the metrics for the measurement system.

Unit II	Electronics Measurements	(07 Hrs.)

Voltage & current measurement, Digital Voltmeter (DVM), types of DVM, Digital Multi meter, true r.m.s. voltmeter, Vector voltmeter, Impedance meter, Q-meter, Harmonic Distortion analyzers, Wave analyzer, Spectrum Analyzer, Network Analyzer, Logic Analyzer.

Mapping of Course Outcomes for Unit II	**CO2: Select and use the instruments for measurement & analysis of basic electronic parameters.**	
Unit III	**Signal Generators**	**(06 Hrs.)**
Audio, RF, Micro wave signal generators, Frequency synthesis techniques, Synthesizers, digital signal generators, Noise generators, characteristics of Pulse, signal and noise.		
Mapping of Course Outcomes for Unit III	**CO3: Identify and use different signal generators for specific applications.**	
Unit IV	**Special purpose CRO**	**(07 Hrs.)**
Dual trace CRO, DSO, Sampling CRO, curve Tracer, Power Oscilloscopes, Delayed sweep CRO, Component Test, Z-modulation and X-Y mode operations, Measurements on oscilloscope, Oscilloscope accessories.		
Mapping of Course Outcomes for Unit IV	**CO4: Understand the principles of different Oscilloscopes for specific applications.**	
Unit V	**Display devices, Recorders and universal counter / Timer**	**(06 Hrs.)**
LCD Display, LED/OLED Display, Plasma Display, X-Y Plotters, Strip Chart Recorders, Universal counter/ Timers (**for time period, time interval, frequency, frequency ratio and pulse measurement**), Communication buses PC / instruments (**EIA/TIA 232, 423, 422, 488**), Internal & external acquisition cards.		
Mapping of Course Outcomes for Unit V	**CO5: Identify the use of other display devices, recorders and timer/counter in measurement system.**	
Unit VI	**Advanced measurement systems**	**(06 Hrs.)**
Automatic Test Equipments, Microwave measurements using Network Analyzer, EMI/EMC test instruments, OTDR, Field Strength Meter, Industrial revolutions & their impact on Industrial Automation, Case study of Electronics Measurement Systems (e.g. **DSO, Multi trace CRO, Spectrum Analyzer, Logic Analyzer**)		
Mapping of Course Outcomes for Unit VI	**CO6: Use the advanced measurement systems for electronics parameter measurement.**	

Learning Resources

Text Books:

1. Oliver-Cage, “Electronic Measurements and Instrumentation”, TMH.
2. Cooper & Helfrick, “Modern Electronics Instrumentation & Measurement Techniques”, PHI, 3rd Edition.

Reference Books:

1. M.M.S. Anand, "Electronics Instruments and Instrumentation Technology", PHI, Eastern Economy Edition.
2. A.K. Sawhney, Puneet Sawhney "A Course in Electrical and Electronic Measurements and Instrumentation", Dhanpat Rai & Co.
3. Allen Moris, Reza Langari, "Measurement and Instrumentation Theory & Applications", Elsevier, Academic Press, 2nd Edition
4. H. S. Kalsi, "Electronics Instrumentation" TMH, 2nd Edition.
5. Elena Popkova, Yulia V. Ragulina, Aleksei V. Bogoviz, "Industry 4.0_ Industrial Revolution of the 21st Century: Studies in Systems, Decision and Control", Springer Volume 169

MOOC / NPTEL Courses:

1. NPTEL Course on **"Electrical Measurements & Electronics Instruments "**
   Link of the Course: **https://nptel.ac.in/courses/108/105/108105153/**

2. NPTEL Course on **"Introduction to Industry 4.0 and Industrial Internet of Things"**
   Link of the Course: **https://onlinecourses.nptel.ac.in/noc21_cs66/preview**

3. NPTEL Course on **"Design Principles of RF and Microwave Filters and Amplifiers"**
   Link of the Course: **https://nptel.ac.in/courses/117/105/117105138/**

4. NPTEL Course **"Optical communications"**
   Link of the Course: **https://nptel.ac.in/courses/117/104/117104127/**

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304185 (C): Fundamentals of JAVA Programming (Elective - I)

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

Prerequisite Courses, if any:

1. Data Structures
2. Object Oriented Programming concept

Companion Course, if any: Fundamentals of JAVA Programming Lab

Course Objectives:

- Make the students familiar with basic concepts and techniques of object oriented programming in Java.
- Develop an ability to write various programs in Java for problem solving.

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

CO1: Understand the basic principles of Java programming language

CO2: Apply the concepts of classes and objects to write programs in Java

CO3: Demonstrate the concepts of methods & Inheritance

CO4: Use the concepts of interfaces & packages for program implementation

CO5: Understand multithreading and Exception handling in Java to develop robust programs

CO6: Use Graphics class, AWT packages and manage input and output files in Java

Course Contents

Unit I	**JAVA Fundamentals**	**(08 Hrs.)**

Review of Object oriented concepts, Evolution of Java, Comparison of Java with other programming languages, Java features, Java and World Wide Web, Java Run Time Environment. JVM architecture. Overview of Java Language, Simple Java Program, Java Program Structure. Installing and Configuring Java.

Java Tokens, Java Statements, Constants, variables, data types. Declaration of variables, Giving values to variables, Scope of variables, arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions, Operator precedence and associatively, Mathematical functions, Control statements- Decision making & looping.

Mapping of Course Outcomes for Unit I	**CO1: Understand the basic principles of Java programming language.**

Unit II	Classes and Objects	(06 Hrs.)
Class Fundamentals, Creating Objects, Accessing Class members, Assigning Object reference variables, Methods, Constructors, using objects as parameters, Argument passing, returning objects, Method Overloading, static members, Nesting of Methods , this keyword, Garbage collection, finalize methods, , final variables and methods, final class.		
Mapping of Course Outcomes for Unit II	**CO2: Apply the concepts of classes and objects to write programs in Java**	
Unit III	**Methods & Inheritance in JAVA**	**(06 Hrs.)**
Abstract Methods and classes, Strings ,One dimensional and two dimensional arrays , wrapper classes, enumerated types, Command line arguments **Inheritance:** Inheritance in Java, Creating Multilevel hierarchy, Constructors in derived class, Method overriding, Dynamic method dispatch.		
Mapping of Course Outcomes for Unit III	**CO3: Demonstrate the concepts of methods & Inheritance.**	
Unit IV	**Interfaces & Packages**	**(06 Hrs.)**
Interfaces: Define, implement and extend, Accessing Interface variables, Default interface methods, Using static method in interface **Packages:** Java API Packages, Using System Packages, Creating accessing and using a package, Importing packages, Adding a class to a Package, Hiding classes.		
Mapping of Course Outcomes for Unit IV	**CO4: Use the concept of interfaces & packages for program implementation.**	
Unit V	**Multithreading & Exception Handling**	**(06 Hrs.)**
Introduction to multithreading: Introduction, Creating thread and extending thread class. Concept of Exception handling: Introduction, Types of errors, Exception handling syntax, Multiple catch statements. I/O basics, Reading console inputs, Writing Console output. Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating a simple applet.		
Mapping of Course Outcomes for Unit V	**CO5: Understand multithreading and Exception handling in Java to develop robust programs**	

Unit VI	Graphics Programming and File Handling	(06 Hrs.)
Graphics class, Introduction to AWT packages, Handling events on AWT components, Introduction to Swing package, components and containers. **Managing input/output files**: Concept of streams, Stream Classes, Byte stream, Character stream, Using Stream, creation of files, reading or writing characters / bytes, Concatenating and buffering files, Random access files.		
Mapping of Course Outcomes for Unit VI	**CO6: Use Graphics class, AWT packages and manage input and output files in Java**	

Learning Resources

Text Books:

1. E Balagurusamy, "Programming with JAVA", Tata McGraw Hill, 6th Edition.
2. Herbert Schildt, "Java: The complete reference", Tata McGraw Hill, 7th Edition.

Reference Books:

1. T. Budd, "Understanding OOP with Java", Pearson Education, 2nd Updated Edition.
2. Y. Daniel Liang (2010), "Introduction to Java programming", Pearson Education, India, 7th Edition.
3. Cay Horstmann , "Core Java Volume 1", Kindle, 11th Edition.

MOOC / NPTEL Courses:

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

Link of the Course: **https://nptel.ac.in/courses/106/105/106105191/**

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304185 (D): Computer Networks (Elective - I)

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

Prerequisite Courses, if any:

1. Principles of Communication Systems
2. Digital Communication

Companion Course, if any: Computer Networks Lab

Course Objectives:

- To explain the concepts of networking, its standards and protocols.
- To give the knowledge of controlling techniques in networking at different layers.
- To explain protocols at different layers of reference model.
- To discuss routing and networking in inter and intra domain.
- To introduce network programming.
- To Illustrate the use of protocols at application layer and its implication in network

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

CO1: Design LAN using appropriate networking architecture, topologies, transmission media, and networking devices.

CO2: Describe the working of controlling techniques for flawless data communication using data link layer protocols.

CO3: Compare the functions of network layer, various switching techniques and internet protocol addressing.

CO4: Distinguish different interior and exterior, unicasting and multicasting protocols.

CO5: Analyze data flow using TCP/UDP Protocols, congestion control techniques for QoS.

CO6: Select and use the protocols at application layer.

Course Contents

Unit I	**Basics of Network & Physical Layer**	**(07 Hrs.)**

Types of networks, Network topologies, Design issues for Layers, Network models, OSI model & TCP / IP protocol suite, Types of addressing, Guided and Unguided Transmission media, Network Devices: Hub, Bridge, Switch, Router, Gateway.

Mapping of Course Outcomes for Unit I	**CO1: Design LAN using appropriate networking architecture, topologies, transmission media, and networking devices.**

Unit II	Data Link Layer	(06 Hrs.)
Data link control, Framing, Flow and error control, Protocols for Noiseless, and Noisy Channels, HDLC, Point to Point Protocol, Media Access Control: Random Access, Controlled Access- Reservation, Channelization protocols.		
Mapping of Course Outcomes for Unit II	**CO2: Describe the working of controlling techniques for flawless data communication using data link layer protocols.**	
Unit III	**Network Layer -I**	**(07 Hrs.)**
Introduction to Network Layer: Network-Layer Services, Circuit switching, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding of IP Packets, Network Layer Protocols: Internet Protocol (IP), ICMPv4, Next Generation IP: IPv6 Addressing, The IPv6 Protocol, The ICMPv6 Protocol, Transition from IPv4 to IPv6.		
Mapping of Course Outcomes for Unit III	**CO3: Compare the functions of network layer, various switching techniques and internet protocol addressing.**	
Unit IV	**Network Layer - II**	**(07 Hrs.)**
Unicast & Multicast Routing: Introduction, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, IGMP Distance Vector, Link State, Path Vector, Routing in Internet: RIP, OSPF, BGP.		
Mapping of Course Outcomes for Unit IV	**CO4: Distinguish different interior and exterior, unicasting and multicasting protocols.**	
Unit V	**Transport Layer**	**(06 Hrs.)**
Introduction to transport layer, User Datagram Protocol, Transmission Control Protocol, TCP Congestion Policy, Stream Control Transmission Protocol, Congestion control and QoS, socket programing.		
Mapping of Course Outcomes for Unit V	**CO5: Analyze data flow using TCP/UDP Protocols, congestion control techniques for QoS.**	
Unit VI	**Application Layer**	**(05 Hrs.)**
Introduction to Application Layer, Standard Client Server Protocols: World Wide Web and HTTP, Telnet, FTP, Email, SMTP, IMAP, POP, DNS, BOOTP, DHCP.		
Mapping of Course Outcomes for Unit VI	**CO6: Select and use the protocols at application layer.**	

Learning Resources

Text Books:

1. Behrouz A. Foruzan, “Data communication and Networking”, Tata McGraw-Hill, 5th Edition.
2. Achyut S Godbole, “Data Communication and Networking”, Tata McGraw-Hill, 1st Edition.

Reference Books:

1. Andrew S. Tannenbaum, “Computer Networks”, Pearson Education,4th Edition, 2003
2. Wayne Tomasi, “Introduction to Data Communication and Networking”, Pearson Education, 1st Edition.
3. Greg Tomsho, Ed Tittel, David Johnson. “Guide to Networking Essentials”, Thomson India Learning, 5th Edition, 2007.
4. William Stallings, “Data and Computer Communication”, Pearson Education, 8th Edition, 2000
5. James F. Kurouse & W. Rouse, “Computer Networking: A Top down Approach”, Pearson Education, 6th Edition.

MOOC / NPTEL Courses:

1. Computer Networks - Course (swayam2.ac.in)
2. Introduction to Computer Networks & Internet Protocols - Course (swayam2.ac.in)
3. Computer Networks and Internet Protocol - Course (nptel.ac.in)
4. NPTEL Course **“Computer Networks”**

Link of the Course: https://nptel.ac.in/courses/106/105/106105183/

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304186: Digital Communication Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 50 Marks**

Prerequisite Courses, if any:

1. Principles of Communication Systems
2. Signals & Systems
3.Control Systems
4.Digital Circuits
5. Electronic Circuits.

Companion Course, if any: Digital Communication Theory

Guidelines for Instructor's Manual

Design minimum 10 Assignments on the topics listed under Group A & B Below & prepare your own Instructor's Manual. Minimum 2 experiments should be designed from group A & B each and Minimum 3 can be from group C &D each. **Use of highend equipment like USRP is encouraged for Group A & B experiments.**

Guidelines for Student's Lab Journal

The student's Lab Journal can be experimental write-ups. It should include following as applicable: Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

Guidelines for Lab /TW Assessment

The practical examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.

List of Laboratory Experiments

Group A (Any Two)

1.	Study of BPSK transmitter & receiver using suitable hardware setup/kit.
2.	Study of QPSK transmitter & receiver using suitable hardware setup/kit.
3.	Study of BFSK transmitter & receiver using suitable hardware setup/kit.

4.	Study of Baseband receiver performance in presence of Noise using suitable hardware setup/kit.
Group B (Any Two)	
1.	Study of Error Control Coding using suitable hardware setup/kit.
2.	Study of DSSS transmitter and receiver using suitable hardware setup/kit.
3.	Study of FHSS transmitter and receiver using suitable hardware setup/kit.
Group C (Any Three)	
1	Simulation study of Performance of M-ary PSK .
2	Simulation study of Performance of M-ary QAM.
3	Simulation study of OFDM transmitter & receiver.
4	Simulation study of random processes. Find various statistical parameters of the random process.
5	Simulation Study of performance of BPSK receiver in presence of noise.
6	Simulation Study of CDMA technique.
Group D (Any Three)	
1	Simulation study of Source Coding technique.
2	Simulation study of various Entropies and mutual information in a communication system.
3	Simulation Study of Linear Block codes.
4	Simulation Study of cyclic codes.
5	Simulation Study of Convolutional codes.
6	Simulation Study of Performance of Digital communication system with error control coding.

Virtual LAB Links:

1. **Link: https://www.etti.unibw.de/labalive/index/digitalmodulation/**

2. **Link: https://vlab.amrita.edu/index.php?sub=59&brch=163&sim=262&cnt=970**

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304187: Database Management Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Oral: 25 Marks**
Prerequisite Courses, if any:		
Companion Course, if any: Database Management System		

List of Laboratory Experiments

Group A- Database Programming Languages – SQL

1.	Study of Open Source Relational Databases: MySQL
2.	Design and develop at SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence and Synonym.
3.	Design and develop at least 5SQL queries for suitable database application using SQL DML statements: Insert and Select with operators and functions.
4.	Design and develop at least 5 SQL queries for suitable database application using SQL DML statements: Update and Delete with operators and functions.
5.	Design and develop at least 5 SQL queries for suitable database application using SQL DML statements: all types of Join and Sub-Query.

Group B- Database Programming Languages – PL / SQL

6.	Write a PL/SQL block of code for the following requirements:- **Schema:** 1. Borrower (Roll no., Name, Date of Issue, Name of Book, Status) 2. Fine (Roll no, Date, Amt.) • Accept roll no. & name of book from user. • Check the number of days (from date of issue), if days are between 15 to 30 then fine amount will be Rs 5per day. • If no. of days>30, per day fine will be Rs 50 per day & for days less than 30, Rs. 5 per day. • After submitting the book, status will change from I to R. • If condition of fine is true, then details will be stored into fine table. **Frame the problem statement for writing PL/SQL block in line with above statement.**
7.	Cursors: (All types: Implicit, Explicit, Cursor FOR Loop, Parameterized Cursor) Write a PL/SQL block of code using parameterized Cursor that will merge the data available in the newly created table N_RollCall with the data available in the table O_RollCall. If the data in the first table already exist in the second table then that data should be skipped. **Frame the separate problem statement for writing PL/SQL block to implement all types of Cursors in line with above statement. The problem statement should clearly state the**

	requirements.
8.	**PL/SQL Stored Procedure and Stored Function.** Write a Stored Procedure namely proc_Grade for the categorization of student. If marks scored by students in examination is <=1500 and marks>=990 then student will be placed in distinction category if marks scored are between 989 and900 category is first class, if marks 899 and 825 category is Higher Second Class Write a PL/SQL block for using procedure created with above requirement. Stud_Marks(name, total_marks) Result(Roll,Name, Class). **Frame the separate problem statement for writing PL/SQL Stored Procedure and function, in line with above statement. The problem statement should clearly state the requirements.**
9.	**Database Trigger** (All Types: Row level and Statement level triggers, Before and After Triggers). Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table. **Frame the problem statement for writing Database Triggers of all types, in-line with above statement. The problem statement should clearly state the requirements.**
Group C- Mini Project: Database Project Life Cycle	
11.	Implement MYSQL/Oracle database connectivity with PHP/python/Java Implement Database navigation operations (add, delete, edit,) using ODBC/JDBC.
12.	Using the database concepts covered in Group A & Group B & connectivity concepts covered in Group C, students in group are expected to design and develop database application with following details: **Requirement Gathering and Scope finalization** **Database Analysis and Design:** • Design Entity Relationship Model, Relational Model, Database Normalization • Implementation : • Front End : Java/Perl/PHP/Python/Ruby/.net • Backend : MYSQL/Oracle • Database Connectivity : ODBC/JDBC **Testing: Data Validation** Group of students should submit the Project Report which will be consist of documentation related to different phases of Software Development Life Cycle: Title of the Project, Abstract, Introduction, scope, Requirements, Data Modeling features, Data Dictionary, Relational Database Design, Database Normalization, Graphical User Interface, Source Code, Testing document, Conclusion. Instructor should maintain progress report of mini project throughout the semester from project group and assign marks as a part of the term work.
Virtual LAB Links: **Link of the Virtual Lab: http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php**	

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304188: Microcontroller Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 50 Marks**
Prerequisite Courses, if any: -		
Companion Course, if any: Microcontroller		
Note: All programs in Embedded C for 8051 and PIC 18F4550 Microcontroller		

List of Laboratory Experiments

Group A (Any Three)	
1.	Simple programs on Memory transfer.
2.	Parallel port interacting of LEDS—Different programs (flashing, Counter, BCD, HEX, Display of Characteristic).
3.	Interfacing of Multiplexed 7-segment display (counting application).
4.	Waveform Generation using DAC.
5.	Interfacing of Stepper motor to 8051- software delay using Timer.
Group B (Any Three)	
6.	Write a program for interfacing button, LED, relay & buzzer.
7.	Interfacing of LCD to PIC 18FXXXX.
8.	Interfacing of 4X4 keypad and displaying key pressed on LCD.
9.	Generate square wave using timer with interrupt.
Group C (Any Two)	
11.	Interfacing serial port with PC both side communication.
12.	Interface analog voltage 0-5V to internal ADC and display value on LCD.
13.	Generation of PWM signal for DC Motor control.
14.	Interfacing of RTC using I2C protocol.

Virtual LAB Links:

http://vlabs.iitb.ac.in/vlabs-dev/labs/8051-Microcontroller-Lab/labs/index.php

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304189(A): Digital Signal Processing Lab (Elective – I)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 25 Marks**

Prerequisite Courses, if any: -
1. Signals & System Lab

Companion Course, if any: - Digital Signal Processing

List of Laboratory Experiments

Group A (All compulsory)

1.	Verify the sampling theorem and aliasing effects with various sampling frequencies. **Also implement the sampling theorem using VLAB.**
2.	Find the z-transform of a given difference equation, compute its pole zero plot and comment on its stability.
3.	Compute DFT and IDFT {e.g. x(n) = {1,2,3,4} using N=4 and N= 8} and observe the effect on the resolution on magnitude plot.
4.	Find N-point circular convolution using formula and verify its results. Implement linear filtering using circular convolution.
5	a) Implement IIR structures using Direct form I/ II/ Cascade form. b) Implement FIR structures using Direct Form/Cascade/Linear phase structures.
6.	Study the windowing effect (time and frequency) for Rectangular, Hamming, Hanning, Blackmann and Kaiser windows.

Group B (Any Two)

7.	Design a Butterworth filter using Bilinear Transformation, for the following conditions: 0.8≤|〖H(e〗^jω)| ≤1 0≤ ≤0.2π |〖H(e〗^jω)≤|≤0.2 0.6≤ ≤π **OR** Design a Second order band pass Digital Butterworth filter with passband of 200 Hz to 300 Hz and sampling frequency of 2000Hz using Bilinear Transformation. **OR** Evaluate the order and the poles of a Butterworth filter which has a 3dB bandwidth of 1000Hz and a attenuation of 20dB at 2000 Hz. Determine the system function H(z) by Bilinear Transformation using T=1/10000

8.	Design the symmetric FIR low pass filter for which desired frequency response is expressed as Hd (ω)={(e^(-jωτ for|ω|≤ ω_c) and 0 elsewhere The length of the filter should be M = 7 and ω_c=1 radians/sample. Make use of the Rectangular/ Hamming/ Hanning/Blackman/ Kaiser window.
9.	Verify the Sampling Theorem in frequency domain using FFT for undersampled, Nyquist and oversampled signals.
10.	Compute the DFT by writing a function for the N > 32 sequence. Calculate the computational complexity. Compare the time required by DFT & FFT functions.
Group C (Any Two)	
11.	Implement the Block Convolution algorithms: a) Overlap-add b) Overlap-save
12.	Find the pitch frequency of given speech signal using the autocorrelation method
13.	Implement the following ECG Signal Processing operations: a) Suppression of motion artifacts in ECG using N point moving average filters. b) Peak detection of ECG signal by using Band-limiting digital filters
14.	Image feature extraction using 2D convolution

Virtual LAB Links:

Link of the Virtual Lab: http://vlabs.iitkgp.ernet.in/dsp/#

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304189 (B): Electronic Measurements Lab (Elective-I)

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 hrs. / week	01	Practical: 25 Marks

Prerequisite Courses, if any:
1. Basic Electronics Engineering
2. Electronic Skill Development Lab

Companion Course, if any: Electronic Measurements

List of Laboratory Experiments

Group A (Any Four)

1.	Statistical analysis of measurements, probable error, calibration of meters
2.	Measurement of RMS of common and true RMS of complex waveforms.
3.	Measurement of L, C, R, Q and Distortion Factor using Q –Meter.
4.	Measurement of Total Harmonic Distortion contained by output of amplifier, inverter.
5.	Measurements of Time period, Time Interval, Frequency and frequency ratio using universal counter/ Timer.

Group B (Any Two)

6.	Measurements using Digital Storage Oscilloscope, different modes of DSO, capturing transients and analysis of waveforms. **https://iitg.vlabs.ac.in/Understanding_The_%20Basic_Functions_Of_An%20Oscilloscope.html**
7.	Measurement using spectrum analyzer by observing spectrum of AM and FM waveforms for different modulation indices.
8.	Case study of measurement system using software package like LABVIEW and other software. **https://www.iitk.ac.in/mimt_lab/vlab/index.php?pg=smith**

Group C (Any Two)

9.	Microwave network analysis. Measurement of SWR, reflection coefficient and s parameters using network analyzer. **https://www.iitk.ac.in/mimt_lab/vlab/index.php?pg=reflection_coefficients**
10.	Measurement and timing analysis of digital signals using Logic Analyzer.
11	Measurement and timing analysis using OTDR.

Virtual LAB Links:

Link of the Virtual Lab: https://eil-iitg.vlabs.ac.in

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304189 (C): Fundamentals of JAVA Programming Lab (Elective - I)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 25 Marks**
Prerequisite Courses, if any: - Knowledge of Object Oriented Programming		
Companion Course, if any: Fundamentals of JAVA Programming		

List of Laboratory Experiments

Group A (All are Compulsory)

1.	Write some simple programs in Java such as: i) To find factorial of number. ii) To display first 50 prime numbers. iii) To find sum and average of N numbers
2.	Write a program in Java to implement a Calculator with simple arithmetic operations such as add, subtract, multiply, divide, factorial etc. using switch case and other simple java statements. The objective of this assignment is to learn Constants, Variables, and Data Types, Operators and Expressions, Decision making statements in Java.
3.	Write a program in Java with class Rectangle with the data fields width, length, area and colour. The length, width and area are of double type and colour is of string type. The methods are get_length(), get_width(), get_colour() and find_area(). Create two objects of Rectangle and compare their area and colour. If the area and colour both are the same for the objects then display " Matching Rectangles", otherwise display " Non-matching Rectangle"
4.	Write a program in JAVA to demonstrate the method and constructor overloading

Group B (Any Four)

5	Write Programs in Java to sort i) List of integers ii) List of names. The objective of this assignment is to learn Arrays and Strings in Java
6.	Write a Program in Java to add two matrices. The objective of this assignment is to learn Arrays in Java
7.	Write a program in Java to create a player class. Inherit the classes Cricket_player, Football_player and Hockey_player from player class. The objective of this assignment is to learn the concepts of inheritance in Java.
8.	Write a Java program which imports user defined package and uses members of the classes contained in the package.
9.	Write a Java program which implements interface.

10	Write a program to create multiple threads and demonstrate how two threads communicate with each other.
Group C (Any Three)	
11.	Write a java program which use try and catch for exception handling.
12.	Write a Java program to draw oval, rectangle, line , text using graphics class
13.	Write a java program in which data is read from one file and should be written in another file line by line.
14.	A Mini project in Java: A group of 4 students can develop a small application in Java

Virtual LAB Links:

Link of the Virtual Lab: https://java-iitd.vlabs.ac.in/

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304189 (D): Computer Networks Lab (Elective – I)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 25 Marks**
Prerequisite Courses, if any: -		
Companion Course, if any: Computer Networks		

List of Laboratory Experiments

NOTE: All experiments should be implemented using Open-Source Tools: Wireshark, Packet Tracer and C / C++

Group A (All Compulsory)

1.	Implementation of LAN using suitable multiuser Windows operating System and demonstrating client-server and peer to peer mode of configuration.
2.	Simulating various Networks (LAN, WAN) using relevant network devices on Simulator a) Ping b) ipconfig / ifconfig c) Host name d) Whois e) Netstat f) Route g) Tracert/Traceroute/ Tracepath h) NSlookup i) ARP j) Finger k) Port Scan / nmap
3.	Observe and note the details of the live type of traffic (ARP, Frame analysis, ethernet) from interface using packet capture and analysis tool
4.	Using a Network Simulator (e.g., packet tracer) Configure router using RIP
5.	Capture and note the packet of HTTP /FTP /Telnet / DHCP Protocol using TCP-stream learn sequence of packets being sent and received.

Group B (Any Four)

1.	Socket Programming in C/C++ on TCP Client, TCP Server.
2.	Write a program to simulate leaky bucket/token bucket.
3.	Observe and note the working of protocols using PING / TRACEROUTE / PATHPING and capture packets in LAN using packet capture and analysis tool.
4.	Configure servers like HTTP / FTP and understand packet sequence and data flowing between client-server using packet analysis tools.
5.	Executing Proxy, web Server using simulator.
6.	Executing Telnet, DHCP Server using simulator.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304190: Skill Development		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Term work: 25 Marks**

Prerequisite Courses, if any:

1. Basics of Electronics Components
2. Working of Operational amplifier
3. Basics of Electronics measurement instruments and Tools

Companion Course, if any: --

Course Objectives:

- To build and upgrade practical knowledge of .an individual.
- To make students Employable with required skill set.
- To promote youth work to assist "Make in India" initiative.
- To grow and build confidence among students on specific skill sets.
- To cultivate Entrepreneur mindset after getting required experience.
- To improve professional skills such as moral/ethics/team work/communication skill/lifelong learning etc.

Course Outcome: After Successfully completing the course,

CO1: Student should recognize the need to engage in independent and life-long learning in required skill sets.

CO2: Student needs to experience the impact of industries on society by visiting different industries and understand the importance of industrial products for analog and digital circuits and systems.

CO3: Student has to make use of the modern electronic and IT Engineering Tools and Technologies for solving electronic engineering problems.

CO4: Student would be able to communicate effectively at different technical and administrative levels.

CO5: Student will exhibit leadership skills both as an individual and as a member in a team in multidisciplinary environment.

Group A: Any ***three experiments*** are expected to be done from the mentioned list.
Group B: Any ***two experiments*** are expected to be done from the mentioned list.
Group C: ***Compulsory Industrial visit***
Group D: Compulsory to ***prepare notes, assignments and other relevant documents*** based on above work.

List of Laboratory Experiments	
Group A (Any Three) **Testing /Measurement/Calibration/Troubleshooting/Maintenance/Installation**	
1.	**Case studies on Study, Testing and maintenance of Batteries.** A. Apply skill sets mentioned in ***#Group A Skills 1*** and may be covered as per availability of lab or equipment's. **OR** B. Apply Skill sets mentioned in ***#Group A Skills 1*** may be covered by visiting any Automobile service centers/Battery maintenance service centers or related industry. **Note: Batteries of e-Vehicle & Technology Involved (Lithium Batteries etc.)**
2.	**Case study on Automotive Electronics. (Sensors, Clusters, Controls, Semiconductor's devices etc.)** A. Apply Skill set mentioned in ***#Group A Skills 1 and Group A Skills 2*** which is related to automotive electronics may be covered as per availability of lab or equipment's. **OR** B. Apply Skill sets mentioned in ***#Group A Skills 1***may be covered by visiting any Automobile service centers or related industry.
3.	**Case study on Biomedical Instrumentation** A. Apply Skill set mentioned in ***#Group A Skills 3*** which is related to automotive electronics may be covered as per availability of lab or equipment's. **OR** B. Visit biomedical instrument maintenance service centers **OR** C. Visit Hospitals or related industry. **Note: Students are expected to know about sensors technology / Interface / maintenance / calibration of electronic instrumentation of some of these equipment's.**
4.	Troubleshooting and maintenance of PCB Boards &Controllers
5.	Troubleshooting and maintenance of Power supply
Group B (Any Two) **Software / Hardware Design**	
1.	**Design and Simulate dc-dc boost converter for battery-based applications** Design a conventional dc-dc boost converter to step-up the battery voltage of 5 V to 10 V. Draw the circuit diagram and find required value of duty ratio. Implement the circuit in open-source TINA software. Plot the graphs of output voltage and PWM signal with respect to time.

2.	**Design a web page(s)** A. Using different text formatting tags B. With links to different pages and allow navigation between pages C. With Images, tables and frames D. Using style sheets to maintain uniform style for all web pages E. Using a form that uses all types of controls. F. Validate all the controls placed on the form using Java Script. **Note: Use maximum above points while designing Web page**.
3.	**SMPS Design** A. Design and Simulate of SMPS of 24 V @ 1A. **OR** B. Design, simulate and Implement buck converter using ICs like LM3842 / LM 3524 and measure performance parameters like 1. Load regulation 2. Line regulation 3. Ripple rejection 4. Output impedance and 5. Dropout voltage. 6. Note: Hardware based assignments: **Note : EDA tool (NI Multisim/ORCAD/PSPICE / Altium Designer suite etc.)**
4.	**Design and Simulate PID Controller based on OP-AMP** Design an analog PID controller to track a reference voltage of 5 V in a circuit. Draw the circuit diagram of the controller and implement the circuit in open-source TINA software. Change the reference voltage to 10 V and show that the circuit can still track this changed reference voltage. Show the effect of 3 controller gains viz. proportional gain, integral gain and derivative gain on the output response.
Group C (Compulsory) **Industrial Visit (Practical Visit)**	
1.	Industrial visit to Maintenance /Calibration/ service department of Electronics industry/Hospitals/Service centers etc. Student Should visit to related field and submit report in a predefined format.
2.	Industrial visit to software industry to understand the different processes and skills required as a software professional engineer

Group D (Compulsory)

Documentation/Specification /Manual

1.	Study of documentation/specification /Manual/SOP **Note: Based on group B assignment, student need to prepare user manual / SOP and make and effective presentation.**

#Group A Skills 1

Testing / Measurement / Calibration / Troubleshooting / Maintenance / Installation

The knowledge and following skill may be developed among students.

- Fundamentals of Basic Electronics and interface, if any.
- Installation and Commissioning of Equipment's.
- Troubleshooting skills in analog circuits, digital circuits, and processors.
- Servicing of Electronics Parts, replacement of Components, if any.
- Knowledge of Auxiliary equipment's and Interface.
- Calibration of Equipment's / medical instrument used in healthcare.
- Basic Knowledge of mechanism operation and maintenance of equipment/system.
- Design and develop Controllers (e-vehicles).
- Knowledge of Motors and interface with Drive system considering Load conditions.
- Battery Servicing and rejuvenation technology.
- Battery Monitoring System.
- Servicing of EV.
- Battery Charging Technology, Installation and Servicing.
- Repair Maintenance of Battery Charging Stations.
- Knowledge of technical specification, make etc. for costing and purchasing.
- Knowledge of Testing of Motors, Controllers, Drives.
- Calibration of Drives.
- Testing of PCB's.

#Group A Skills 2

Testing / Measurement / Calibration / Troubleshooting / Maintenance / Installation

- Diagnosis of Ignition System Faults:
- Study of Automobile Electrical Wiring: -
- Study of Automotive cluster:
- Study of Automotive Powertrain etc.

#Group A Skills 3

Testing / Measurement / Calibration / Troubleshooting / Maintenance / Installation

- ECG
- Multi-para monitors
- Magnetic resonance imaging MRI
- X Ray
- Basic Measurement devices like BP, Sugar, Pulse rate etc
- Interface of protecting devices UPS or any other Auxiliary devices.
- Embedded System Boards, Controllers, Processors introduction (Motherboard etc.)

Learning Resources

Reference Books:

1. Ron Lenk, “Practical design of Power Supplies”, John Wiley & Sons, 2005.
2. Abraham I. Pressman,” Switching Power Supply Design”, McGraw-Hill, 3rd Edition, 2009.
3. Khandpur R.S., "Biomedical Instrumentation”, TMH, 3rd Edition.
4. W Bosshart, “Printed Circuit Boards - Design & Technology”, Tata McGraw Hill, 1st Edition.
5. D.Patranabis, “Principles of Industrial Instrumentation”, TMH Publishing Co., 2nd Edition, 2008
6. R.K. Jain, “Mechanical and Industrial Measurement”, Khanna Publishers, New Delhi,11th Edition,1999,
7. L.D. Goettsche, “Maintenance of Instruments and systems – Practical guides for measurement and control”, International Society for Automation, 2nd Edition, 1995.
8. Henry W.Ott, “Noise Reduction Techniques in Electronic Systems”, John Wiley & Sons, USA,2nd Edition.
9. Kim R Fowler, “Electronic Instrument Design”, Oxford University Press, 1997, 1st Edition.
10. Jiuchun Jiang, And Caiping Zhang, “Fundamentals and Applications of Lithium-Ion Batteries In Electric Drive Vehicles”, Wiley Publication, 1st Edition.
11. Web Technologies: Black Book, 2018, Dreamtech Press (1 January 2018), ISBN-10: 9386052490, ISBN-13: 978-9386052490
12. Jennifer Robbins, “Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics”, Shroff/O'Reilly, 5th Edition.
13. Thomas Powell, “Web Design: The complete Reference”, Tata McGraw Hill; 2nd Edition.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304191 (A): Mandatory Audit Course - 5		
Teaching Scheme:	**Credit**	**Examination Scheme:**
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List of Courses to be opted (Any one) under Mandatory Audit Course 5

- Developing Soft skills and Personality
- Entrepreneurship and IP Strategy
- Urbanization and Environment
- Environmental & Resource Economics
- Environment and Development
- Globalization and Culture

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory 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 the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

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:

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 www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

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.
- 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, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.

SEMESTER - VI

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304192: Cellular Networks

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

Prerequisite Courses, if any:
1. Basic knowledge of - Probability, Random variables and Modulation.

Companion Course, if any: Cellular Networks Lab

Course Objectives: To make the students understand

- Various propagation Model and Estimation techniques of wireless communication system.
- OFDM and MIMO technologies to explain modern wireless systems.
- Various aspects of mobile communication system.
- Various aspects of wireless-system planning.
- Different Generation of Mobile Networks.
- Diversified issues that can enhance Network Performance.

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

CO1: Understand fundamentals of wireless communications.

CO2: Discuss and study OFDM and MIMO concepts.

CO3: Elaborate fundamentals mobile communication.

CO4: Describes aspects of wireless system planning.

CO5: Understand of modern and futuristic wireless networks architecture.

CO6: Summarize different issues in performance analysis.

Course Contents

Unit I	Introduction of Wireless Channel	(06 Hrs.)

Introduction, Free Space Propagation Model, Ground-Reflection Scenario, Hata Model and Receiver-Noise Computation. Channel Estimation techniques and Diversity in wireless communications.

Mapping of Course Outcomes for Unit I	CO1: Understand fundamentals of wireless communications.

Unit II	Orthogonal Frequency Division Multiplexing	(06 Hrs.)

Introduction, Motivation and Multicarrier basics, OFDM example, bit error rate for OFDM.

Multiple-Input Multiple-Output Wireless Communications: Introduction to MIMO Wireless Communications, MIMO System Model and MIMO-OFDM.

Mapping of Course Outcomes for Unit II	CO2: Discuss and study OFDM and MIMO concepts.

Unit III	Introduction to Mobile Communication	(08 Hrs.)
Introduction to Cellular Service Progression, Cell Geometry, Overview of Cellular mobile and Network architecture, Cellular radio system design-- Frequency assignments, frequency reuse channels, Concept of cell splitting and Cell sectoring. Significance of Handover in cellular systems with Handoff algorithms and roaming.		
Mapping of Course Outcomes for Unit III	**CO3: Elaborate fundamentals mobile communication.**	
Unit IV	**Wireless System Planning**	**(06 Hrs.)**
Link-Budget Analysis, Tele-traffic Theory, Tele-traffic System Model and Steady State Analysis.		
Mapping of Course Outcomes for Unit IV	**CO4: Describes aspects of wireless system planning.**	
Unit V	**Wireless and Mobile Technologies and Protocols and their performance evaluation**	**(06 Hrs.)**
Introduction, Wireless and mobile technologies, LTE- advanced, 5G – Architecture, wireless local area network and Simulations of wireless networks.		
Mapping of Course Outcomes for Unit V	**CO5: Understand of modern and futuristic wireless networks architecture**	
Unit VI	**Performance Analysis Issues**	**(08 Hrs.)**
Introduction to Network coding, basic hamming code and significance of Information Theory. Interference suppression and Power control. MAC layer scheduling and connection admission in mobile communication.		
Mapping of Course Outcomes for Unit VI	**CO6: Summarize different issues in performance analysis**	

Learning Resources

Text Books:

1. Rappaport, T. S., "Wireless Communications--Principles and Practice", Pearson, 2nd Edition.

2. Jagannatham, A. K., "Principles of Modern Wireless Communication Systems", McGraw-Hill Education.

Reference Books:

1. Cristopher Cox, “An Introduction to LTE: LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications”, Wiley, 2nd Edition.
2. E. Dahlman, J. Skold, and S. Parkvall, “4G, LTE-Advanced Pro and The Road to 5G”, Academic Press, 3rd Edition.
3. B. P. Lathi, “Modern Digital and Analog Communications Systems”. Oxford university press, 2015, 4th Edition.
4. Obaidat, P. Nicopolitids, “Modeling and simulation of computer networks and systems: Methodologies and applications” Elsevier, 1st Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **“Introduction to Wireless & Cellular Communications”**
   Link of the Course: https://nptel.ac.in/courses/106/106/106106167/

1. NPTEL Course **“Advanced 3G and 4G Wireless Mobile Communications”**
   Link of the Course: https://nptel.ac.in/courses/117/104/117104099/

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304193: Project Management

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

Prerequisite Courses, if any: NIL

Companion Course, if any: NIL

Course Objectives: To make the students understand

- The basics of project management and its life cycle
- The process of project identification, selection criteria of the project and how the project planning is undertaken.
- The organizational structure within a project and issues related to project management
- The techniques for effective project scheduling and resource considerations in project.
- The basics of effective handling the risks as well as managing finances within the project
- The complete product development process and requirements for entrepreneurship along with related legal issues.

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

CO1: Apply the fundamental knowledge of project management for effectively handling the projects.

CO2: Identify and select the appropriate project based on feasibility study and undertake its effective planning.

CO3: Assimilate effectively within the organizational structure of project and handle project management related issues in an efficient manner.

CO4: Apply the project scheduling techniques to create a Project Schedule Plan and accordingly utilize the resources to meet the project deadline.

CO5: Identify and assess the project risks and manage finances in line with Project Financial Management Process.

CO6: Develop new products assessing their commercial viability and develop skillsets for becoming successful entrepreneurs while being fully aware of the legal issues related to Product development and Entrepreneurship.

Course Contents		
Unit I	**Fundamentals of Project Management**	**(06 Hrs.)**
Basics of Project Management: Definition of Project, The Project Life Cycle, Definition of project management, Need of Project management, Project Management process and its importance, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles.		
Mapping of Course Outcomes for Unit I	**CO1: Apply the fundamental knowledge of project management for effectively handling the projects.**	
Unit II	**Project Identification, Selection & Planning**	**(06 Hrs.)**
Project Identification and Selection: Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point. **Project Planning:** Introduction and need for Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)		
Mapping of Course Outcomes for Unit II	**CO2: Identify and select the appropriate project based on feasibility study and undertake its effective planning.**	
Unit III	**Project Organizational structure & Issues**	**(07 Hrs.)**
Organizational Structure and Organizational Issues: Introduction, Concept of Organizational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team Management and Diversity Management, Change management		
Mapping of Course Outcomes for Unit III	**CO3: Assimilate effectively within the organizational structure of project and handle project management related issues in an efficient manner.**	
Unit IV	**Project Scheduling**	**(07 Hrs.)**
PERT and CPM: Introduction, Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost System **Resources Considerations in Projects:** Introduction, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, Cost Forecasts		
Mapping of Course Outcomes for Unit IV	**CO4: Apply the project scheduling techniques to create a Project Schedule plan and accordingly utilize the resources to meet the project deadline.**	

Unit V	Project Risk & Financial Management	(08 Hrs.)
Project Risk Management: Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, Steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks **Introduction to Project Management Tools** such as: Trello, JIRA and Asana. **Financial Management in Projects:** Project Finance structure, Process of Project Financial Management: Conducting Feasibility Studies, Planning the Project Finance, Arranging the Financial Package, Controlling the Financial Package, Controlling Financial Risk, Options Models.		
Mapping of Course Outcomes for Unit V	**CO5: Identify and assess the project risks and manage finances in line with Project Financial Management Process.**	
Unit VI	**Product Development & Entrepreneurship**	**(08 Hrs.)**
Product Development: Introduction, Development Process and organizations, product planning, identifying customer needs, Product Significations, concept generation, selection, testing, Design for Manufacturing, Prototyping, Robust Design **Entrepreneurship:** Concept, knowledge, and skills requirement; characteristic of successful entrepreneurs; entrepreneurship process; factors impacting emergence of entrepreneurship **Legal issues related to Product development and Entrepreneurship:** Intellectual property rights- patents, trademarks, copyrights, trade secrets, licensing, franchising.		
Mapping of Course Outcomes for Unit VI	**CO6: Develop new products assessing their commercial viability and develop skillsets for becoming successful entrepreneurs while being fully aware of the legal issues related to Product development and Entrepreneurship.**	

Learning Resources

Text Books:

1. H.Kerzer, “Project Management: A Systems Approach to Planning, Scheduling, and Controlling”, John Wiley & Sons, Inc., 10th Edition, 2009.
2. Chandra, P., “Projects”, Tata McGraw-Hill Education, 8th Edition, 2009.

Reference Books:

1. Morris, P. W. G. and Pinto, J. K., "The Wiley Guide to Managing Projects", JohnWiley & Sons, 2004.
2. Karl Ulrich, Steven Eppinger, "Product Design and Development", McGraw Hill / Irvin, 3rd Edition 2009.
3. R. Majumdar, "Product Management in India", PHI, 2nd Edition, 2010.
4. G.S. Batra, "Development of Entrepreneurship", Deep and Deep publications, New Delhi.
5. Christine Petersen, "The Practical Guide to Project Management", PMP,1st Edition, 2013.
6. Russell W. Darnall, John M. Preston, "Project Management from Simple to Complex", The Saylor Foundation.
7. Levy, F. K. and Wiest, J. D., "A Management Guide to PERT/CPM", Prentice Hall, 2nd Edition, 1969.
8. Lewis, R., "Project Management: Strategic Design and Implementation", McGraw-Hill, 5th Edition. 2006.
9. Venkataraman. R., J.K. Pinto, "Cost and Value Management in Projects", John Wiley & sons.

MOOC / NPTEL Courses:

1. NPTEL Course **"Project Management for Managers"**

   Link of the Course: https://nptel.ac.in/courses/110/107/110107081/

2. NPTEL Course on **"Intellectual Property Rights and Competition Law"**

   Link of the Course: https://nptel.ac.in/courses/110/105/110105139/

List of Tutorials to be carried out

1.	Understanding Impact of Delays in Project Completions with a company's case study.
2.	Designing a Work Breakdown Structure (WBS) for any sample project.
3.	Case study on Conflict Resolution and understanding its challenges.
4.	Solve examples on Project scheduling using CPM and PERT Model.
5.	Assignment on Risk Identification and Risk Analysis with a company's example and/ or exploration of various project management tools.
6.	Prepare a Business plan for an sample Product/ Service to be launched.

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304194: Power Devices & Circuits

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

Prerequisite Courses, if any:

1. Basic Electrical Engineering
2. Basic Electronics Engineering
3. Electronic Circuits
4. Electrical Circuits

Companion Course, if any: Power Devices & Circuits Lab

Course Objectives:

- To introduce different power devices viz. SCR, GTO, MOSFET and IGBT with construction, characteristics, repetitive and non repetitive ratings and typical triggering/driver circuits.
- To understand working, design and performance analysis and applications of various power converter circuits such as ac to dc converters, inverter and chopper
- To know various protection circuit requirements of power electronic devices.

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

CO1: To differentiate based on the characteristic parameters among SCR, GTO, MOSFET & IGBT and identify suitability of the power device for certain applications and understand the significance of device ratings.

CO2: To design triggering / driver circuits for various power devices.

CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.

CO4: To understand significance and design of various protections circuits for power devices.

CO5: To evaluate the performance of uninterruptible power supplies, switch mode power supplies and battery.

CO6: To understand case studies of power electronics in applications like electric vehicles, solar systems etc.

Course Contents		
Unit I	**Study of Power Devices**	**(06 Hrs.)**
Construction, VI characteristics (input, output and transfer if any), switching characteristics of SCR, GTO, Power MOSFET and IGBT, Performance overview of Silicon, Silicon Carbide & GaN based MOSFET and IGBT, various repetitive and non-repetitive ratings of SCR, GTO , Power MOSFET & IGBT and their significance, requirement of a typical triggering / driver (such as opto isolator) circuits for various power devices, importance of series and parallel operations of various power devices **(no derivation and numerical).**		
Mapping of Course Outcomes for Unit I	**CO1: To differentiate based on the characteristic parameters among SCR, GTO, MOSFET & IGBT and identify suitability of the power device for certain applications and understand the significance of device ratings.** **CO2: To design triggering / driver circuits for various power devices**	
Unit II	**AC to DC Power Converters**	**(06 Hrs.)**
Concept of line & forced commutation, Single phase Semi & Full converters using SCR for R and R-L loads and its performance analysis and numerical, Effect of source inductance, Significance of power factor and its improvement using PWM based techniques, Three phase Full converters using SCR for R load and its performance analysis, Single Phase PWM Rectifier using IGBT, Three Phase Controlled Rectifier Using IGBT, Difference between SCR based conventional rectifiers and IGBT based rectifiers.		
Mapping of Course Outcomes for Unit II	**CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.**	
Unit III	**DC to AC Converters**	**(06 Hrs.)**
Single phase half and full bridge square wave inverter for R and R-L load using MOSFET / IGBT and its performance analysis and numerical, Cross conduction in inverter, need of voltage control and strategies in inverters, classifications of voltage control techniques, control of voltage using various PWM techniques and their advantages, concept and need of harmonic elimination / reduction in inverters, Three Phase voltage source inverter for balanced star R load with 120 and 180 degree mode of operation, device utilization factor, Advanced Converters like matrix inverter, multi-level inverters and their topologies and its driver circuits (no derivation and numerical).		
Mapping of Course Outcomes for Unit III	**CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.**	
Unit IV	**DC to DC Converters**	**(06 Hrs.)**
Classification of choppers, Step down chopper for R and RL load and its performance analysis, Step up chopper, various control strategies for choppers, types of choppers (isolated and non isolated) such as type A, B, C, D & E, switch mode power supply (SMPS) viz buck, boost and buck-boost, Fly back, Half and full Bridge isolated and non-isolated interleaved bidirectional topologies, and concept of integrated converter and design of LM3524 based choppers, concept of maximum power point tracking (MPPT).		
Mapping of Course Outcomes for Unit IV	**CO3: To evaluate and analyze various performance parameters of the different converters and its topologies.**	

Unit V	Power Devices Protection and Circuits	(06 Hrs.)
Over voltage, over current, di/dt and dv/dt protection circuits and their design, Various cooling techniques and heat sink design, Resonant converters such as Zero current switching (ZCS) and Zero voltage switching (ZVS), Electromagnetic interference such as radiated and conducted EMI, Difference between EMI and EMC, EMI sources and soft switching and minimizing / shielding techniques for EMI, Various EMI and EMC standards, Importance of isolation transformer.		
Mapping of Course Outcomes for Unit V	**CO4: To understand significance and design of various protections circuits for power devices.**	
Unit VI	**Power Electronics Applications**	**(06 Hrs.)**
AC Voltage Controller using IGBT & SCR, Fan Regulator, Electronic Ballast, LED Lamp driver, DC motor drive for single phase separately excited dc motor, BLDC motor drive, Variable voltage & variable frequency three phase induction motor drive, On-line and Off- line UPS, study of various selection criteria and performance parameters of batteries in battery operated power systems, battery charging models and modes for EVs, Architecture of EVs battery charger, PFC stage circuit topologies with details of Full-bridge boost rectifier and Full-bridge interleaved for EV battery charger, case study of power electronics in electric vehicle and photovoltaic solar system		
Mapping of Course Outcomes for Unit VI	**CO5: To evaluate the performance of uninterruptible power supplies, switch mode power supplies and battery.** **CO6: To understand case studies of power electronics in applications like electric vehicles, solar systems etc.**	

Learning Resources

Text Books:

1. M. H. Rashid, “Power Electronics Circuits Devices and Applications”, PHI,4th Edition 2017 New Delhi.
2. M. D. Singh and K. B. Khanchandani, “Power Electronics”, TMH, 2nd Edition 2006.

Reference Books:

1. Bogdan M. Wilamowski, J. David Irwin, "The Power Electronics and Motor Drives Handbook", CRC Press, 1st Edition, 2011. ; **eBook: ISBN 9780429165627, 2019.**
2. Muhammad H. Rashid , "Power Electronics Handbook", Academic Press, 2nd Edition, 2001
3. Ned Mohan, T. Undeland & W. Robbins, "Power Electronics Converters Applications and Design, John Willey & sons, Singapore, 2nd Edition Oxford University Press, New Delhi, 2005
4. Ali Emadi Alireza Khaligh Zhong Nie Young Joo Lee, "Integrated Power Electronic Converters and Digital Control", CRC Press, 1st Edition.
5. Vinod Kumar Khanna "Insulated Gate Bipolar Transistor IGBT Theory and Design", John Wiley & Sons, Illustrated Edition.
   Print ISBN:9780471238454; Online ISBN:9780471722915, DOI:10.1002/047172291.
6. L. Ashok Kumar, S. Albert Alexander and Madhuvanthani Rajendran, "Power Electronic Converters for Solar Photovoltaic Systems", Elsevier, 1st Edition, 2020.

MOOC / NPTEL Courses:

1. NPTEL Course on **"Power Electronics "**

Link of the Course: https://nptel.ac.in/courses/108/105/108105066/

https://nptel.ac.in/courses/108/102/108102145/

https://nptel.ac.in/courses/108/107/108107128/

https://nptel.ac.in/courses/108/108/108108077/

https://batteryuniversity.com/

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304195 (A): Digital Image Processing (Elective - II)

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

Prerequisite Courses, if any:

Companion Course, if any: Digital Image Processing Lab

Course Objectives:

- To become familiar with digital image fundamentals.
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To study the image segmentation and representation techniques.
- To become familiar with image compression methods.
- To learn concepts of degradation function and restoration techniques.
- To understand the Object Recognition.

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

CO1: Apply knowledge of mathematics for image understanding and analysis.

CO2: Implement spatial domain image operations.

CO3: Design and realize various algorithms for image segmentation.

CO4: Design and realize various algorithms for image Compression.

CO5: Apply restoration to remove noise in the image.

CO6: Describe the object recognition system.

Course Contents

Unit I	DIP Fundamentals	(08 Hrs.)

Fundamental steps of Image Processing, components of IP, Image formation, image sampling and quantization, image types, Image histogram Color Fundamentals, Color Models, pixel connectivity, Pseudo color image processing.

Mapping of Course Outcomes for Unit I	CO1: Apply knowledge of mathematics for image understanding and analysis.

Unit II	Image Enhancement in Spatial Domain	(07 Hrs.)

Image enhancement in spatial domain, Basic gray level transformation, histogram processing, enhancement using arithmetic and logic operations, basic spatial filtering, smoothing and sharpening spatial filters, Intensity transformation, contrast stretching, histogram equalization.

Mapping of Course Outcomes for Unit II	CO2: Implement spatial domain image operations.

Unit III	Image Segmentation	(06 Hrs.)
Point, line and edge detection, Thresholding, Regions Based segmentation, Edge linking and boundary detection, Hough transform.		
Mapping of Course Outcomes for Unit III	**CO3: Design and realize various algorithms for image segmentation.**	
Unit IV	**Image Compression**	**(07 Hrs.)**
Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Concept of Discrete Cosine Transform , JPEG Compression standard, Y CB CR transformation, Introduction to MPEG standard ,Motion estimation, compensation, Introduction to video compression.		
Mapping of Course Outcomes for Unit IV	**CO4: Design and realize various algorithms for image compression.**	
Unit V	**Image Restoration**	**(07 Hrs.)**
A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the Fourier transform and the frequency domain, estimating the degradation function.		
Mapping of Course Outcomes for Unit V	**CO5: Apply restoration to remove noise in the image.**	
Unit VI	**Object Recognition**	**(07 Hrs.)**
Object Recognition- patterns and pattern classes, recognition based on decision theoretic methods, structural methods. **Case studies:** Character recognition, Content based image retrieval, image classification, Introduction to Deep learning using CNN.		
Mapping of Course Outcomes for Unit VI	**CO6: Describe the object recognition system.**	

Learning Resources

Text Books:

1. Gonzalez & Woods, “Digital Image Processing”, Pearson Education, 3rd Edition, 2008

2. S Sridhar, “Digital Image Processing”, Oxford University Press, 2nd Edition.

Reference Books:

1. Jain Anil K., “Fundamentals Digital Image Processing”, Prentice Hall India, 4th Edition.
2. Milan Sonka, Vaclav Hlavav, Roger Boyle, “Image Processing, Analysis and Machine Vision”, Thomson Learning, 2nd Edition., 2001
3. Pratt W.K, “Digital Image Processing”, John Wiley & Sons, 3rd Edition, 2007
4. Jayaraman. S, Veerakumar. T, “Digital Image Processing”, McGraw Hill Education, 2nd Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **“Digital Image Processing”**

Link of the Course: **https://nptel.ac.in/courses/117/105/117105079/**

1. NPTEL Course **“Digital Image Processing”**

Link of the Course: **https://nptel.ac.in/courses/106/105/106105032/**

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304195 (B): Sensors in Automation (Elective -II)

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

Prerequisite Courses, if any:

1. Basic Electrical Engineering
2. Basic Electronics Engineering

Companion Course, if any: Sensors in Automation Lab

Course Objectives: To make the students understand about:

- Concept of Sensors/Transducers and their Static and Dynamic Characteristics.
- Sensors used in Industry for Temperature and Humidity Measurement.
- Sensors used for Sensors used for Force, Pressure, Stress and Flow measurements.
- Sensors used for Displacement and Level Measurement.
- Applications of Image and Biosensors.
- Role of Sensors/Transducers in IoT applications.

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

CO1: Understand the Concepts of Sensors/Transducers, classify and evaluate static and Dynamic Characteristics of Measurement Systems.

CO2: Choose the proper sensor comparing different standards and guidelines for measurements of Temperature and Humidity.

CO3: Choose the proper sensor comparing different standards and guidelines for measurements of Force, Pressure, Stress and Flow

CO4: Choose the proper sensor comparing different standards and guidelines for measurements of Displacement, Vibration, Acceleration and Level

CO5: Explore sensors to profound areas like environmental, Agricultural and bio-medical equipment and sustainability.

CO6: Explore IoT based applications of Sensors and Transducers.

Course Contents

Unit I	Introduction to Sensors &Transducers	(06 Hrs.)

Concept of Sensor, Concept of Transducer, Comparison between Sensors and Transducers , Role of Sensors in Automation, Broad Classification of Sensors and Transducers, Role of Transducer in measurement Systems, Block Diagram Measurement system, Study of Static and Dynamic Characteristics of Measurement Systems: Accuracy, Precision, Reproducibility, Linearity, repeatability, resolution, Sensitivity, Range, Span, Dead Zone, Hysteresis, Backlash, Dynamic Characteristics: Fidelity, Time response and frequency response, Classification of errors – Error analysis. Concept and Basic Principle of working of Resistive, Capacitive and Inductive sensors.

Mapping of Course Outcomes for Unit I	CO1: Understand the concepts of Sensors / Transducers, classify and evaluate static and Dynamic Characteristics of Measurement Systems.

Unit II	Sensors for Temperature and Humidity Measurement	(06 Hrs.)

Temperature Measurement: Units of Temperature Measurement / Temp Measurement Scales; Celsius Scale, Fahrenheit Scale, Kelvin Scale, Rankine Scale-Unit Conversions Broad Classification of Temperature Transducers, RTD (e.g.PT-100), Thermocouple, Thermistors, Optical Fiber Sensors.

(Basic Principle of Working, Selection Criteria, Installation and Calibration, Signal Conditioning (e.g Instrumentation Amplifier (with AD-620).

DC bridge: Wheatstone bridges, **AC Bridge:** Wein Bridge, Schering Bridge, Signal Conditioning: 2 Wire, 3-Wire and 4-Wire Compensation.

IR Temperature Sensor: MLX90614 ESF Non-Contact Human Body Infrared Temperature Measurement Module.

Smart temperature and solid state sensors: LM35, AD590 **(Only for real time application/implementation in project based learning)**

Humidity: Hygrometer, Soil Humidity Sensor, Soil Hygrometer (DHT11, TI HDC1050)

Mapping of Course Outcomes for Unit II	CO2: Choose the proper sensor comparing different standards and guidelines for measurements of Temperature and Humidity.

Unit III	Sensors for Force, Pressure, Stress and Flow	(06 Hrs.)

(Basic Principle of Working, Selection Criteria, Installation and Calibration, Signal Conditioning)

- **Pressure scales:** Newton, Bar, Pascal, PSI -Unit Conversions
- Absolute, Gauge and Vacuum Pressure

Classification of Pressure sensors: Strain gauge (Load Cell using Strain gauge), Piezoelectric Transducer, Solid State Pressure Sensors (**IC's like GY-63 MS5611-01BA03 to be discussed**)

Differential Pressure Transducer flow measurement **(only Mention of basic Principle of working, Bernoulli's theorem)**, Orifice, Venturi, Nozzle flow meter **(only Descriptive)**, Pneumatic sensors (bellows, diaphragm), Ultrasonic and Hall effect Sensors for flow Measurement

Solid State Flow Sensors: YF-S201, E8FC-25D, Fiber-Optic Sensors.

Mapping of Course Outcomes for Unit III	**CO3: Choose the proper sensor comparing different standards and guidelines for measurements of Force, Pressure, Stress and Flow.**	
Unit IV	**Sensors for Displacement, Vibration, Acceleration and Level**	**(06 Hrs.)**
(Basic Principle of Working, Selection Criteria, Installation and Calibration, Signal Conditioning) **Classification of Displacement Sensors:** Potentiometer, Strain-gauged element, Capacitive element, Differential transformers, Eddy current proximity sensors, Inductive and Capacitive Proximity switch, Optical encoders. Pneumatic sensors (**Bellows, Diaphragm**), Hall effect sensors, Accelerometer, Gyroscope and Magnetometer (**ADXL335/345**), Electro-Optical Sensors, Position Encoders.		
Mapping of Course Outcomes for Unit IV	**CO4: Choose the proper sensor comparing different standards and guidelines for measurements of Displacement, Vibration, Acceleration and Level.**	
Unit V	**Sensors in Environmental Studies, Bio Sensors**	**(06 Hrs.)**
Charge-Coupled and CMOS Image Sensors, Biosensors Resonant mirror, electrochemical, surface Plasmon resonance, Light addressable Potentio-Metric., Ph Measurement, CMOS MQ-2 Smoke LPG Butane Hydrogen Gas Sensor Detector Module **(MQ-3 Alcohol Detector Gas Sensor Module MQ 135 Air Quality / Gas Detector Sensor Module for Arduino Data Sheet MLX90614 non-contact temperature sensor)**, Camera Sensor Ultrasonic proximity, Colour Sensors, Light Sensors Like Light Dependent Resistance(LDR), Photo Diode, Photo Transistors, RFID sensors, e.g. EM18 module, Applications RFID Sensors, MEMS and NEMS sensors.		
Mapping of Course Outcomes for Unit V	**CO5: Explore sensors to profound areas like environmental, Agricultural and bio-medical equipment and sustainability.**	
Unit VI	**Latest trends in Sensors Applications**	**(07 Hrs.)**
Basic Concept of Data Acquisition Systems (Block Diagram Understanding), Basic Concept of IoT, Sensor Interface in IoT systems. **Case Study 1**: IoT based Agriculture/Greenhouse systems.(Block Diagram) (**Mention of Optical Sensors, Electro-Chemical Sensors, Mechanical Sensors Dielectric Soil Moisture Sensors, Air Flow Sensors may be considered**) **Case Study 2**: IoT based Healthcare Systems.(Block Diagram) (**Mention of ECG Module, Temperature, ,Humidity, Accelerometer, Oxygen Level, Heart Rate sensors**) **Case Study 3**: IoT based Automobile Sector (Engine Management System) (**Mention of Fuel Level, Ignition, Exhaust Sensors**)		
Mapping of Course Outcomes for Unit VI	**CO6: Explore IoT based applications of Sensors and Transducers.**	

Learning Resources

Text Books:

1. Sawhney A. K., "Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai & Sons, 4th Edition, 1994.
2. D. Patranabis, “Sensors and Transducers”, Prentice Hall India Learning Private Limited, 2nd Edition.

Reference Books:

1. Liptak, “Instrument Engineers Handbook Process Control”, Elsevier exclusive; 3rd Edition.
2. John G. Webster, "Instrumentation and Sensors Handbook", CRC Press, 1st Edition, 1999.
3. A. Bahga, V. Madisetti, “Internet of Things A Hands-on Approach” Hands-on Approach Text book, 1st Edition
4. B.C. Nakra, K.K. Chaudhary, “Instrumentation, Measurement and Analysis”, McGraw Hill Education India Private Limited, 4th Edition.
5. C.S. Rangan, G.R. Sarma, V.S.V. Mani, “Instrumentation: Devices and System”, TMH, 2nd Edition, 1983.

MOOC / NPTEL Courses:

1. NPTEL Course **“Sensors and Actuators”**

Link of the course: **https://nptel.ac.in/courses/108/108/108108147/**

Savitribai Phule Pune University

Third Year of E & TC Engineering (2019 Course)

304195 (C): Advanced JAVA Programming (Elective - II)

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

Prerequisite Courses, if any:

1. Fundamentals of Java Programming

Companion Course, if any: Advanced JAVA Programming Lab

Course Objectives: Make the learner to:

- Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
- Design and develop Web applications
- Designing Enterprise based applications by encapsulating an application's business logic.
- Designing applications using pre-built frameworks.

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

CO1: Design and develop GUI applications using Applets.

CO2: Apply relevant AWT/ swing components to handle the given event.

CO3: Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.

CO4: Learn to access database through Java programs, using Java Database Connectivity (JDBC)

CO5: Invoke the remote methods in an application using Remote Method Invocation (RMI)

CO6: Develop program for client /server communication using Java Networking classes.

Course Contents

Unit I	Applet	(06 Hrs.)

Applet Basics – Introduction, limitations of AWT, Applet architecture – HTML APPLET tag – Passing parameter to Appletget, DocumentBase() and getCodeBase() , Japplet: Icons and Labels Text Fields Buttons, Combo Boxes , Checkboxes, Tabbed Panes, Scroll Panes, Trees: Tables

Mapping of Course Outcomes for Unit I	CO1: Design and develop GUI applications using Applets.

Unit II	Event Handling using AWT/Swing components	(08 Hrs.)

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes. The AWT class hierarchy, user interface

components- labels, button, canvas, scrollbars, text components, checkbox, checkbox groups, choices, lists panels – scroll pane, dialogs, menu bar, graphics, layout manager – layout manager types – boarder, grid, flow, card and grib bag.

Mapping of Course Outcomes for Unit II	**CO2: Apply relevant AWT/ swing components to handle the given event.**

Unit III	**GUI Programming**	**(06 Hrs.)**

Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets, Sequence, Map, Understanding Hashing, and Use of Array List & Vector.

Mapping of Course Outcomes for Unit III	**CO3: Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.**

Unit IV	**Database Programming using JDBC**	**(06 Hrs.)**

The Concept of JDBC, JDBC Driver Types & Architecture, JDBC Packages, A Brief Overview of the JDBC process, Database Connection, Connecting to non-conventional Databases Java Data Based Client/server, Basic JDBC program Concept, Statement, Result Set, Prepared Statement, Callable Statement, Executing SQL commands, Executing queries

Mapping of Course Outcomes for Unit IV	**CO4: Learn to access database through Java programs, using Java Database Connectivity (JDBC).**

Unit V	**Remote Method Invocation (RMI)**	**(06 Hrs.)**

Remote Method Invocation: Architecture, RMI registry, the RMI Programming Model; Interfaces and Implementations; Writing distributed application with RMI, Naming services, Naming and Directory Services, Setting up Remote Method Invocation – RMI with Applets, Remote Object Activation; The Roles of Client and Server, Simple Client/Server Application using RMI.

Mapping of Course Outcomes for Unit V	**CO5: Invoke the remote methods in an application using Remote Method Invocation (RMI)**

Unit VI	**Networking**	**(08 Hrs.)**

The java.net package, Connection oriented transmission – Stream Socket Class, creating a Socket to a remote host on a port (creating TCP client and server), Simple Socket Program Example.

InetAddress, Factory Methods, Instance Methods, Inet4Address and Inet6Address, TCP/IP Client Sockets. URL, URLConnection, HttpURLConnection, The URI Class, Cookies, TCP/IP Server Sockets, Datagrams, DatagramSocket, DatagramPacket, A Datagram Example.

Connecting to a Server, Implementing Servers, Sending EMail, Servlet overview – the Java web server – The Life Cycle of a Servlet, your first servlet.	
Mapping of Course Outcomes for Unit VI	**CO6: Develop program for client /server communication using Java Networking classes.**

Learning Resources

Text Books:

1. Herbert Schildt, "Java: The complete reference", Tata McGraw Hill, 7th Edition
2. Jim Keogh, "Complete Reference J2EE" , Enterpr
3. E. Balaguruswamy, "Programming with JAVA: A Primer" McGraw Hill Education, India, 5th Edition.

Reference Books:

1. "Java 6 Programming", Black Book, Dreamtech
2. "Java Server Programming, Java EE6 (J2EE 1.6)", Black Book, Dreamtech
3. M.T. Savaliya,"Advanced Java Technology", Dreamtech

MOOC / NPTEL Courses:

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

Link of the Course: **https://nptel.ac.in/courses/106/105/106105191/**

2. Udemy course **"Advanced Java Programming"**

Link of the Course: **https://www.udemy.com/course/advanced-java-programming**

Savitribai Phule Pune University

Third Year of E & TC Engineering (2019 Course)

304195 (D): Embedded Processors (Elective - II)

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

Prerequisite Courses, if any:

1. Digital Systems
2. Microcontrollers

Companion Course, if any: Embedded Processors Lab

Course Objectives:

- To make the students aware of the need of Embedded C and programming in Embedded C.
- To get the students acquainted with the need and applications of ARM Microprocessors in Embedded systems.
- To get insight of architecture and features of ARM 7 and ARM CORTEX M4 microcontroller.
- To enhance the capabilities of students to interface of various I/O devices, sensors and communication devices.

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

CO1: Understand basics of Embedded C Programming and usage of Embedded C and study different software tools for programming microcontrollers.

CO2: Get acquainted with various Embedded Processor architectures related to industrial application.

CO3: Know about the programming of ARM 7 based microcontroller with on chip peripherals and external peripherals.

CO4: Understand the architectures of ARM Cortex M4 Microcontrollers and its advantages over ARM 7 Microcontrollers.

CO5: Implement the real world programming of ARM 7 based microcontroller with on chip peripherals and external peripherals.

CO6: Recognize the interfacing of real world sensors and standard buses. Will also able to design different case studies.

Course Contents

Unit I	Embedded Processor Fundamentals	(06 Hrs.)

Programming in Embedded C: Using C for Embedded C, data types, storage class, operators, Branching: if, else-if, Looping: for, while, do-while.

Embedded System Development Environment: IDE (Introduction) types of file generated on cross-compilation, assembler, disassembler, Simulators and Debuggers.

Embedded System definition, Embedded Processor definition and classification, The RISC and CISC, von Neumann and Harvard Architecture, ARM processors and its versions, features of ARM Processor Families: ARM7, ARM9 & ARM11, ARM Design Philosophy.

Mapping of Course Outcomes for Unit I	**CO1: To understand basics of Embedded C Programming and usage of Embedded C and study different software tools for programming microcontrollers.**

Unit II	ARM7 Based Microcontroller	(08 Hrs.)

ARM core data flow model, Programmers model, Registers, CPSR and SPSR, Processor modes, ARM Nomenclature.

LPC2148: Features, Block Diagram and Description, System Control Block, Memory Map, System Control Block (PLL and VPB divider), Pin Connect Block, GPIO, Timer Block for Delay Generation, LPC 2148 Interfacing with LED, Switches, Relay, Interfacing LCD and keypad.

Mapping of Course Outcomes for Unit II	**CO2: To get acquainted with various Embedded Processor architectures related to industrial application.**

Unit III	Real World Interfacing with ARM7 Based Microcontroller	(06 Hrs)

UART Programming for transmission and reception of characters, Interfacing the peripherals to LPC2148: GSM and GPS using UART, on-chip ADC using interrupt (VIC), EEPROM using I2C, on-chip DAC for waveform generation, Interfacing with ARM 7 with DHT 11 sensor and servomotor.

Mapping of Course Outcomes for Unit III	**CO3: To Know about the programming of ARM 7 based microcontroller with on chip peripherals and external peripherals.**

Unit IV	Introduction to ARM CORTEX M4 Based Microcontroller	(08 Hrs)

Introduction to ARM CORTEX series: CORTEX A, R, M processors**,** Firmware development using CMSIS Standard. Introduction to ARM CORTEX M4 microprocessor core, programmer model, Processor Modes, Memory Map, Introduction Arm Cortex-M cores, STM32F4xx Architecture, ARM STM Bus Architecture, STM32F4xx Clock and SYSCLK, Peripheral Clock, PLL clock, Interrupts and Exceptions in STM32F4xx.

Mapping of Course Outcomes for Unit IV	**CO4: To understand the architectures of ARM Cortex M4 Microcontrollers and its advantages over ARM 7 Microcontrollers.**

Unit V	Real World Interfacing with Cortex M4 Based Microcontroller	(06 Hrs.)
GPIO Programming, Interfacing seven segment LED, LDR and MQ3 sensor with STM32F4xx, STM32F4xx: Counters and Timers: Timer and Delay Generation, UART Programming, on chip ADC and On-chip DAC for waveform generation.		
Mapping of Course Outcomes for Unit V	**CO5: Implement the real world programming of ARM 7 based microcontroller with on chip peripherals and external peripherals.**	
Unit VI	**Case Studies with Cortex M Based Microcontroller**	**(06 Hrs.)**
STM32F4xx Interfacing with accelerometer MPU 6050, Ultrasonic Sensor HC-SR04, PWM: Controlling speed and direction of DC Motor CAN Bus: Features, CAN Frame, sequence of transmitting and receiving data on CAN Bus.		
Mapping of Course Outcomes for Unit VI	**CO6: To become aware of the interfacing of real world sensors and standard buses. Will also able to develop embedded application using different case studies.**	

Learning Resources

Text Books:

1. K.V. Shibu, "Introduction to Embedded Systems", McGraw Hill Education India Private Limited, 2nd Edition
2. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide – Designing and Optimizing System Software", Elsevier, 1st Edition.
3. Shujen Chen, Muhammad Ali Mazidi, Eshragh Ghaemi, "STM32 Arm Programming for Embedded Systems: Using C Language with STM32", Nucleo, Micro DigitalEd., Illustrated Edition,2018.

Reference Books:

1. UM10139 LPC214x User manual, NXP Semiconductor
2. RM0390 Reference manual, STM32F446xx advanced Arm®-based 32-bit MCUs
3. Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes, 3rd Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"ARM Based Development"**, video course

   Link of the Course: **https://nptel.ac.in/courses/117/106/117106111/**

2. NPTEL Course on **" Embedded System Design with ARM", video course**

   Link of the Course: **https://nptel.ac.in/courses/106/105/106105193/**

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304195 (E): Network Security (Elective-II)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 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 introduce various network models, security threats and attacks and fundamentals of network security.

- To imbibe good foundation of network security in students for implementation of new network security algorithms.
- To understand different network models and the protocols used in each layer.
- To acquire detailed approach of encryption decryption for the data to transmit.
- To understand the role of network security as a tool for protection of different network entities.
- To be able to accurately apply security algorithms to real world security issues.
- To ensure windows and web browser security through implementation of various encryption standards.

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

CO1: Analyze attacks on computers and computer security.

CO2: Demonstrate knowledge of cryptography techniques.

CO3: Illustrate various Symmetric and Asymmetric keys for Ciphers

CO4: Evaluate different Message Authentication Algorithms and Hash Functions

CO5: Get acquainted with various aspects of E-Mail Security

CO6: Assimilate various aspects of Web Security

Course Contents

Unit I	Attacks on Computers and Computer Security	(06 Hrs.)

Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security

Mapping of Course Outcomes for Unit I	CO1: Analyze attacks on computers and computer security.

Unit II	Cryptography-Concepts and Techniques	(06 Hrs.)

Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, stenography, key range and key size, possible types of attacks.

Mapping of Course Outcomes for Unit II	**CO2: Demonstrate knowledge of cryptography techniques.**	
Unit III	**Symmetric and Asymmetric key for Ciphers**	**(08 Hrs.)**
Block Cipher principles & Algorithms (DES, AES, Blowfish), Differential and Linear Crypt analysis, Block cipher modes of operation, Stream ciphers, RC4, Location and placement of encryption function, Key distribution, Asymmetric key Ciphers, Principles of public key crypto systems, Algorithms (RSA, Diffie-Hellman, ECC), Key Distribution.		
Mapping of Course Outcomes for Unit III	**CO3: Illustrate various Symmetric and Asymmetric keys for Ciphers.**	
Unit IV	**Message Authentication Algorithms and Hash Functions**	**(07 Hrs.)**
Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm, HMAC, CMAC, Digital signatures, knapsack algorithm, Authentication Applications such as Kerberos, X.509 Authentication Service, Public – Key Infrastructure, Biometric Authentication.		
Mapping of Course Outcomes for Unit IV	**CO4: Evaluate different Message Authentication Algorithms and Hash Functions.**	
Unit V	**E-Mail Security**	**(06 Hrs.)**
Pretty Good Privacy, S/MIME, IP security overview, IP Security architecture, Authentication Header, Encapsulating , Security payload, Combining security associations, Key management		
Mapping of Course Outcomes for Unit V	**CO5: Get acquainted with various aspects of E-Mail Security**	
Unit VI	**Web Security**	**(07 Hrs.)**
Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction, Intruders, Intrusion detection, password management, virus and related threats, Countermeasures, Firewall design principles, types of firewalls, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual E lections.		
Mapping of Course Outcomes for Unit VI	**CO6**: Assimilate various aspects of Web Security	

Learning Resources

Text Books:

1. William Stallings , “Cryptography and Network Security” ,Pearson Education, 4th Edition
2. Atul Kahate, “Cryptography and Network Security”, McGraw Hill, 3rd Edition.
3. C K Shymala, N Harini, Dr. T R Padmanabhan, “Cryptography and Network Security”, Wiley India,1st Edition.

Reference Books:

1. Forouzan Mukhopadhyay, “Cryptography and Network Security”, Mc Graw Hill, 2nd Edition.
2. Mark Stamp, “Information Security, Principles and Practice”, Wiley India, 2nd Edition.
3. W.M. Arthur Conklin, Greg White, “Principles of Computer Security”, TMH, 4th Edition.
4. Neal Krawetz, “Introduction to Network Security”, CENGAGE Learning Distributor, 1st Edition.
5. Bernard Menezes, “Network Security and Cryptography”, CENGAGE Learning Distributor, 1st Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **“Introduction to Cyber Security ”**

   Link of the Course: https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

2. NPTEL Course “**Information Security – 5 – Secure Systems Engineering**”

   Link of the Course: https://nptel.ac.in/courses/106/106/106106199/

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304196: Cellular Networks Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Oral: 50 Marks**
Prerequisite Courses, if any: -		
Companion Course, if any: Cellular Networks		

List of Laboratory Experiments	
Group A (Expt. 1 is compulsory and any two from Expt. 2 to 4)	
1.	Compute and compare the median loss by employing Hata model for various distance for carrier frequencies of 2.1 GHz and 6 GHz. Assume transmit and receive antenna heights of 40 m and 2 m in a large city. Plot the graph of path loss vs distance.
2.	Simulate BER performance over a Rayleigh fading wireless channel with BPSK transmission for SNR: 0 to 50 dB.
3.	Simulate BER performance over a wireline AWGN channel with BPSK transmission for SNR: 0 to 50 dB.
4.	Estimate fading channel coefficient in AWGN for given transmitted pilot symbols and received outputs across the standard Rayleigh fading wireless channel (Single Rx/Tx antenna).
5.	Compute the RMS delay spread for a given Power profile and plot the graph of Power vs Delay.
Group B (Expt. 6 is compulsory and any two from Expt. 7 to 10)	
6.	Perform a Link-Budget analysis for a wireless communication system.
7.	Simulate BER performance of multi-antenna Rayleigh channel for SNR varying from 0 to 60 dB.
8.	Simulate and Compute minimum spacing required between the antenna for independent fading channels against operating carrier frequency bands for every generation of mobile standards.
9.	Estimate channel coefficient vector Multi-Antenna Systems.
10.	Compute doppler shift of the received signal for different carrier frequency of mobile generations by considering vehicle is moving at 60 miles per hour at an angle of 30 degree with the line joining the base station.
Group C (Expt. 11 is compulsory and any two from Expt. 12 to 15)	
11.	Simulate mobile environment to evaluate performance parameters using any open source Network Simulator tool.
12.	Bread-board implementation to demonstrate and evaluate performance metrics of loss system
13.	Program to implement OFDM and evaluate frame error rate against SNR
14.	Program to understand Scheduling Mechanism for resource sharing
15.	Simulate a cellular system with 48 channels per cell and blocking probability of 2%. Assume traffic per user is 0.04 E. What is the number pf users that can be supported in a city of 603 km^2 area if cell radios are changed in the steps of 500 m, 700m, 900 m, 1000 m 1200 m and 1500 m
Virtual LAB Links:	

1. **Link of the Virtual Lab:**

Fading Channels: **http://www.vlab.co.in/ as**

2. **Link of the Virtual Lab:**

Mobile Communications: **http://fcmcvlab.iitkgp.ac.in**

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304197: Power Devices & Circuits Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 50 Marks**
Prerequisite Courses, if any: 1. Electrical Circuit Laboratory 2. Electronic Circuit Laboratory		
Companion Course, if any: Power Devices & Circuits		

List of Laboratory Experiments

Group A (All Compulsary)	
1.	VI Characteristics of SCR i) Plot output V-I characteristics to measure I_H, I_L and voltage before and after breakdown , ii) Observe the effect of gate current on forward break down iii) gate characteristics iv) compare with datasheet specifications
2.	V-I Characteristics of Power MOSFET i) Plot output characteristics and calculate output resistance ii) Plot transfer characteristics and measure threshold voltage iii) compare with datasheet specifications
3.	V-I Characteristics of IGBT i) Plot output characteristics and calculate output resistance ii) Plot transfer characteristics and measure threshold voltage iii) compare with datasheet specifications
Group B (Any 2)	
6.	Single phase Full Converter using IGBT / SCR with R & R-L load i) Observe load voltage waveform, ii) Measurement of average o/p voltage across loads, iii) Verification of theoretical values with practically measured values.
8.	Single-Phase PWM Power MOSFET / IGBT based bridge inverter for R and motor load i) Observe output voltage waveforms and measure set of rms output voltage for varying pulse width and variable input dc voltage for R and motor load, ii) compare measured output voltages with the theoretical findings
9.	Step down / Step up chopper using power MOSFET / IGBT i) Measure duty cycle and observer effect on average load voltage for DC chopper
Group C (Any 4)	
11.	SMPS /UPS Performance Evaluation i) find load & line regulation characteristics for no load condition and at 500 mA & 1A load ii) compare the performance with supplier specifications
12.	Single phase AC voltage controller using IGBT/SCR for R and RL load i) Observe output rms voltage waveforms, ii) Measurement output voltage across load, iii) Verification of theoretical values with practically measured values. Or Simulation of the Single phase AC voltage controller using Powersim / any open source circuit simulation software

13.	To study speed control of DC / single phase AC motor
14.	To design and implement a solar cell operated emergency lighting system.
15.	To study battery testing, safety and maintenance of batteries
• **Visit to solar power generation plant is recommended**	

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304198 (A): Digital Image Processing Lab (Elective - II)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 25 Marks**

Prerequisite Courses, if any: -

Companion Course, if any: Digital Image Processing

NOTE:

1.Use the MATLAB / SCILAB / Open CV.

2. For Group A recommended not to use inbuilt functions

List of Laboratory Experiments

Group A (All Compulsory)

1.	Introduction to Image Processing Toolbox/ CVIP tools (MATLAB/SCILAB/Open CV)
2.	Perform the following basic operations on image a. Obtain Negative image b. Obtain Flip image
3.	(a) Implement Gray level slicing (intensity level slicing) in to read cameraman image. (b) Read an 8 bit image and to see the effect of each bit on the image. (c) Read an image and to extract 8 different planes i.e. 'bit plane slicing."
4.	Implement various Smoothing spatial filter.
5.	Perform the following basic operations on image: a. Point Detection b. Line Detection c. Edge Detection d. Thresholding
6	Implement and study the effect of Different Mask (Sobel, Prewitt and Roberts)

Group B (Any Two)

7.	Implement region based segmentation.
8.	Implement Image compression using DCT Transform.
9.	Implement various noise models and their Histogram.
10.	Read an image, plot its histogram then do histogram equalization. Comment about the result.

Group C (Any One)	
11.	Implement inverse filter and wiener filter over image and comment on them.
12.	Implement Huffman coding algorithm for image compression.
14.	Implement wiener filter over image and comment on them.

Virtual LAB Links:

Link of the Virtual Lab: https://cse19-iiith.vlabs.ac.in/

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304198 (B): Sensors in Automation Lab (Elective - II)

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 hrs. / week	01	Practical: 25 Marks

Prerequisite Courses, if any: -
1. Basic Electronics Engineering
2. Basic Electrical Engineering

Companion Course, if any: Sensors in Automation

List of Laboratory Experiments

Group A (Any Five)

1.	Temperature Measurement using appropriate sensor (Thermocouple/RTD).
2.	Weight Measurement using Load Cell.
3.	Liquid Level using Capacitive Sensor.

NOTE: Observe and plot Input/ Output characteristics, Hysteresis, and Sensitivity in above experiments.

4.	Position control using Servomechanism using photoelectric pickups.
5.	Moisture Measurement using appropriate Sensor and plot its static characteristics.

Group B (Any Two)

6.	To measure speed of a rotating shaft using appropriate sensor, plot the measurement characteristics.
7.	R - Color Sensing using appropriate sensor.
8.	To measure acceleration and orientation (x,y,z axis) using MEMS gyro/accelerometer sensor such as ADXL335.
9.	Simulate the performance of chemical sensor (PH).

Group C (Any Two)

10.	Acquisition of Minimum 2 Sensor Data using a Data Acquisition Systems
11.	Temperature Measurement using IR Detector
12.	Heart rate measurement using appropriate sensor
13.	Simulate the performance of Biosensor

Virtual LAB Links:

1. https://slcoep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering

2. http://uorepc-nitk.vlabs.ac.in/index.html

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University Third Year of E & TC Engineering (2019 Course) 304198 (C): Advanced JAVA Programming Lab (Elective – II)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 25 Marks**

Prerequisite Courses, if any:
1.Fundamentals of Java Programming

Companion Course, if any: Advanced JAVA Programming

List of Laboratory Experiments

Group A (All are Compulsory)

1.	Write a program to demonstrate status of key on an Applet window such as KeyPressed, KeyReleased, KeyUp, KeyDown.
2.	Write a program to create a frame using AWT. Implement mouseClicked, mouseEntered() and mouseExited() events. Frame should become visible when the mouse enters it.
3.	Develop a GUI which accepts the information regarding the marks for all the subjects of a student in the examination. Display the result for a student in a separate window.
4.	Write a program to insert and retrieve the data from the database using JDBC.
5.	Develop an RMI application which accepts a string or a number and checks that string or number is palindrome or not.
6.	Write a program to demonstrate the use of InetAddress class and its factory methods.

Group B (Any Two)

7.	A. Write Servlet (procedure for client side) to display the username and password accepted from the client. B. Write Servlet (procedure for server side) to display the username and password accepted from the client.
8.	Write program with suitable example to develop your remote interface, implement your RMI server, implement application that create your server, also develop security policy file.
9.	Write a database application that uses any JDBC driver.

Group C (Any Two)

10.	Write a simple JSP page to display a simple message (It may be a simple html page).
11.	Create login form and perform state management using Cookies, HttpSession and URL Rewriting.
12.	Create a simple calculator application using servlet.
13.	Create a registration servlet in Java using JDBC. Accept the details such as Username, Password, Email, and Country from the user using HTML Form and store the registration details in the database.

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304198 (D): Embedded Processors Lab (Elective – II)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 25 Marks**
Prerequisite Courses, if any: -		
Companion Course, if any: Embedded Processors		

List of Laboratory Experiments

Group A (Any Three)	
1.	Interfacing 16 X 2-character LCD display and Keypad with ARM LPC 2148 Microcontroller to display the key pressed.
2.	Write embedded C program to use timer block of LPC 2148 along with Switches to generate suitable delay to toggle LEDs.
3.	To generate different waveforms using on-chip DAC for LPC 2148.
4.	Use on-chip ADC to read the analog value and display digital value on LCD for LPC 2148.
5.	Interfacing GPS with UART using LPC 2148
Group B (Any Three)	
6.	Interfacing Seven Segment LED using STM32F4xx
7.	Write embedded C program to Transmit a character from keyboard using on chip UART for STM32F4xx.
8.	Write embedded C program to on chip ADC implementation with STM32F4xx
9.	To control speed and direction of DC Motor using PWM Block for STM32F4xx.
Group B (Any Two)	
10.	Interfacing DHT11 with LPC2148.
11.	Interfacing accelerometer cum Gyroscope MPU 6050 with STM32F4xx.
12.	Interfacing Ultrasonic Sensor HC-SR04 with STM32F4xx.
13.	Interfacing LDR and MQ3 sensor with STM32F4xx

Virtual LAB Links:

Link of the Virtual Lab: http: // vlabs.iikgp.ernet.in/rtes/

Note: Additional 2 experiments to be performed using the virtual lab

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304198 (E): Network Security Lab (Elective – II)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 25 Marks**

Prerequisite Courses, if any: -

Companion Course, if any: Network Security

	Group A (Any Three)
1.	Design and implement for the insecurity of default passwords, printed passwords and password transmitted in plain text.
2.	Write a program for Encryption and Decryption.
3.	Write a program to perform encryption and decryption using the following algorithms: Ceaser Cipher, Substitution Cipher http://vlabs.iitb.ac.in/bootcamp/labs/dbms/exp13/
4.	Write a program to implement digital Signature http://cse29-iiith.vlabs.ac.in/
	Group B (Any Two)
6.	Isolating WLAN traffic using separate firewall for VPN connection
7.	Study of different wireless network components and features of any one of the Mobile Security Apps
8.	Implementation of Symmetric and Asymmetric cryptography
9.	Implementation of Steganography
	Group C (Any Three)
10.	Implementation of DES http://cse29-iiith.vlabs.ac.in/
11.	Implementation of AES http://cse29-iiith.vlabs.ac.in/
12.	Implementation of Windows security using firewall and other tools
13.	Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)
14.	Implementation of Hash functions http://cse29-iiith.vlabs.ac.in/

Virtual LAB Links:

Links of the Virtual Lab:

http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Byte_Karma/index.html

Note: Additional 2 experiments to be performed using the virtual lab

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304199: Internship		
Teaching Scheme:	**Credit**	**Examination Scheme:**
**	04	Term Work: 100 Marks

Course Objective:

- Expose Students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Expose students to the engineer's responsibilities and professional ethics from social, economic and administrative view.
- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

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

CO1: To develop professional competence through internship.

CO2: To apply academic knowledge in a personal and professional environment.

CO3: To build the professional network and expose students to future employees.

CO4: Apply professional and societal ethics in their day to day life.

CO5: To become a responsible professional having social, economic and administrative considerations.

CO6: To make own career goals and personal aspirations.

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment, practices and culture. Internship is structured, short-term, supervised training often focused on particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic, and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply theoretical knowledge from academics to the realities of the field work/training. The following

guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

A. Duration:

Internship to be completed after semester 5 and before commencement of semester 6 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 6.

B. Framework of Internship:

- ✓ During the vacation after 5th semester, students are ready for industrial experience.
- ✓ Every student is required to prepare a file containing documentary proofs of the activities done by him. The evaluation of these activities will be done by Programmed Head / Cell In-charge / Project Head / TPO / faculty mentor or Industry Supervisor.
- ✓ Student can take internship work in the form of the following but not limited to:
- ✓ Working for consultancy / research project undertaken by department/Institute
- ✓ Development of VLABs
- ✓ Contribution or internship at Incubation/ Innovation /Entrepreneurship / Institutional Innovation Council /Start-up cells of the institute/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises/IPR/Rural internships to make themselves ready for industry
- ✓ Development of new product / Business plan / registration of start – up.
- ✓ Internship through Internshala.
- ✓ Research internship under Professors at institutes of National importance such as IISc's, IIT's, Research Organizations etc.
- ✓ Participate in Open Source development.

C. Internship Guidelines:

a) Guidelines to the Institute:

Department will arrange internship for students in industries / organization after fifth semester or as per AICTE/ affiliating University guidelines & managing internships. The general procedure for arranging internship is given below:

Step 1: Request Letter/ Email should go to industry to allot various slots of 4-6 weeks as internship periods for the students. Students request letter /profile / interest areas may be submitted to industries for their willingness for providing the training.

Step 2: Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students.

Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

Step 4: Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department.

Step 5: Students will submit training report after completion of internship.

Step 6: Training Certificate to be obtained from industry.

Step 7: List of students who have completed their internship successfully will be issued by Training and Placement Cell.

b) Guidelines to the students:

Any absenteeism by students during their internship should be informed immediately to the mentor/reporting manager and the internal guide. No special considerations will be accepted. Students cannot take leave for college work or fest activities. The leave permission for any college related activities will be solely approved by the HOD. The monthly attendance format should be duly submitted to the internal guide by the intern.

c) Internal reporting Guidelines:

Every intern should send weekly report to their internal guide without fail. It is mandatory for the intern to send weekly reports to their respective guide on regular basis. Interns should have at least fortnightly verbal communication with the internal guide without fail. In cases where in the company wants to secure their confidential information in the project / internship report, the internal guide should duly co-ordinate with the respective mentor/reporting manager on the method of reporting to assure that no information will be leaked outside and is purely for academic purposes.

d) Internship Diary / Internship Workbook:

Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary account of the observations, impressions, information gathered and suggestions given, if any. The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working.

Internship Diary/workbook and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. Internship Diary / workbook may be evaluated on the basis of the following criteria:

- Proper and timely documented entries.
- Adequacy & quality of information recorded
- Data recorded.

- Thought process and recording techniques used.
- Organization of the information.

e) Internship Work Evaluation:

Every student is required to prepare a maintain documentary proofs of the activities done by him / her as internship diary or as workbook. The evaluation of these activities will be done by Programme Head/ Cell In-charge / Project Head / faculty mentor or Industry Supervisor based on-overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External - a supervisor from place of internship).

f) Evaluation through Seminar presentation / Viva-voce at the institute:

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- ✓ Depth of knowledge and skills Communication & Presentation Skills.
- ✓ Team Work
- ✓ Creativity
- ✓ Planning & Organizational skills
- ✓ Adaptability and Analytical Skills
- ✓ Attitude & behavior at work.
- ✓ Societal Understanding
- ✓ Ethics
- ✓ Regularity and punctuality
- ✓ Attendance record
- ✓ Log book
- ✓ Student's Feedback from External Internship Supervisor

g) Internship Report:

The report shall be presented covering following recommended fields but limited to:

- ➢ Title/Cover Page
- ➢ Internship completion certificate.
- ➢ Internship Place Details- Company background-organization and activities/Scope and object of the study / personal observation.
- ➢ Index/Table of Contents
- ➢ Introduction
- ➢ Title/Problem statement/objectives
- ➢ Motivation/Scope and rationale of the study

- Methodological details
- Results / Analysis /inferences and conclusion
- Suggestions / Recommendations for improvement to industry, if any
- Attendance Record
- List of reference (Library books, magazines and other sources)

h) Feedback from internship supervisor (External and Internal):

Post internship, faculty coordinator should collect feedback about student with following recommended parameters:

- ✓ Technical knowledge
- ✓ Discipline
- ✓ Punctuality
- ✓ Commitment
- ✓ Willingness to do the work
- ✓ Communication skill
- ✓ Individual work

Savitribai Phule Pune University **Third Year of E & Tc Engineering (2019 Course)** **304200: Mini Project**		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 04 hrs. / week	**02**	**Term Work: 25 Marks** **Oral: 50 Marks**

Course Objectives:

- To understand the ―Product Development Process‟ including budgeting through Mini Project.
- To plan for various activities of the project and distribute the work amongst team members.
- To inculcate electronic hardware implementation skills by -
- Learning PCB artwork design using an appropriate EDA tool.
- Imbibing good soldering and effective trouble-shooting practices.
- Following correct grounding and shielding practices.
- To develop student‘s abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.
- To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.

Course Outcome:

On completion of the course, student will be able to

CO1: Understand, plan and execute a Mini Project with team.

CO2: Implement electronic hardware by learning PCB artwork design, soldering techniques, testing and troubleshooting etc.

CO3: Prepare a technical report based on the Mini project.

CO 4: Deliver technical seminar based on the Mini Project work carried out.

A) Execution of Mini Project

- Project group shall consist of **not more than 3** students per group.
- Mini Project Work should be carried out in the Design / Projects Laboratory.
- Project designs ideas can be necessarily adapted from recent issues of electronic design magazines Application notes from well known device manufacturers may also be referred.
- Use of Hardware devices/components is mandatory.
- Layout versus schematic verification is mandatory.
- Bare board test report shall be generated.
- Assembly of components and enclosure design is mandatory.

B: Selection: Domains for projects may be from the following, but not limited to:

- Instrumentation and Control Systems
- Electronic Communication Systems
- Biomedical Electronics
- Power Electronics
- Audio , Video Systems
- Embedded Systems
- Mechatronic Systems

- Microcontroller based projects should preferably use Microchip PIC controllers / ATmega controller / AVR microcontrollers / Ardino / Rasberry Pi.

C. Monitoring: (for students and teachers both): Suggested Plan for various activities to be monitored by the teacher.

Week 1 & 2: Formation of groups, Finalization of Mini project & Distribution of work.

Week 3 & 4: PCB artwork design using an appropriate EDA tool, Simulation.

Week 5 to 8: PCB manufacturing through vendor/at lab, Hardware assembly, programming (if required) Testing, Enclosure Design, Fabrication etc

Week 9 & 10: Testing of final product, Preparation, Checking & Correcting of the Draft Copy of Report

Week 11 & 12: Demonstration and Group presentations.

Log book for all these activities shall be maintained and shall be produced at the time of examination.

D. Report writing: A project report with following contents shall be prepared:

- Title
- Specifications
- Block Diagram
- Circuit Diagram
- Selection of components, calculations
- Simulation Results
- PCB Art work
- Testing Procedures
- Enclosure Design
- Test Results & Conclusion
- References

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304191 (B): Mandatory Audit Course - 6		
Teaching Scheme:	**Credit**	**Examination Scheme:**
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List of Courses to be opted (Any one) under Mandatory Audit Course 6

- Patent Law for Engineers and Scientists
- English language for competitive exams
- Energy Resources, Economics and Environment
- Principles of Human Resource Management
- Six Sigma
- Non-Conventional Energy Resources

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory 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 the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

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:

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 www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

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.
- 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, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.

Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

B.E (Electronics & Telecommunication Engineering)

(Course 2019)

(w.e.f. June 2022)

Savitribai Phule Pune University, Pune
B.E. (Electronics & Telecommunication) 2019 Course
(With effect from Academic Year 2022-23)

Semester-VII

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
404181	Radiation & Microwave Theory	03	-	-	30	70	-	-	-	100	03	-	-	03
404182	VLSI Design and Technology	03	-	-	30	70	-	-	-	100	03	-	-	03
404183	Cloud Computing	03	-	-	30	70	-	-	-	100	03	-	-	03
404184	Elective - 3	03	-	-	30	70	-	-	-	100	03	-	-	03
404185	Elective - 4	03	-	-	30	70	-	-	-	100	03	-	-	03
404186	Lab Practice - 1 (RMT & Cloud Computing)	-	04	-	-	-	25	-	50	75	-	02	-	02
404187	Lab Practice - 2 (VLSI Design & Elective -3)	-	04	-	-	-	25	50	-	75	-	02	-	02
404188	Project Stage - I	-	02	-	-	-	50	-	-	50	-	01	-	01
404189	Mandatory Audit Course 7	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**10**	**-**	**150**	**350**	**100**	**50**	**50**	**700**	-	-	-	-
	Total Credits										**15**	**05**	**-**	**20**

Elective - 3	Elective - 4
1. Speech Processing	1. Data Mining
2. PLC SCADA & Automation	2. Electronic Product Development
3. JAVA Script	3. Deep Learning
4. Embedded & RTOS	4. Low Power CMOS
5. Modernized IoT	5. Smart Antennas

Mandatory Audit Course - 7
1. Management Information System
2. Patent Search & Analysis
3. Knowledge Management
4. Energy Economics & Policy
5. Educational Leadership
6. Human Resource Development

Savitribai Phule Pune University, Pune
B.E. (Electronics & Telecommunication) 2019 Course
(With effect from Academic Year 2022-23)

Semester-VIII

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
404190	Fiber Optic Communication	03	-	-	30	70	-	-	-	100	03	-	-	03
404191	Elective - 5	03	-	-	30	70	-	-	-	100	03	-	-	03
404192	Elective - 6	03	-	-	30	70	-	-	-	100	03	-	-	03
404193	Innovation & Entrepreneurship	-	-	02	-	-	50	-	-	50	-	-	02	02
404194	Digital Business Management	-	-	02	-	-	50	-	-	50	-	-	02	02
404195	Fiber Optic Lab	-	02	-	-	-	25	-	50	75	-	01	-	01
404196	Lab Practice - 3 (Elective - 5)	-	02	-	-	-	25	50	-	75	-	01	-	01
404197	Project Stage - II	-	10	-	-	-	100	-	50	150	-	05	-	05
	Total	**09**	**14**	**04**	**90**	**210**	**250**	**50**	**100**	**700**	**-**	**-**	**-**	**-**
									Total Credits		**09**	**07**	**04**	**20**

Elective - 5	Elective - 6
1. Biomedical Signal Processing	1. System on Chip
2. Industrial Drives & Automation	2. Nano Electronics
3. Android Development	3. Remote Sensing
4. Embedded System Design	4. Digital Marketing
5. Mobile Computing	5. Open Elective

Program Outcomes (PO's)	
Engineering Graduates will be able to:	
1.	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2.	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3.	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4.	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of theinformation to provide valid conclusions.
5.	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6.	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant tothe professional engineering practice.
7.	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and needfor sustainable development.
8.	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9.	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10.	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11.	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12.	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

SEMESTER - VII

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404181: Radiation and Microwave Theory

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Electromagnetic Field Theory

Companion Course, if any:

1. Lab Practice – 1

Course Objectives:

1. To introduce fundamental theory of radiation and microwaves.
2. To understand theory of passive and active components of microwave systems.
3. To know the characteristics of various microwave solid state active devices.
4. To learn microwave measurement techniques.

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

CO1: Apply the fundamentals of electromagnetic to derive free space propagation equation and distinguish various performance parameters of antenna.

CO2: Identify various modes in the waveguide. Compare: coaxial line, rectangular waveguides & striplines and identify applications of the same.

CO3: Explore construction and working of principles passive microwave devices/components.

CO4: Explore construction and working of principles active microwave devices/components.

CO5: Analyze the structure, characteristics, operation, equivalent circuits and applications of various microwave solid state active devices.

CO6: Know the various microwave systems, device set ups of microwave measurement devices and Identify the effect of radiations on environmental sustainability.

Course Contents

Unit I	Fundamental Theory of Radiation and Radiating Elements	6 Hrs.

Fundamental equations for free space propagation, Friis transmission equation, Definition of antenna, radiation mechanism and types of antenna, performance parameters such as radiation pattern, directivity, gain, efficiency, half power beam width, bandwidth, polarization, input impedance, radiation efficiency, effective length, effective area, radiation sphere.

Mapping of Course Outcomes for Unit I	**CO1: Apply** the fundamentals of electromagnetic to derive free space propagation equation and distinguish various performance parameters of antenna.

Unit II	Transmission Lines and Waveguides	6 Hrs.
Introduction to microwaves, short history of microwave engineering, frequency band definitions, advantages and applications of microwaves (overall applications). Introduction to wave guides, advantages of waveguides, comparison of waveguides and co-axial cables, Rectangular waveguides, modes of propagation in waveguides, cut off frequency, dominant mode, waveguide characteristics and parameters, excitation in waveguides, coupling methods (probe, slot, loop), application of re-entrant cavities, coupling of cavities, Striplines: Structural details, types and applications.		
Mapping of Course Outcomes for Unit II	**CO2: Identify various modes in the waveguide. Compare: coaxial line, rectangular waveguides & striplines and identify applications of the same.**	
Unit III	**Passive Microwave Components**	**6 Hrs.**
Construction, working principle and scattering analysis of passive microwave components such as E-plane, H-plane and magic tee. Ferrite composition, characteristics and Faraday rotation principle. Construction, working principle and scattering analysis of isolator, circulator and directional coupler. Construction and operation of gyrator.		
Mapping of Course Outcomes for Unit III	**CO3: Explore construction and working of principles passive microwave devices / components.**	
Unit IV	**Active Microwave Components**	**6 Hrs.**
Limitations of conventional tubes, O and M type classification of microwave tubes, re-entrant cavity, velocity modulation. Construction, operation, performance analysis and applications of -Single cavity and two cavity klystron, Cylindrical wave magnetron and Helix traveling wave.		
Mapping of Course Outcomes for Unit IV	**CO4: Explore construction and working of principles active microwave devices/components.**	
Unit V	**Solid State Microwave Devices**	**6 Hrs.**
Introduction, Principle of operation, construction, characteristics, parameters with analysis of Microwave transistors, MOSFET, Varactor diodes, Parametric amplifiers, PIN diodes, Tunnel diodes, application as amplifiers, oscillators, modulators, demodulators, Schottky Barrier diodes, Transferred Electron devices: Gunn diode, Avalanche diode, Transit Time devices like IMPATT, TRAPATT diodes.		
Mapping of Course Outcomes for Unit V	**CO5: Analyze the structure, characteristics, operation, equivalent circuits and applications of various microwave solid state active devices.**	

Unit VI	Microwave Systems and Microwave Measurement Techniques	6 Hrs.
Microwave terrestrial and satellite communication system, Fundamentals of RADAR and RADAR range equation. Industrial applications of microwaves such as microwave heating, medical application such as microwave diathermy. Microwave measurement devices such as slotted line, tunable detector, VSWR meter, power meter, and their working principles. Microwave measurement techniques to measure S-parameters, frequency, power, attenuation, VSWR, impedance. Radiation hazards and protection.		
Mapping of Course Outcomes for Unit VI	**CO6: Know the various microwave systems, device set ups of microwave measurement devices and Identify the effect of radiations on environmental sustainability.**	

Learning Resources

Text Books:

1. C.A. Balanis, "Antenna Theory - Analysis and Design", 4th Edition, John Wiley.
2. Samuel Y. Liao, "Microwave Devices and Circuits", 3rd Edition, Pearson.
3. Annapurna Das and Sisir K. Das, "Microwave Engineering", 2nd Edition, Tata McGraw Hill.

Reference Books:

1. K. D. Prasad, "Antenna & Wave Propagation", 3rd Edition, Satya Prakashan, New Delhi.
2. E.C. Jordon and E.G. Balman, "Electromagnetic Waves and Radiation Systems", 2nd Edition, Prentice Hall Inc.
3. David M. Pozar, "Microwave Engineering", 4th Edition, John Wiley.
4. Ahmad Shahid Khan, "Microwave Engineering: Concepts and Fundamentals", CRC Press
5. M. Kulkarni, "Microwave and Radar Engineering, 3rd Edition, Umesh Publication

MOOC / NPTEL Courses:

1. NPTEL Course on "**Microwave Theory and Techniques**", By Prof. Girish Kumar, IIT Mumbai
   Link: https://nptel.ac.in/courses/108101112

2. NPTEL Course on "**Antenna**", By Prof. Girish Kumar, IIT Mumbai
   Link: https://nptel.ac.in/courses/108101092

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404182: VLSI Design and Technology

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Digital Electronics

Companion Course, if any:

1. Lab Practice – 2

Course Objectives:

1. To explore Hardware Description Language (HDL) and respective digital design methodologies.
2. To train the students for Complementary Metal Oxide Semiconductor (CMOS) circuit designs.
3. To realize importance of testability in logic circuit design.
4. To overview an Application Specific Integrated Circuit (ASIC) issues and to understand Programmable Logic Devices (PLD) architectures with advanced features.

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

CO1: Develop effective HDL codes for digital design.
CO2: Apply knowledge of real time issues in digital design.
CO3: Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
CO4: Design CMOS circuits for specified applications.
CO5: Analyze various issues and constraints in design of an ASIC.
CO6: Apply knowledge of testability in design and Build In Self Test (BIST) circuit.

Course Contents

Unit I	Design with HDL	7 Hrs.

Design Flow, Language constructs, Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, HDL modeling of Combinational, Sequential circuits and FSM. Simulations, Synthesis, Efficient coding styles, Hierarchical and flat designs, Partitioning for synthesis, Pipelining, Resource sharing.

Mapping of Course Outcomes for Unit I	CO1: Develop effective HDL codes for digital design.

Unit II	Digital Design and Issues	6 Hrs.

Sequential synchronous machine design, Moore and Mealy machines, HDL code for Machines, FIFO. Meta-stability and solutions. Noise margin, Fan-out, Skew, Timing considerations, Hazards, Clock distribution, Clock jitter, Supply and ground bounce, Power distribution techniques, Power optimization. Interconnect routing techniques, Wire parasitic, Signal integrity issues. I/O architecture.

Mapping of Course Outcomes for Unit II	CO2: Apply knowledge of real time issues in digital design.

Unit III	PLD Architectures and Applications	6 Hrs.
Design Flow. CPLD Architecture, Features, Specifications, Applications. FPGA Architecture, Features, Specifications, Applications. Clock management techniques. The Simulation and Synthesis Tools, FPGA synthesis and implementation. Comparison of CPLD & FPGA.		
Mapping of Course Outcomes for Unit III	**CO3: Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.**	
Unit IV	**Digital CMOS Circuits**	**7 Hrs.**
N-MOS, P-MOS and CMOS. MOSFET parasitic, Technology scaling, Channel length modulation, Hot electron effect, Velocity saturation. CMOS Inverter, Device sizing, CMOS combinational logic design, Power dissipations, Power delay product, Body Effect, Rise and fall times, Latch Up effect, Transmission gates.		
Mapping of Course Outcomes for Unit IV	**CO4: Design CMOS circuits for specified applications.**	
Unit V	**Application Specific Integrated Circuits**	**7 Hrs.**
Design Flow, Cell design specifications, Spice simulation, AC and DC analysis, Transfer Characteristics, Transient responses, Noise analysis, Lambda rules, Design Rule Check, Fabrication methods of circuit elements, Layout of cell, Library cell designing for NAND & NOR, Circuit Extraction, Electrical Rule Check, Layout Vs. Schematic, Post-layout Simulation and Parasitic extraction, Design Issues like Antenna effect, Electro migration effect, Cross talk and Drain punch through, Timing analysis.		
Mapping of Course Outcomes for Unit V	**CO5: Analyze various issues and constraints in design of an ASIC.**	
Unit VI	**VLSI Testing and Analysis**	**6 Hrs.**
Types of fault, Need of Design for Testability (DFT), DFT Guideline, Testability, Fault models, Path sensitizing, Test pattern generation, Sequential circuit test, Built In Self Test, JTAG & Boundary scan, TAP Controller.		
Mapping of Course Outcomes for Unit VI	**Apply knowledge of testability in design and Build In Self Test (BIST) circuit.**	

Learning Resources

Text Books:

1. Charles H. Roth, "Digital Systems Design using VHDL", 2nd Edition, Thompson Learning
2. Wyane Wolf, "Modern VLSI Design (IP-Based Design)", 4th Edition, Prentice Hall.
3. Steve Kilts, "Advanced FPGA Design Architecture, Implementation and Optimization" Wiley Interscience.
4. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", 4th Edition, Pearson Publication.

Reference Books:

1. R. Jacob Baker, “CMOS Circuit Design, Layout, and Simulation”, 3rd Edition, Wiley-IEEE Press.
2. John F. Wakerly, “Digital Design Principles and Practices”, 3rd Edition, Prentice Hall.
3. M. Morris Mano , “Digital Design”, 3rd Edition , Pearson.
4. Cem Unsalan, Bora Tar, “Digital System Design with FPGA: Implementation Using Verilog and VHDL”, McGraw-Hill.

MOOC / NPTEL Courses:

1. NPTEL Course on “**VLSI Technology**”, By Dr. Nandita Dasgupta, IIT Madras

   Link: https://nptel.ac.in/courses/117106093

2. NPTEL Course on “**VLSI Circuits**”, By Prof. S.Srinivasan, IIT Madras

   Link: https://nptel.ac.in/courses/117106092

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404183: Cloud Computing

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Database Management

Companion Course, if any:

1. Lab Practice – 1

Course Objectives:

1. To introduce the fundamentals of Cloud computing, its technologies, Challenges and Applications
2. To give Insights into the virtualization technologies and Architecture.
3. To know the relationship between Cloud and SOA.
4. To classify and evaluate Cloud Security Issues.
5. To apply theory to practical knowledge through case Studies.

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

CO1: Understand the basic concepts of Cloud Computing.
CO2: Describe the underlying principles of different Cloud Service Models.
CO3: Classify the types of Virtualization.
CO4: Examine the Cloud Architecture and understand the importance of Cloud Security.
CO5: Develop applications on Cloud Platforms.
CO6: Evaluate distributed computing and the Internet of Things.

Course Contents

Unit I	Fundamentals of Cloud Computing	6 Hrs.

Introduction to Cloud Computing, History of Cloud Computing, Characteristics of Cloud Computing, Cloud Types: NIST, Cloud cube, Cloud service models, Cloud Computing deployment models, Exploring the Cloud Computing Stack, Advantages, Disadvantages and Applications of cloud computing.

Mapping of Course Outcomes for Unit I	CO1: Understand the basic concepts of Cloud Computing.

Unit II	Cloud Service Models	6 Hrs.

Introduction and benefits of Cloud services, Characteristics, benefits, applications of different cloud service models, Software as a service(SaaS), Platform as a service (PaaS), Infrastructure as a service (IaaS), Network as a service (NaaS), Identity as a service (IdaaS), Database as a service (DbaaS), Comparison of cloud services.

Mapping of Course Outcomes for Unit II	**CO2: Describe the underlying principles of different Cloud Service Models.**	
Unit III	**Virtualization**	**6 Hrs.**
Introduction to Virtualization, Difference between Cloud Computing and Virtualization **Types of Virtualization:** Hardware, Software, Operating system, Server, Storage, Methods of implementing storage Virtualization, Network Virtualization Types, Advantages, Disadvantages, Virtualization Architecture and Software, Virtual Clustering, Applications of Virtualization.		
Mapping of Course Outcomes for Unit III	**CO3: Classify the types of Virtualization.**	
Unit IV	**Service Oriented Architecture and Cloud Security**	**7 Hrs.**
Cloud Computing Architecture (COA): Design principles, Cloud computing life cycle (CCLC), Cloud computing reference architecture, Service Oriented Architecture (SOA) characteristics and fundamental components. **Cloud Security:** Cloud CIA security model (Confidentiality, Integrity and Availability), Cloud computing security architecture, Service provider security issues, Cloud Security Issues and challenges, Security issues in virtualization, Host Security, Data Security, Firewalls.		
Mapping of Course Outcomes for Unit IV	**CO4: Examine the Cloud Architecture and understand the importance of Cloud Security.**	
Unit V	**Cloud Environment and Application Development**	**7 Hrs.**
Cloud Platforms: Google App Engine, Compute Services, Storage Services, Communication Services, Amazon Web Services Architecture and core concepts, Application Lifecycle, Cost Model, Microsoft Azure Cloud services Azure core concepts, Windows Azure Platform Appliance.		
Mapping of Course Outcomes for Unit V	**CO5: Develop applications on Cloud Platforms.**	
Unit VI	**Distributed Computing and Internet of Things**	**6 Hrs.**
Distributed Computing: Need, Distributed computing vs. Cloud computing, Enabling Technologies for the Internet of Things, Innovative Applications of the Internet of Things, Online Social and Professional Networking.		
Mapping of Course Outcomes for Unit VI	**CO6: Evaluate Distributed Computing and the Internet of Things.**	

Learning Resources

Text Books:

1. Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, "Cloud Computing: Black Book", Dreamtech Press.
2. Surbhi Rastogi, "Cloud Computing Simplified", 2021 Edition, BPB Publications.
3. Kai Hwang, Geoffrey.C.Fox., Jack J. Dongarra, "Distributed and Cloud Computing: From Parallel Processing to Internet of Things", MK Publications, Elsevier

Reference Books:

1. Kamal Kant Hiran, et al. "Cloud Computing: Master the concepts, Architecture and Applications with Real-world examples and Case Studies", 1st Edition, BPB Publication.
2. Judith Hurwitz, "Cloud Computing for dummies", 2nd Edition, Wiley India.
3. A. Srinavasan, J. Suresh, "Cloud Computing: A Practical Approach for Learning and Implementation", Pearson.
4. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", McGraw-Hill.
5. Barrie Sosinsky, "Cloud Computing Bible", Wiley Publishing Inc.
6. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", McGraw Hill Education

MOOC / NPTEL Courses:

1. NPTEL Course on "**Cloud Computing**", By Prof. Soumya Kanti Ghosh, IIT Kharagpur.

   Link: https://nptel.ac.in/courses/106105093

2. NPTEL Course on "**Google Cloud Computing Foundation Course**", By Prof. Soumya Kanti Ghosh, IIT Kharagpur.

   Link: https://nptel.ac.in/courses/106105223

Recommended Websites:

1. www.whatiscloud.com
2. www.cloudcomputingpatterns.org
3. www.w3schools.com

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404184 (A): Speech Processing (Elective - III)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Signals & Systems
2. Digital Signal Processing

Companion Course, if any:

1. Lab Practice – 2

Course Objectives:

1. To understand basics of Human speech production mechanism and classification of speech sounds.
2. To understand the short-term analysis of speech signal in time and frequency domain.
3. To extract the information of the speech signal in terms of cepstral features.
4. To understand various audio and speech coding techniques using speech Modelling algorithms.
5. To provide a platform for developing applications in the field of speech and audio processing.

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

CO1: Understand basics of Human speech production mechanism.

CO2: Classify speech sounds based on acoustic and articulatory phonetics.

CO3: Analyse speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).

CO4: Evaluate speech signal for extracting LPC and MFCC Parameters of speech signal.

CO5: Implement algorithms for processing of speech and audio signals considering the properties of acoustic signals.

CO6: Design speech recognition application for speech signal analysis.

Course Contents

Unit I	Fundamentals of Speech Processing	6 Hrs.

Human speech production mechanism, LTI model for speech production, Nature of speech signal, phonetics, articulators, manner of articulation, place of articulation, linear time varying model.

Classification of speech sounds: vowels, semivowels, nasal diphthongs, stops, affricates, fricative, vowel triangle.

Parameters of speech: Fundamental frequency or pitch frequency-Autocorrelation method for finding pitch period, AMDF method for finding pitch period. Formants.

Mapping of Course Outcomes for Unit I	CO1: Understand basics of Human speech production mechanism.

Unit II	Time and Frequency domain methods for Speech and Audio signal analysis.	7 Hrs.
Time dependent speech processing. Short-time energy, short time average magnitude, Short time average zero crossing rate. Speech Vs. silence discrimination using energy and zero crossing rate. Short-time autocorrelation function, short-time average magnitude difference function. Audio feature extraction, Spectral centroid, spectral spread, spectral entropy, spectral flux, spectral roll-off. Spectrogram: narrow band and wide band spectrogram.		
Mapping of Course Outcomes for Unit II	**CO2: Classify speech sounds based on acoustic and articulatory phonetics.**	
Unit III	**Linear prediction and cepstral analysis**	**6 Hrs.**
Basic principles of linear predictive analysis, Linear prediction of speech, auto correlation, formulation of LPC equation, solution of LPC equations, Cepstral analysis of speech, cepstral coefficients, Computation of Mel Frequency Cepstral Coefficients (MFCC).		
Mapping of Course Outcomes for Unit III	**CO3: Analyse speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).**	
Unit IV	**Speech and Audio Coding**	**6 Hrs.**
Time domain waveform coding: Linear PCM, Companded PCM, DPCM. **Spectral coders:** Filter bank analysis, sub-band coders, Adaptive transform coders (ATC), Harmonic coding. Linear predictive coders (LPC), Non-LP source voice coders: phase vocoders, Homomorphic (Cepstral) vocoders.		
Mapping of Course Outcomes for Unit IV	**CO4: Evaluate speech signal for extracting LPC and MFCC Parameters of speech signal.**	
Unit V	**Applications of Speech Processing**	**6 Hrs.**
Automatic Speech Recognition, Feature Extraction for ASR, Deterministic sequence recognition, Statistical Sequence recognition, ASR systems, Speaker identification and verification. **Speech Synthesis:** Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, intelligibility and naturalness in speech synthesis, role of prosody.		
Mapping of Course Outcomes for Unit V	**CO5: Implement algorithms for processing of speech and audio signals considering the properties of acoustic signals.**	
Unit VI	**Speech Processing using Machine Learning techniques**	**6 Hrs.**
Comparison of speech processing applications **Automatic Speech Recognition** and **Speech Synthesis- Text-to-Speech Synthesis** using Support Vector Machine (SVM), Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN). Performance parameters for comparison - Accuracy, True Positives, True Negatives, False Positives, False Negatives, Sensitivity, Specificity, Area Under Curve (AUC), Receiver Operating Characteristic (ROC).		

Mapping of Course Outcomes for Unit VI	CO6: Design speech recognition application for speech signal analysis.

Learning Resources

Text Books:

1. L.R.Rabiner and S.W.Schafer, "Digital Processing of Speech Signals" 1st Edition Pearson Education.
2. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 2nd Edition, Pearson Education.

Reference Books:

1. Thomas F. Quateri, "Discrete-Time Speech Signal Processing: Principles and Practice", Prentice Hall- Signal Processing Series.
2. Shaila Apte, "Speech and Audio Processing", 1st Edition, Wiley India Publication.
3. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", 2nd Edition, Wiley India Publication.
4. Uday Kamath, John Liu, James Whitaker, "Deep Learning for NLP and Speech Recognition", 1st Edition , Springer Publication

MOOC / NPTEL Courses:

1. NPTEL Course on "**Digital Speech Processing**", By Prof. Shyamal Kumar Das Mandal, IIT Kharagpur.

   Link: https://nptel.ac.in/courses/117105145

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404184 (B): PLC SCADA and Automation (Elective - III)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Control Systems
2. Sensor's in Automation
3. Power Devices and Circuits

Companion Course, if any:

1. Lab Practice – 2

Course Objectives:

1. Understanding and Recognize Industrial control problems.
2. Concept of PLC's and Its Importance in Industrial Automation.
3. Development of Ladder Programming in PLC and PLC Interface in real time applications.
4. Overview of technology of advanced automation Systems such as SCADA, DCS Systems.
5. Learning of CNC fundamentals and Important Protocols in Industrial Automation

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

CO1: Understand and Recognize Industrial Control Problems.
CO2: **Analyze** & explain different hardware functions of PLC.
CO3: Develop Ladder Programming in PLC and PLC Interface in real time applications.
CO4: Explore and interpret functionality of SCADA.
CO5: Identify and interpret the functionality of DCS.
CO6: Define and explain CNC machines and Applications of Industrial Protocols.

Course Contents

Unit I	Elements of Process Control Automation	7 Hrs.

Process control principles, Control System Evaluation, Analog control, Digital control, Architecture of Industrial Automation Systems (Automation Pyramid), Advantages and limitations of Automation, Concept and Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire & 3-Wire transmitters, Concept of VFD, Energy conservation schemes through VFD.

Mapping of Course Outcomes for Unit I	CO1: Understand and Recognize Industrial Control Problems

Unit II	Fundamentals of PLC	7 Hrs.

Architecture of PLC- Types of PLC's, Applications of PLC's, PC v/s PLC, Different Modules, Power Supply Unit etc. Need of PLC, Different Types of Sensors- Sinking, Sourcing. Operation and function. Monitoring of Process through Sensors- Connection Details. Analog Addressing, continuous Process Monitoring and Control.

Mapping of Course Outcomes for Unit II	CO2: Analyze & explain different hardware functions of PLC.

Unit III	Programming of Programmable Logic Controllers	7 Hrs.
PLC programming, NO/ NC Concept, Ladder diagram: of logic gates, arithmetic instructions, multiplexer, Ladder diagram for different logical conditions or logical equations or truth table. Timers: types of timer, Characteristics, Function of timer in PLC, Classification of a PLC timer, Ladder diagram using timer, PLC counter, Ladder diagram using counter. PLC Programming of Branded PLCs. Concept of P,PI,PD,PID w.r.t. PLC, Data File Handling- Forcing I/O.		
Mapping of Course Outcomes for Unit III	**CO3: Develop Ladder Programming in PLC and PLC Interface in real time applications.**	
Unit IV	**Supervisory Control and Data Acquisition Systems (SCADA)**	**6 Hrs.**
Concept of SCADA, Architecture of SCADA, Components of SCADA Systems, MTU- functions of MTU, RTU- Functions of RTU, Directly interact with devices such as sensors, valves, pumps, motors, and more through human-machine interface (HMI) software. Working of SCADA, Applications of SCADA in Industrial Automation like Oil and gas, Power etc.		
Mapping of Course Outcomes for Unit IV	**CO4: Explore and interpret functionality of SCADA.**	
Unit V	**Distributed Control Systems (DCS)**	**6 Hrs.**
Basic Concept of DCS, History and Hierarchy of DCS, Basic Componenents of DCS as Operator Station, Control Module, and I/O module , Types of DCS, Need of DCS, Functions of each level, Advantages and Disadvantages, Applications of DCS such as Water Treatment Plant, Comparison of PLC, DCS and SCADA		
Mapping of Course Outcomes for Unit V	**CO5: Identify and interpret the functionality of DCS.**	
Unit VI	**CNC Machines and Industrial Protocols**	**7 Hrs.**
Introduction of CNC Machines, Basics and need of CNC machines, NC, CNC and DNC (Direct NC) systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines. Industrial Communication: Devicenet, Foundation Fieldbus, PROFIBUS, MODBUS, Ethernet, TCP/IP, Concept of Industry 4.0.		
Mapping of Course Outcomes for Unit VI	**CO6: Define and explain CNC machines and Applications of Industrial Protocols.**	

Learning Resources

Text Books:

1. Curtis Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson Education.
2. Madhuchhanda Mitra, Samarjit Sen Gupta, "Programmable Logic controllers and Industrial Automation", 2nd Edition, Penram International Publishing India Pvt. Ltd.

Reference Books:

1. Stuart A. Boyer, "SCADA Supervisory Control and Data Acquisition", 4th Edition, ISA Publication.
2. John W. Webb, Ronold A Reis," Programmable Logic Controllers, Principles and Applications", 5th Edition, Prentice Hall of India Pvt. Ltd.
3. Kilian, "Modern control technology: components & systems", 2nd Edition, Delmar.
4. Bela G Liptak "Process Software and Digital Networks", 4th Edition, CRC Press
5. Pollack. Herman, W & Robinson., T. "Computer Numerical Control", Prentice Hall.
6. Pabla, B.S. &Adithan, M. "CNC Machines", New Age Publishers.
7. R.G. Jamkar, "Industrial Automation Using PLC SCADA & DCS" Global Education Limited

MOOC / NPTEL Courses:

1. NPTEL Course on "**Industrial Automation and Control**", by Prof. S. Mukhopadhyay, IIT Kharagpur.

Link: https://nptel.ac.in/courses/108105088

Savitribai Phule Pune University

Fourth Year of E & TC Engineering (2019 Course)

404184 (C): Java Script (Elective - III)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Fundamentals of Java Programming
2. Advanced Java Programming

Companion Course, if any:

1. Lab Practice – 2

Course Objectives:

1. To learn the syntax and semantics of Java script.
2. To understand the data types and variables in Java script.
3. To learn how functions and objects are used in Java script.
4. To learn how to use regular expressions in java script for handling various string operations.
5. To understand the concept of object models and event handling in java script programs.
6. To learn the use of java script for controlling Windows and form handling

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

CO1: Use basic features of java script.

CO2: Use relevant data types for developing application in java script.

CO3: Use the function and objects as self-contained, with data passing in and out through well-defined interfaces in development of small systems.

CO4: Apply the regular expression for Text matching and manipulation.

CO5: Explore use of the various aspects of JavaScript object models that are fundamental to the proper use of the language.

CO6: Develop the application using windows controlling and form handling.

Course Contents

Unit I	Introduction to Java Scripts	6 Hrs.

Introduction – First Look at JavaScript, Adding JavaScript to XHTML Documents- The <script> Element, Using the <script> Element, Event Handlers, Linked Scripts, History and Use of JavaScript, JavaScript Core Features- Overview-Basic Definitions, Language Characteristics, Variables, Basic Data Types, Composite Types, Flow Control Statements, Loops, Functions, Input and Output in JavaScript, Regular Expressions.

Mapping of Course Outcomes for Unit I	CO1: Use basic features of java script.

Unit II	Data Types and Variables	8 Hrs.
JavaScript's Primitive Types- Numbers, Hexadecimal Literals, Octal Literals, Special Values, Data Representation Issues, Data Representation Issues, Strings, Undefined and Null; Composite Types- Objects, The typeof Operator, Type Conversion, Variables. Operators, Expressions, and Statements- Statement Basics, Whitespace, Termination: Semicolons and Returns, Blocks. **Operators**- Assignment Operator, Arithmetic Operators, Bitwise Operators, Bitwise Shift Operators, Increment/Decrement, Logical Operators, void Operator, Object Operators **Core JavaScript Statements**- if Statements, switch, while Loops, do-while Loops, for Loops, for Loops, Object-Related Statements, Object Loops Using for in		
Mapping of Course Outcomes for Unit II	**CO2: Use relevant data types for developing application in java script.**	
Unit III	**Functions and Objects**	**6 Hrs.**
Function Basics- Parameter-Passing Basics, return Statements, Parameter Passing: In and Out. Global and Local Variables- Mask Out, Local functions **Functions as Objects-** Function Literals and Anonymous Functions, Static Variables, Advanced Parameter Passing, Recursive Functions, Using Functions **Objects-** Objects in JavaScript, Object Fundamentals Enumerating Properties, Objects Are Reference Types, Passing Objects to Functions, Common Properties and Methods, Array, Date, Math, Number, String, Object Types and Primitive Types		
Mapping of Course Outcomes for Unit III	**CO3: Use the function and objects as self-contained, with data passing in and out through well-defined interfaces in development of small systems.**	
Unit IV	**Regular Expressions**	**6 Hrs.**
The Need for Regular Expressions, Introduction to JavaScript Regular Expressions, Creating Patterns, Repetition Quantifiers, Grouping, Common Character Classes, RegExp Object, exec(). **String Methods for Regular Expressions:** search(), split(),replace(),replace() with Sub expressions **Advanced Regular Expressions:** Multiline Matching, Non-capturing Parentheses, Lookahead, Greedy Matching, Limitations of Regular Expressions.		
Mapping of Course Outcomes for Unit IV	**CO4: Apply the regular expression for Text matching and manipulation.**	
Unit V	**Fundamental Client-Side JavaScript and Event Handling**	**6 Hrs**
JavaScript Object Models: Object Model Overview, The Initial JavaScript Object Model, The Object Models **The Standard Document Object Model**: DOM Flavors, Document Trees, Accessing Elements, Creating Nodes, Inserting and Appending Nodes, Deleting and Replacing Nodes, The DOM and HTML Elements, The DOM and CSS, The DOM Versus DHTML Object Models. Overview of Events and Event Handling, The Basic Event Model, Netscape 4 Event Model, Internet Explorer 4+ Event Model, DOM2 Event Model, Event Model Issues.		
Mapping of Course Outcomes for Unit V	**CO5: Explore use of the various aspects of JavaScript object models that are fundamental to the proper use of the language.**	

Unit VI	Using Java scripts	8 Hrs.
Controlling Windows and Frames: Introduction to Window, Dialogs, Opening and Closing Generic Windows, Window Features, Writing to Windows, Controlling Windows, Window Events, Frames: A Special Case of Windows, Frames: A Special Case of Windows. **Form Handling:** Form Basics, Form Fields, Select Menus Option Groups, Other Form Elements: Label, Fieldset, and Legend, Form Validation, Form Usability and JavaScript, Dynamic Forms.		
Mapping of Course Outcomes for Unit VI	**CO6: Develop the application using windows controlling and for handling.**	

Learning Resources

Text Books:

1. Thomas Powell and Fritz Schneider, "JavaScript 2.0: The Complete Reference", 2nd Edition, McGraw Hill
2. Kogent Learning Solutions, "HTML, JavaScript, PHP, Java, JSP, XML and AJAX" Black Book, Dreamtech Press.

Reference Books:

1. Jon Duckett, "JavaScript & J Query: Interactive Front-End Web Development", John Wiley & Sons.
2. David Flanagan, "JavaScript: The Definitive Guide", 7th Edition, O'Reilly Media.
3. Mike Mackgrath, "Javascripts in Easy Steps" Dreamtech Press

MOOC / NPTEL Courses:

1. NPTEL Course on "**Internet Technology**", by Prof. Indranil Sengupta, IIT Kharagpur
   Link: https://nptel.ac.in/courses/106105084

2. Udemy course on **"JavaScript: Understanding the Weird Parts**"
   Link: **https://www.udemy.com/course/understand-javascript/**

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404184 (D): Embedded System & RTOS (Elective - III)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. ARM7 / ARM9 / ARM Cortex- M

Companion Course, if any:

1. Lab Practice - 2

Course Objectives:

1. To understand the Embedded system design issues.
2. To understand real time operating system concepts.
3. To understand the Embedded Linux environment
4. To understand embedded software development and testing tools.

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

CO1: Apply design metrics of Embedded systems to design real time applications to match recent trends in technology.
CO2: Apply Real time systems concepts.
CO3: Evaluate µCOS operating system and its services.
CO4: Apply Embedded Linux Development Environment and testing tools.
CO5: Analyze Linux operating system and device drivers.
CO6: Analyze the hardware – software co design issues for testing of real time Embedded system.

Course Contents

Unit I	Introduction to Embedded Systems	8 Hrs.

Introduction to Embedded Systems, Architecture, Classification and Characteristics of Embedded System, Design Process, Design Metrics and optimization of various parameters of embedded system. Embedded processor technology, IC technology, Design technology. Software development life cycle. Various models like waterfall, spiral,V, Rapid Prototyping models and Comparison

Mapping of Course Outcomes for Unit I	CO1: Apply design metrics of Embedded systems to design real time applications to match recent trends in technology.

Unit II	Concepts of Real Time Operating System	6 Hrs.

Foreground/ Background systems, Critical section of code, Resource, Shared resource, multitasking, Task, Context switch, Kernel, Scheduler, Non-Preemptive Kernel , Preemptive Kernel, Reentrancy, Round robin scheduling, Task Priorities, Static & Dynamic Priority, Priority Inversion, Assigning task priorities, Mutual Exclusion, Deadlock, Clock Tick, Memory requirements, Semaphore as signaling & Synchronizing, External Interrupt, Advantages & disadvantages of real time kernels.

Mapping of Course Outcomes for Unit II	CO2: Apply Real time systems concepts.

Unit III	µCOS II	6 Hrs.
Features of µCOS II Kernel structure. µCOS II RTOS services: Task management, Time management, Intertask Communication and Synchronization.		
Mapping of Course Outcomes for Unit III	**CO3: Evaluate µCOS operating system and its services.**	
Unit IV	**Embedded Linux Development Environment**	**6 Hrs.**
Need of Linux, Embedded Linux Today, Open Source and the GPL, BIOS Versus Boot loader, Storage Considerations, Embedded Linux Distributions. Embedded Development Environment, Cross-Development Environment, Host System Requirements, Hosting Target Boards. Development Tools, GNU Debugger, Tracing and Profiling Tools, Binary Utilities.		
Mapping of Course Outcomes for Unit IV	**CO4: Apply Embedded Linux Development Environment and testing tools.**	
Unit V	**Linux Kernel Structure**	**6 Hrs.**
Linux Kernel Background, Linux Kernel Construction, Kernel Build System, Kernel Configuration. Role of a Bootloader, Bootloader Challenges. A Universal Bootloader: Das UBoot. Porting U-Boot. Device Driver Concepts, Module Utilities, Driver Methods. Linux File System & Concepts		
Mapping of Course Outcomes for Unit V	**CO5: Analyze Linux operating system and device drivers.**	
Unit VI	**Embedded Software Development and Testing**	**8 Hrs.**
Embedded Software development process and tool chain, Host and Target Machines, Porting Embedded Software into the Target System, Testing on Host Machine, Simulators. Introduction to Development Platform Trends (only introduce IDE, board Details and Application) Arduino, Beaglebone, Rasberry PI, Intel Galileo Gen 2 (Simple Programs to discussed)		
Mapping of Course Outcomes for Unit VI	**CO6: Analyze the hardware – software co design issues for testing of real time Embedded system.**	

Learning Resources

Text Books:

1. Jean J. Labrosse, "MicroC OS II, The Real-Time Kernel", 2nd Edition, CMP Books.
2. Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach "2nd Edition, Prentice Hall.

Reference Books:

1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd Edition, McGraw Hill.
2. Frank Vahid and Tony Givargis, "Embedded System Design – A Unified Hardware/Software Introduction " 3rd Edition, Wiley.
3. David E. Simon, "An Embedded Software Prime", Pearson Education.

MOOC / NPTEL Courses:

1. NPTEL Course on "**Embedded System Design with ARM**", by Prof. Indranil Sengupta, and Prof. Kamalika Datta, IIT Kharagpur
   Link of the Course: https://nptel.ac.in/courses/106105193

2. NPTEL Course on "**Real-Time Systems**", by Prof. Rajib Mall, Prof. Durga Prasad Mohapatra, IIT Kharagpur
   Link of the Course: https://nptel.ac.in/courses/106105229

Savitribai Phule Pune University

Fourth Year of E & TC Engineering (2019 Course)

404184 (E): Modernized IoT (Elective - III)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End-Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Basics of sensors and hardware components
2. Basic networking concepts
3. Knowledge of Microcontroller and embedded systems

Companion Course, if any:

1. Lab Practice- 2

Course Objectives:

1. To introduce the fundamentals of sensors and actuators along with the basic concepts of an IoT & IoE.
2. To give Insights into the Architecture and M2M technology for an IoT.
3. To Exposing students to the usage of Protocol Standardization for IoT with IoT Edge and Gateway Network with Communication protocols.
4. To develop design skills in industrial IoT.
5. To provide IoT Solutions with sensor-based application through embedded system platform.

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

CO1: Comprehend and analyze concepts of sensors, actuators, IoT and IoE.
CO2: Interpret IoT Architecture Design Aspects.
CO3: Comprehend the operation of IoT protocols.
CO4: Describe various IoT boards, interfacing, and programming for IoT.
CO5: Illustrate the technologies, Catalysts, and precursors of IIoT using suitable use cases.
CO6: **Provide** suitable solution for domain specific applications of IoT.

Course Contents

Unit I	Sensors, Actuators, IoT & IoE	6 Hrs.

Definitions, Types of sensors, Types of Actuators, Example and Working, Networking Basics, RFID Principals and components, Wireless Sensor Networks, Definition, and characteristics of an IoT, Physical Design of an IoT, Logical design of IoT, Communication Models, Communication API's, What is the IoE? Difference between IoT and IoE, Pillars of the IoE, Connecting the Unconnected, Transitioning to the IoE, Bringing It All Together.

Mapping of Course Outcomes for Unit I	CO1: Comprehend and analyze concepts of sensors, actuators, IoT and IoE.

Unit II	IoT Architecture Design Aspects	6 Hrs.

IoT-An Architectural Overview, building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations. M2M and IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management

Mapping of Course Outcomes for Unit II	CO2: Interpret IoT Architecture Design Aspects.

Unit III	IoT Protocols	6 Hrs.
PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, Z Wave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7 - Network Layer-IPv4, IPv6, 6LoWPAN, 6TiSCH, ND, DHCP, ICMP, RPL, CORPL, CARP, Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS) – Session Layer HTTP, CoAP, XMPP, AMQP, MQTT		
Mapping of Course Outcomes for Unit III	**CO3: Comprehend the operation of IoT protocols.**	
Unit IV	**Interfacing Boards and Programming**	**6 Hrs.**
Introduction to IoT Boards, Interfacing with IoT Boards, IoT deployment for Raspberry Pi /Arduino/Equivalent platform – Reading from Sensors, Communication: Connecting microcontroller with mobile devices – communication through Bluetooth, wifi and USB - Contiki OS- Cooja Simulator.		
Mapping of Course Outcomes for Unit IV	**CO4: Describe various IoT boards, interfacing, and programming for IoT.**	
Unit V	**Industrial IoT**	**6 Hrs.**
Introduction, Key IIOT technologies, Catalysts, and precursors of IIoT, Innovation and the IIoT, Applications of IIoT Examples: Healthcare, Oil and Gas Industry, Logistics and the Industrial Internet, Retail applications, IoT innovations and design methodologies, Industrial Internet Architecture Framework (IIAF): Control domain, operational domain and application domain, Three tier topology, Design of low power device network, legacy industrial protocols, Bluetooth, Zigbee IP, Z-wave, Wi-Fi backscatter in IIoT design.		
Mapping of Course Outcomes for Unit V	**CO5: Illustrate the technologies, Catalysts, and precursors of IIoT using suitable use cases.**	
Unit VI	**Applications of IoT**	**6 Hrs.**
Smart Environment: Forest Fire Detection, Air Pollution, Smart Cities: Parking, Structural Health, Noise Urban maps, Smart Metering: Smart Grid, Tank level, Photovoltaic Installations, Silos Stock Calculation, Health: Fall Detection, Medical Fridges, Sportsmen Care, Patients Surveillance, Ultraviolet Radiation		
Mapping of Course Outcomes for Unit VI	**CO6**: **Provide** suitable solution for domain specific applications of IoT.	

Learning Resources

Text Books:

1. Ovidiu Vermesan, Peter Fresiss, “Internet of Things” From research and innovation to market Deployment”, River Publishers series in Communication, USA.
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, 2nd Edition, Wiley Publications.

Reference Books:

1. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", River Publishers Series in Communication
2. "Internet of Things: Case Studies", Libelium Inc, White papers, Spain
   http://www.libelium.com/resources/case-studies

MOOC / NPTEL Courses:

1. NPTEL Course on "**Introduction to IoT**", by Prof. Sudip Misra, IIT Kharagpur
   Link of the Course: https://nptel.ac.in/courses/106105166

2. NPTEL Course on "**Introduction to Industry 4.0 and Industrial Internet of Things**", by Prof. Sudip Misra, IIT Kharagpur
   Link of the Course: https://nptel.ac.in/courses/106105195

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404185 (A): Data Mining (Elective - IV)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Database Management Systems
2. Signals and Systems

Companion Course, if any:

Course Objectives:

1. To understand the basic concepts of Data mining and major issues in Data Mining.
2. To be familiar with the Data warehouse architecture and its Implementation.
3. To characterize the kinds of patterns that can be discovered by classification, clustering, and association rule mining.
4. To describe and demonstrate basic data mining algorithms, methods, tools.
5. To understand and apply various classification and clustering techniques using tools.
6. To understand latest trends in Data Mining.

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

CO1: Understand the process of data mining and performance issues in data mining

CO2: Apply data preprocessing techniques to the historical data collected in data warehouse

CO3: Analyze various types of Frequent pattern analysis methods and advanced Pattern mining techniques

CO4: Evaluate various data mining algorithms for developing effective data mining models

CO5: Analyze different clustering and outlier detection methods

CO6: Design data mining models in different mining application areas

Course Contents

Unit I	Introduction to Data Mining	7 Hrs.

Introduction: Definition, Mining Functionalities, Kinds of Patterns, Technologies used for data mining- Machine Learning, Database Systems and Data Warehouses, Major Issues in Data Mining - Mining Methodology, User Interaction, Efficiency and Scalability, Diversity of Database Types, Data Mining and Society

Mapping of Course Outcomes for Unit I	CO1: Understand types of data to be mined, choose and major issues in Data Mining.

Unit II	Data Preprocessing and Data Ware housing	6 Hrs.

Data Objects and Attribute, Data Cleaning: Missing Values, Noisy Data- Binning, Clustering, Regression, Computer and Human inspection, Inconsistent Data, Data Integration and Transformation. Data Reduction.

Data Warehouse: Basic Concepts, Data Warehouse Modeling, Data Warehouse Design and Usage

Mapping of Course Outcomes for Unit II	CO2: Perform different data processing, Model and design the Data Warehouse

Unit III	Frequent Pattern Analysis and Advanced Pattern Mining	7 Hrs
Frequent Pattern Analysis: Basic Concepts, Frequent Itemset Mining Methods Pattern Evaluation Method. **Advanced Pattern Mining:** Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy,		
Mapping of Course Outcomes for Unit III	**CO3: Understand the Frequent pattern analysis and advanced Pattern mining.**	
Unit IV	**Data mining algorithms**	**7 Hrs.**
Classification - Basic issues regarding classification and predication - General Approach to solving a classification problem- Decision Tree Classification, Attribute Selection Measures, Tree Pruning- Bayesian Classification – Rule Based Classification – Support Vector Machines.		
Mapping of Course Outcomes for Unit IV	**CO4: Choose and employ suitable data mining algorithms to build analytical applications**	
Unit V	**Cluster Analysis and Outlier Detection**	**7 Hrs.**
Basics and Importance of Cluster Analysis- Different Types of Clusters Partitioning Methods, Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods. **Outlier Detection:** Need, Detection Methods, Approaches – Statistical, Proximity-Based, Clustering-Based, Classification-Based, Outlier Detection in High-Dimensional Data		
Mapping of Course Outcomes for Unit V	**CO5: Implement clustering and outlier detection methods.**	
Unit VI	**Advanced Concepts**	**6 Hrs.**
Basic concepts in Mining data streams: Mining Time series Data Mining sequence patterns in Transactional database Mining Object, Spatial Multimedia, Text - extracting attributes (keywords), structural approaches (parsing, soft parsing). **Web Mining:** Introduction to Web Mining, Web content mining, Web usage mining, Web Structure mining, Web log structure and issues regarding web logs, Spatial Data Mining.		
Mapping of Course Outcomes for Unit VI	**CO6: Orient towards the advanced approaches of Data mining.**	

Learning Resources

Text Books:

1. Jiawei Han & Micheline Kamber, "Data Mining: Concepts and Techniques", 3rd Edition Elsevier.
2. Margaret H Dunham, "Data Mining Introductory and Advanced topics", 1st Edition Pearson

Reference Books:

1. Ian H. Witten and Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques" 2nd Edition, Morgan Kaufmann.

MOOC / NPTEL Courses:

1. NPTEL Course "**Data Mining**" by Prof. Pabitra Mitra IIT Kharagpur

   Link of the Course: https://nptel.ac.in/courses/106105174

2. NPTEL Course "**Business analytics and data mining Modeling using R**" by Dr. Gaurav Dixit IIT Roorkee

   Link of the Course: https://nptel.ac.in/courses/110107092

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404185 (B): Electronics Product Design (Elective - IV)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:

1. To understand the stages of product (hardware/ software) design and development.
2. To learn the different considerations of analog, digital and mixed circuit design.
3. To be acquainted with methods of PCB design and different tools used for PCB Design.
4. To understand the importance of testing in product design cycle.
5. To understand the processes and importance of documentation.

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

CO1: Understand and explain design flow of design of electronics product.

CO2: Associate with various circuit design issues and testing.

CO3: Inferring different software designing aspects and the Importance of product test & test specifications.

CO4: Summarizing printed circuit boards and different parameters.

CO5: Estimating assorted product design aspects.

CO6: Exemplifying special design considerations and importance of documentation.

Course Contents

Unit I	Introduction to Electronic Product Design	6 Hrs.

Overview Of System Engineering, System Perspectives, Documentation, Concept Development, Requirements, Design Development, Rapid Prototyping And Field Testing, Validation, Verification And Integration, Maintenance And Life Cycle Costs, Failure, Iteration And Judgment, Good Engineering, Architecturing, Design Concerns And Heuristics, Teamwork And Trust.

Mapping of Course Outcomes for Unit I	CO1: Understand and explain design flow of design of electronics product.

Unit II	Circuit Design and Testing Methods	6 Hrs.

From Symbols To Substance, Convert Requirements Into Design, Reliability, Fault Tolerance, High Speed Design, Low Power Design, Noise And Error Budget, Standard Data Buses And Networks, Reset And Power Failure Detection, Interface: Inputs, Outputs, Breadboards, Evaluation Boards And Prototypes.

Mapping of Course Outcomes for Unit II	CO2: Associate with various circuit design issues and testing.

Unit III	Software Design and Testing Methods	6 Hrs.
Types Of Software, Traditional Software Life Cycle, Models, Metrics and Software Limitations, Risk Abatement and Failure Preventions, Software Bugs and Testing, Good Programming Practice, User Interface, Embedded, Real Time Software, Case Studies and Design Examples.		
Mapping of Course Outcomes for Unit III	**CO3: Inferring different software designing aspects and the Importance of product test & test specifications.**	
Unit IV	**PCB Design**	**6 Hrs.**
Circuit Boards, Component Placement, Routing Signal Traces, Grounds, Returns and Shields, Connectors and Cables, Design for Manufacture, Testing and Maintenance, Power Conversion Choices, Power Distribution, Line Conditioning, Electromagnetic Interference, Heat Transfer, Mechanisms For Cooling, Heat Sink Selection, Heat Pipes and Thermal Pillows, Fans and Forced Cooling, Liquid Cooling, Evaporation and Refrigeration, Trade-Offs In Design.		
Mapping of Course Outcomes for Unit IV	**CO4: Summarizing printed circuit boards and different parameters.**	
Unit V	**Product Debugging and Testing**	**6 Hrs.**
Steps Of Debugging, Techniques for Troubleshooting, Characterization, Electromechanical Components, Passive Components, Active Components, Active Devices, Operational Amplifier, Analog-Digital Conversion, Digital Components, Inspection and Test Of Components, Simulation, Prototyping and Testing, Integration, Validation and Verification. Procurement, Manufacturing, Maintenance and Repair.		
Mapping of Course Outcomes for Unit V	**CO5: Estimating assorted product design aspects.**	
Unit VI	**Documentation**	**6 Hrs.**
Definition, Need, Types of Documentation, Records, Accountability and Liability. Audience. Preparation, Presentation, Preservation of Documents. Methods of Documentation, Visual Techniques, Layout of Documentation, Bill of Material.		
Mapping of Course Outcomes for Unit VI	**CO6: Exemplifying special design considerations and importance of documentation.**	

Learning Resources

Text Books:

1. Kim Fowler, “Electronic Instrument Design”, Oxford University Press.
2. Robert J. Herrick, “Printed Circuit board design Techniques for EMC Compliance”, 2nd Edition, IEEE press.

Reference Books:

1. James K. Peckol, “Embedded Systems – A Contemporary Design Tool”, Wiley Publication
2. J.C. Whitakar, “The Electronics Handbook”, CRC press.

Udemy Courses :

1. Introduction to Product Management

   Link: **https://www.udemy.com/product-management/**

2. Fundamental Steps of Product Management

   Link: **https://www.udemy.com/productmgt/**

3. Digital Product Manufacturing: The Roadmap to Success

   Link: **https://www.udemy.com/digital-product-manufacturing/**

4. Agile Product Owner Career Guide

   Link: **https://www.udemy.com/product-owner-career-guide/**

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404185 (B): Deep Learning (Elective - IV)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 Hrs. / Week	**03**	**In-Sem (Theory): 30 Marks** **End Sem (Theory): 70 Marks**

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:

1. To comprehend the theoretical foundations, algorithms and methodologies of Neural Network.
2. To design and develop an application using specific deep learning models and know complexity of Deep Learning algorithms and their limitations
3. To examine the case studies of deep learning techniques

Course Outcomes: On completion of the course, learner will be able to:
CO1: Classify machine learning algorithms and its types.
CO2: Discuss the concepts of deep learning and its Frameworks.
CO3: Identify the deep learning architectures with respect to the applications.
CO4: Demonstrate different architectures of Convolutional neural networks.
CO5: Discuss natural language processing architectures.
CO6: Make use of various case studies and deep learning applications.

Course Contents

Unit I	Machine Learning	6 Hrs.
Introduction to Machine Learning, Types of Machines Learning, Linear Regression, Classification and Logistic Regression, Decision Tree and Random Forest, Naïve Bayes and Support Vector Machine. Applications of machine learning		
Mapping of Course Outcomes for Unit I	**CO1: Classify machine learning algorithms and its types.**	
Unit II	**Introduction to Deep Learning and Frameworks**	**6 Hrs.**
Deep Learning Basics: Intro, History, capabilities, the perceptron, Multi Layer Perceptron, ANN architecture. Tensor Flow, Creating and Manipulating Tensor Flow Variables, Tensor Flow Operations, Placeholder Tensors, Managing Models over the CPU and GPU, Specifying the Logistic Regression Model in Tensor Flow, Logging and Training the Logistic Regression, Introduction to Keras, PyTorch.		
Mapping of Course Outcomes for Unit II	**CO2: Discuss the concepts of deep learning and its Frameworks.**	

Unit III	Deep Learning Architecture	6 Hrs.
Width and Depth of Neural Networks, Different Activation Functions, Batch-normalization, Overfitting and generalization., Dropout, regularization Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications		
Mapping of Course Outcomes for Unit III	**CO3: Identify the deep learning architectures with respect to the applications.**	
Unit IV	**Computer Vision**	**6 Hrs.**
Architectural Overview, Motivation, Layers, Filters, Parameter sharing, Regularization, Convolution neural networks (CNNs), convolution, pooling and its variations, different deep CNN architectures - LeNet, AlexNet, VGG, PlacesNet, DenseNet, Training a CNNs: weights initialization, batch normalization, hyperparameter tuning . **Popular CNN Architectures:** ResNet, AlexNet – Applications.		
Mapping of Course Outcomes for Unit IV	**CO4: Demonstrate different architectures of Convolutional neural networks.**	
Unit V	**Natural Language Processing**	**6 Hrs.**
Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks. Advanced RNN: LSTM, GRU, introduction to Generative Adversarial Networks (GANs).		
Mapping of Course Outcomes for Unit V	**CO5: Discuss natural language processing architectures.**	
Unit VI	**Case Study and Applictions**	**6 Hrs.**
Computer Vision: Image Classification, Image net- Detection-Audio Wave Net. **Natural Language Processing:** Sentimental Analysis, Text preprocessing and chatBot		
Mapping of Course Outcomes for Unit VI	**CO6: Make use of various case studies and deep learning applications.**	

Learning Resources

Text Books:

1. Nikhil Buduma, “Fundamentals of Deep Learning Designing Next-Generation Machine Intelligence Algorithms”, 1st Edition, O’REILLY.
2. Michael Nielsen, “Neural Networks and Deep Learning”, Determination Press.
3. Ian Goodfellow, YoshuaBengio and Aaron Courville, “Deep Learning”, MIT Press.
4. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media.
5. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press.
6. Ethem Alpaydin,"Introduction to Machine Learning”, 3rd Edition, Prentice Hall of India.
7. Umberto Michelucci “Applied Deep Learning. A Case-based Approach to Understanding”, Deep Neural Networks” Apress, 2018.

Reference Books:

1. Goodfellow. I., Bengio.Y., and Courville, A.,"Deep Learning", MIT Press.
2. Bishop, C.M., "Pattern Recognition and Machine Learning", Springer.
3. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Education.

MOOC / NPTEL Courses:

1. NPTEL Course on "**Deep Learning**", by Prof. Prabir Kumar Bhiswas, IIT Kharagpur.

   Link of the Course: https://nptel.ac.in/courses/106105215

2. NPTEL Course on "**Deep Learning - Part I**", by Prof. Sudarshan Iyengar, Prof Sanatan Sukhija IIT Ropar

   Link of the Course: https://nptel.ac.in/courses/106106184

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404185 (D): Low Power CMOS (Elective - IV)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Electronic Circuits
2. Digital Circuits

Companion Course, if any:

1. VLSI Design and Technology

Course Objectives: is to make the student

1. Identify sources of power in an IC.
2. To relate the power reduction techniques based on technology independent and technology. dependent power dissipation mechanism in various MOS logic style.
3. To describe suitable techniques to reduce the power dissipation.
4. To design memory circuits with low power dissipation.
5. To learn to use CAD tools for low power synthesis .

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

CO1: Explain the sources of power dissipation in CMOS.
CO2: Classify the special techniques to mitigate the power consumption in CMOS circuits.
CO3: Summarize the power optimization and trade off techniques in digital circuits.
CO4: Illustrate the power estimation at logic and circuit level.
CO5: Explain the software design for low power in various level.
CO6: Use the CAD tools for low power synthesis.

Course Contents

Unit I	Fundamentals of Power Dissipation in CMOS	07 Hrs.

Sources of power dissipation, Physics of power dissipation in MOSFET devices: The MIS structure, long channel MOSFET, Submicron MOSFET, gate induced drain leakage, Power dissipation in CMOS: short circuit dissipation, dynamic dissipation, load capacitance, Low power VLSI design: Limits, principles of low power design, hierarchy of limits, fundamental limit, material limit, device limit, system limit.

Mapping of Course Outcomes for Unit I	CO1: Explain the sources of power dissipation in CMOS.

Unit II	Power Optimization Techniques	08 Hrs.
Power Reduction in Clock Networks: Clock Gating, Reduced Swing Clock, Oscillator Circuit for Clock Generation, Frequency Division and Multiplication, Other Clock Power Reduction Techniques, CMOS Floating Node: Tristate Keeper Circuit, Blocking Gate, Low Power Bus: Low Swing Bus, Charge Recycling Bus, Delay Balancing, Low Power Techniques for SRAM: SRAM Cell, Memory Bank Partitioning, Pulsed Word line and Reduced bit line Swing. Introduction to Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach –Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.		
Mapping of Course Outcomes for Unit II	**CO2: Classify the special techniques to mitigate the power consumption in CMOS circuits.**	
Unit III	**Design of Low Power Circuits**	**07 Hrs.**
Transistor and Gate Sizing : Sizing an Inverter Chain, Transistor and Gate Sizing for Dynamic Power Reduction, Transistor Sizing for Leakage Power Reduction, Network Restructuring and Reorganization : Transistor Network Restructuring, Transistor Network Partitioning and Reorganization, Special Latches and Flip-flops : Self-gating Flip-flop, Combinational Flip-flop, Double Edge Triggered Flip-flop, Low Power Digital Cell Library : Cell Sizes and Spacing, Varieties of Boolean Functions, Adjustable Device Threshold Voltage.		
Mapping of Course Outcomes for Unit III	**CO3: Summarize the power optimization and trade off techniques in digital circuits.**	
Unit IV	**Power Estimation**	**07 Hrs.**
Modelling of signals, signal probability calculation, Statistical techniques, estimation of glitching power, Sensitivity analysis, Power estimation using input vector compaction, power dissipation in Domino logic, circuit reliability, power estimation at the circuit level, Estimation of maximum power: test generation based approach, steepest descent, generic based algorithm based approach.		
Mapping of Course Outcomes for Unit IV	**CO4: Illustrate the power estimation at logic and circuit level.**	
Unit V	**Software Design for Low Power**	**07 Hrs.**
Sources of software power dissipation, software power estimation: Gate level, architecture level, bus switching activity, instruction level power analysis, software power optimization: minimizing memory access costs, instruction selection and ordering, power management, Automated low power code generation, Co-design for low power.		
Mapping of Course Outcomes for Unit V	**CO5: Explain the software design for low power in various level**	
Unit VI	**Hardware Design for Low Power**	**06 Hrs.**
Adiabatic Switching Circuits, Battery-aware Synthesis, Variation tolerant design, CAD tools for low power synthesis.		
Mapping of Course Outcomes for Unit VI	**CO6: Able to use the CAD tools for low power synthesis**	

Learning Resources

Text Books:

1. Kaushik Roy and S. C. Prasad, “Low power CMOS VLSI Circuit Design”, Wiley Publication
2. Gary Yeap, “Practical Low Power Digital VLSI Design”, Springer
3. A. P. Chandrasekaran and R. W. Broadersen, “Low Power Digital CMOS Design”, Kluwer,1995

Reference Books:

1. J. B. Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley Publication
2. Dimitrios Soudris, Christians Pignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer.
3. James B. Kulo, Shih-Chia Lin, “Low voltage SOI CMOS VLSI devices and Circuits”, John Wiley and sons.
4. Steven M. Rubin, “Computer Aids for VLSI Design”, Addison Wesley Publishing
5. Abdelatif Belaouar, Mohamed. I. Elmasry, “Low power digital VLSI design”, Kluwer.

Online Resources:

1. https://www.youtube.com/watch?v=w0cSahiDvFQ
2. https://www.youtube.com/watch?v=LjDb6VQlOeQ
3. http://freevideolectures.com/Course/3059/Low-Power-VLSI-Circuits-and-Systems
4. http://www.springer.com/us/book/9788132219361

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404185 (E): Smart Antennas (Elective - IV)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory):70 Marks

Prerequisite Courses, if any:

1. Electromagnetic Field Theory
2. Cellular Networks

Companion Course, if any:

Course Objectives:

1. To understand design principles of various radiating elements.
2. To understand theory reconfiguration antenna and smart antenna.
3. To learn DOA estimation techniques for smart antenna.
4. To understand beam forming and MIMO technology.
5. The main focus will be on the 4G, 5G and beyond needs of antenna to improve the signal quality, power management and BW for higher data rate.

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

CO1: Compare various linear wire antenna and uniform array in terms of antenna parameters and analyze them based on the current distribution and identify an appropriate wire antenna for given application.

CO2: Classify Microstrip & re-configurable antenna and techniques.

CO3: Describe smart antenna systems and discuss the beam steering and mutual coupling effects.

CO4: Explain DOA estimation methods and classify.

CO5: Classify the beam forming methods.

CO6: Describe and Compare MIMO systems.

Course Contents

Unit I	Radiating Elements and Array	8 Hrs.

Comparison of various radiating elements- Infinitesimal dipole, small dipole, finite length dipole, half wave length dipole, and analytical treatment of these elements. Types of Array antenna, two element array, N-element array, Uniform amplitude-uniformed spaced linear broadside and end fire array.

Mapping of Course Outcomes for Unit I	CO1: Compare various linear wire antenna and uniform array in terms of antenna parameters and analyze them based on the current distribution and identify an appropriate wire antenna for given application.

Unit II	Microstrip and Reconfigurable Antenna	6 Hrs.

Microstrip antenna: Introduction, feeding techniques, Fractal antenna and array.

Re-configurable Antenna: Classification of re-configurable antenna, Re-configurable techniques, Multiple Re-configurable features in antenna.

Mapping of Course Outcomes for Unit II	CO2: Classify Microstrip & re-configurable antenna and techniques.

Unit III	Smart Antennas	8 Hrs.
Introduction, Need for Smart Antennas, Overview: Smart Antenna Configurations, Switched-Beam Antennas, Adaptive Antenna Approach, beam steering, degree of freedom. **Architecture of a Smart Antenna System:** Transmitter and Receiver, Types of Smart Antennas, Benefits and Drawbacks of Smart Antennas, Mutual Coupling Effects, Applications of Smart Antennas.		
Mapping of Course Outcomes for Unit III	**CO3: Describe smart antenna systems and discuss the beam steering and mutual coupling effects.**	
Unit IV	**Direction of Arrival Estimation (DOA) Methods**	**6 Hrs.**
Spectral estimation methods, linear prediction method, Maximum entropy method, Maximum likelihood method, Eigen structure methods, MUSIC algorithm – root music and cyclic music algorithm, the ESPRIT algorithm.		
Mapping of Course Outcomes for Unit IV	**CO4: Explain DOA estimation methods and classify.**	
Unit V	**Beam Forming Methods**	**6 Hrs.**
Classical Beam former, Statistically Optimum Beam-forming Weight Vectors, Maximum SNR Beam former, Multiple Sidelobe Canceler and Maximum, SINR Beam former, Minimum Mean Square Error (MMSE), Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV), Adaptive Algorithms for Beam forming.		
Mapping of Course Outcomes for Unit V	**CO5: Classify the beam forming methods.**	
Unit VI	**MIMO Antennas**	**6 Hrs.**
Introduction, Principles of MIMO systems: SISO, SIMO, MISO MIMO, Hybrid antenna array for mm Wave, massive MIMO: concept and applications.		
Mapping of Course Outcomes for Unit VI	**CO6: Describe and Compare MIMO systems.**	

Learning Resources

Text Books:

1. C.A. Balanis “Antenna Theory: Analysis and Design”, 4th Edition, John Wiley & Sons.
2. Lal Chand Godara, “Smart Antennas”, CRC Press, LLC-20.
3. Ahmed El Zooghby, “Smart Antenna Engineering**”,** ARTECH HOUSE, INC, 2005**.**

Reference Books:

1. C.A.Balanis,“Introduction to Smart Antennas”, John Wiley & Sons
2. Mohammod Ali, “Reconfigurable antenna Design and Analysis”, Publisher: Artech House
3. George Tsoulos,“ MIMO system technology for wireless communications”, CRC- Taylor & Francis.
4. Long Zhao, Hui Zhao , Kan Zheng, Wei Xiang,“Massive MIMO in 5G Networks: Selected Applications”, Springer.
5. Jian Li and Petre Stoica,“ Robust adaptive Beamforming”, John Wiley.

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404186: Lab Practice - 1

Teaching Scheme:	Credit	Examination Scheme:
Practical: 04 Hrs. / Week	02	Term Work: 25 Marks Oral: 50 Marks

Companion Course, if any:

1. Radiation and Microwave Theory
2. Cloud Computing

Guidelines for Student's Lab Journal

The student's Lab Journal can be experimental write-ups. It should include following as applicable: Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

Guidelines for Lab /TW Assessment

The oral examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.

Subject: Radiation and Microwave Theory

List of Experiments

1.	To study of different types of Microwave Components
2.	To measure radiation pattern and gain of horn or parabolic antenna at microwave frequency
3.	To measure and plot Mode characteristics of Reflex klystron.
4.	To measure V-I characteristics of Gunn Diode and study of PIN modulator.
5.	To measure and verify port characteristics of microwave tees (E, H, E-H or magic planes).
6.	To measure and verify port characteristics of directional coupler and calculate coupling factor, insertion loss and directivity.
7.	To measure and verify port characteristics of isolator and circulator and calculate insertion loss and isolation in dB.
8.	To measure wavelength of the microwave using microwave test bench and verify with its theoretical calculations.
9.	To plot standing wave pattern and measure SWR for open, short and matched termination at microwave frequency using slotted section with probe carriage.
10.	Study the network analyzer and carry out the measurements of s-parameters.
11.	To design and simulate any type of microwave antenna using EM simulation software.

Virtual Lab:

1. **https://www.ee.iitb.ac.in/course/~vel/ (Virtual Electromagnetics Lab.)**
2. **http://www.iitk.ac.in/mimt_lab/vlab/index.php (RF and Microwave Characterization Lab.)**

Subject: Cloud Computing	
List of Experiments (Any 6 to be performed)	
1.	Install Google App Engine. Create hello world app and other simple web applications using python / java.
2.	Use GAE launcher to launch the web applications.
3.	Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
4.	Find a procedure to transfer the files from one virtual machine to another virtual machine.
5.	Find a procedure to launch virtual machine using try stack (Online Openstack Demo Version)
6.	Design and deploy a PaaS environment.
7.	Design and develop custom Application (Mini Project) using Cloud (like Salesforce/GCP/AWS.)
8.	Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store.
Case Studies (Any 2 to be performed)	
1.	Data storage security in private cloud.
2.	Application of IoT / Ubiquitous based on cloud.
3.	Tools for building private cloud.
4.	Instance creation in cloud environment.

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404187: Lab Practice – 2

Teaching Scheme:	Credit	Examination Scheme:
Practical: 04 Hrs. / Week	02	Term Work: 25 Marks Practical: 50 Marks

Companion Course, if any:

1. VLSI Design and Technology
2. Speech Processing (Elective - III)
3. PLC SCADA and Automation (Elective - III)
4. JAVA Script (Elective - III)
5. Embedded System and RTOS (Elective - III)
6. Modernized IoT (Elective - III)

Guidelines for Student's Lab Journal

The student's Lab Journal can be experimental write-ups. It should include following as applicable: Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

Guidelines for Lab /TW Assessment

The oral examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.

Subject: VLSI Design and Technology

Part A: To write VHDL code, simulate with test bench, synthesis, implement on PLD **(Any 5 to be performed)**

1.	4 bit ALU for Add, Subtract, AND, NAND, OR, XOR & XNOR.
2.	Universal shift register with mode selection input for SISO, SIPO, PISO, & PIPO.
3.	Mod - N Counter
4.	FIFO memory
5.	LCD Interface
6.	Keypad interface

Part B: To prepare CMOS layout in selected technology, simulate with & without capacitive load, comment on rise & fall times. **(Any 3 to be performed)**

1.	Inverter, NAND, NOR gates
2.	Half Adder & Full Adder
3.	2:1 Mux using logic gates & transmission gates
4.	One bit SRAM Cell

Virtual Lab:

1. **https://vlsi-iitg.vlabs.ac.in (Digital VLSI Design Lab.)**
2. **https://cse14-iiith.vlabs.ac.in/ (VLSI Lab.)**

Subject: Speech Processing (Elective - III)

NOTE:

1. To perform the experiments software like Python, SCILAB, OCTAVE or **any appropriate open source software can be used.**
2. For analysis of speech signals tools like PRAAT, Audacity, WAVESURFER, WEKA can be used.

Part A (Any 7 to be performed)

1.	Record speech signals (isolated words, continuous speech) and analyse the speech signal using speech analysis tool (e.g. PRAAT). Observe spectrogram, pitch, formants, intensity etc.
2.	Write a program for extracting pitch period for a voiced part of the speech signal using autocorrelation method and average magnitude difference function (AMDF).
3.	Write a program to compute short time Energy and ZCR for different frame rates and comment on the result.
4.	Write a program to classify voiced, unvoiced and silence frames using frame level energy and zero crossing rate.
5.	Write a program to compute narrow band and wide band spectrogram. Comment on the time and frequency resolution of wide band and narrow band spectrogram.
6.	Write a program to design a Mel filter bank and using this filter bank write a program to extract MFCC features.
7.	Write a program to perform the cepstral analysis of speech signal and detect the pitch from the voiced part using cepstrum analysis.
8.	Write a program to enhance the noisy speech signal using spectral subtraction method.
9.	Write a program to extract frequency domain audio features like SC, SF and Spectral roll off.

Part B (Any 1 to be performed)

1.	Write a program for Automatic Speech Recognition using Convolutional Neural Networks (CNN) or Recurrent Neural Networks (RNN).
2.	Write a program for Text to Speech synthesis using Convolutional Neural Networks (CNN) or Recurrent Neural Networks (RNN).

Virtual Lab:

1. **https://ssp-iiith.vlabs.ac.in/Introduction.html**
2. **https://vlab.amrita.edu/index.php?sub=59&brch=164**

Speech database:

http://festvox.org/databases/iiit_voices/

Subject: PLC SCADA and Automation (Elective - III)	
Part A (Any 5 to be performed)	
1.	Implementation of Logic Gates Using PLC(Software/Hardware Implementation).
2.	Development of a ladder program for DOL Starter.
3.	Implementation of Boolean Expression using PLC(Software/Hardware Implementation).
4.	Traffic Light Control using PLC (Any Application of Timer using PLC will be accepted) (Software/Hardware Implementation).
5.	Counting Objects (Any Application of Counter using PLC will be accepted) (Software/Hardware Implementation).
6.	Interfacing of Encoder with PLC to control a particular application.
7.	Interfacing of Limit Switch/ Proximity Switch/or any sensor/sensors with PLC to control a particular application.
Part B (Any 2 to be performed)	
1.	Interfacing of RTD with PLC for Temperature control application.
2.	Motor speed control using PLC and VFD.
3.	Pneumatic Trainer Kit/Hydraulic Trainer Kit control using PLC.
4.	Close Loop control using PID Controller (Any One Parameter Like Temperature, Flow, Pressure, Level)
Part C (Any 1 to be performed)	
1.	Any Example Using SCADA.
2.	Study of Hardware and Software Platform for DCS **https://ial-coep.vlabs.ac.in/exp/software-platforms-dcs/procedure.html**
3.	PLC controlled Case study- 1: **[Faculty will give (or students will choose) one problem statement to a group of 2/3 students. Students will develop a program and simulate it on their own]** **Suggested case studies (Not Limited to)** **a. Bottle Filling Plant using PLC** **b. Operation of Lift (Elevator) using PLC** **c. PLC based Gas Detection System using Ladder Logic Project** **d. Alarm Management Systems using PLC** **e. Water Distribution System using PLC**
Virtual Lab: 1. **http://plc-coep.vlabs.ac.in/ (Programmable Logic Controller Lab.)** 2. **http://ial-coep.vlabs.ac.in/List%20of%20experiments.html (Industrial Automation Lab.)**	

Subject: JAVA Script (Elective - III)	
Part A (Compulsory)	
1.	Write a JavaScript program to calculate area of triangle, area of rectangle and area of circle
2.	Write a JavaScript program to generate the multiplication table of a given number.
3.	Write a JavaScript program to following operations on a given string, • Reverse string • Replace characters of a string. • String is Palindrome.
4.	Write a JavaScript program to compare two strings using various methods.
5.	Write a JavaScript program that will create a countdown timer.
Part B (Any 2 to be performed)	
1.	Write a JavaScript program that will create an array and perform following operations • To remove specific element from the array. • Check if an array contains a specified value. • To empty an array
2.	Write a JavaScript program that will append an object to an array and will check if an object is an array.
3.	Write a JavaScript program to illustrate different Set operations like- • Union • Intersection • Difference • Set Difference
Part C (Any 2 to be performed)	
1.	Write a JavaScript program to create a Home page of any website and change background color using • On mouse over event • On focus event
2.	Create a student information Form to accept information like Name, Address, City, State Gender, Mobile Number, and email id. Perform validations for: • Correct Names • Mobile Names • Email I.D.'s • If no entered value • Re-display for wrongly entered values with message • Congratulation and Welcome page upon successful entries
3.	Design and implement a simple calculator using Java script for operations like addition multiplication, subtraction, division, square of a number etc: • Design a calculator like text field for input and output, buttons for numbers and operations etc. • Validate input values • Prompt / Alerts for invalid values etc.

Virtual Lab:

1. **https://cse02-iiith.vlabs.ac.in/List%20of%20experiments.html (Computer Programming Lab.)**

Subject: Embedded System and RTOS (Elective - III)	
Part A (Any 4 to be performed)	
NOTE: Practicals from 1 to 5 in Group A can be performed using µCOS -II / Free RTOS on ARM 7 / ARM Cotex – M / Arduino	
1.	Multitasking in µCOS II RTOS using minimum 3 tasks on ARM7/ ARM Cortex- M.
2.	Semaphore as signaling & Synchronizing on ARM7/ ARM Cortex- M.
3.	Mailbox implementation for message passing on ARM7/ ARM Cortex- M.
4.	Queue implementation for message passing on ARM7/ ARM Cortex- M.
5.	Implementation of MUTEX using minimum 3 tasks on ARM7/ ARM Cortex- M.
6.	Porting of linux operating system on ARM9/ARM Cortex-M.
Part B (Any 4 to be performed)	
1.	Interfacing sensors and actuators with Arduino Uno- Door opener using Ultrasonic sensor and servo motor.
2.	Weather Station- Build a cloud-ready temperature and Humidity sensor (DHT-11/22) with the Node MCU and the any IoT Platform.
3.	IoT based Wireless Controlled Home Automation using ESP8266.
4.	Interfacing of 4 LED bank with Raspberry Pi to blink.
5.	Interfacing Sensors and actuators with Raspberry Pi- Hand gesture robot.

Virtual Lab:

1. **https://docs.simuli.co/getting-started/arduino/arduino-ide-and-vlab**

2. **https://docs.simuli.co/getting-started/raspberry-pi/setting-up-iotify-virtual-lab**

Subject: Modernized IoT (Elective – III)	
List of Experiments	
1.	Study of Raspberry-Pi, Beagle board, Arduino, and different operating systems for Raspberry-Pi/Beagle board/Arduino. Understanding the process of OS installation on Raspberry-Pi/Beagle board/Arduino
2.	Open-source prototype platform- Raspberry-Pi/Beagle board/Arduino -Simple program digital read/write using LED and Switch -Analog read/write using sensor and actuators.
3.	Interfacing sensors and actuators with Arduino/Raspberry-pi.
4.	IoT based Stepper Motor/DC Motor Control with Arduino/Raspberry Pi.
5.	Introduction to MQTT/ CoAP and sending sensor data to cloud using Raspberry-Pi/Beagle board/Arduino.
6.	Get the status of a bulb at a remote place (on the LAN) through web.
7.	Interfacing Arduino to Bluetooth Module
8.	Communicate between Arduino and Raspberry PI using any wireless medium like ZigBee
9.	IoT based small project implementation on the topics based on small problem statements of the fields like chat bot, smart home (Home Automation), social issues and environmental issues etc. This project can be built on any IoT simulation platform like Tinkercad, Cooja etc.

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404188: Project Phase – I

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / Week	01	Term Work: 50 Marks

Course Objectives:

- To understand the basic concepts & broad principles of projects.
- To understand the value of achieving perfection in project implementation & completion.
- To apply the theoretical concepts to solve real life problems with teamwork and Multidisciplinary approach.
- To demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context.

Course Outcomes:

CO1: Demonstrate a sound technical knowledge in field of E&TC in the form of project.
CO2: Undertake real life problem identification, formulation and solution.
CO3: Design engineering solutions to complex problems utilizing a systematic approach.
CO4: Demonstrate the knowledge, effective communication skills and attitudes as professional engineer.

Project phase 1 is an integral part of the project work. The project work shall be based on the knowledge acquired by the student during the graduation and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems in the field of Electronics and communication where the student likes to acquire specialized skills. The student shall prepare the duly certified Fourth report of project work in standard format for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

Guidelines:

1. Group Size: The student shall carry the project work individually or by a group of students. Optimum group size shall be 3 students. However, if project complexity demands a maximum group size of 4 students, the project committee should be convinced about such complexity and scope of the work. Projects selected should meet and contribute towards the needs of the society.
2. Selection and approval of topic: Topic should be related to real life application in the field of Electronics and Telecommunication engineering.
3. The topic may be based on : Investigation of the latest development in a specific field of Electronics or Communication / The investigation of practical problem in manufacture and / or testing of electronics or communication equipment/ Software based projects related to VHDL, Communication, Instrumentation, Signal Processing agriculture Engineering etc. with the justification for techniques used / any topic in the field of E&TC may be allowed.
4. Interdisciplinary projects should be encouraged. The examination of Interdisciplinary projects shall be conducted independently in respective departments.
5. The term work assessment of project phase 1 shall be based on Innovative Idea of selected project, literature survey, Depth of understanding, Applications, Individual contributions, presentation, project report, timely completion of work.
6. The department should prepare project planner and should follow accordingly
7. A log book of work carried out during the semester should be maintained with weekly review remarks by the guide and committee.
8. A certified copy of report preferably using LATEX is required to be presented to external examiner at the time of Fourth examination.
9. The project report must undergo by plagiarism check and the similarity index must be less than 15%. The plagiarism report should be included in the project report.

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404189: Mandatory Audit Course - 7		
Teaching Scheme:	**Credit**	**Examination Scheme:**
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GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory 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 the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

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:

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 www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.

- After clearing the examination successfully; student will be awarded with certificate.

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.
- 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, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.

SEMESTER - VIII

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404190: Fiber Optic Communication

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Digital Communication
2. Electromagnetics Field Theory

Companion Course, if any:

1. Fiber Optic Lab

Course Objectives:

1. To familiarize learners with various components & equipments used in fiber optic communication systems.
2. To study the impact of choice of components on system design.
3. To introduce students to the WDM components and their role in capacity upgrade.
4. To extend the fundamentals to design and analysis of fiber optic communication links.
5. Expose students to the measurement standards, specifications and state of art developments in optical networks.

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

CO1: Explain the working of components and measurement equipments in optical fiber networks.

CO2: Calculate the important parameters associated with optical components used in fiber optic telecommunication systems.

CO3: Compare and contrast the performance of major components in optical links.

CO4: Evaluate the performance viability of optical links using the power and rise time budget analysis.

CO5: Design digital optical link by proper selection of components and check its viability using simulation tools.

CO6: Compile technical information related to state of art components, standards, simulation tools and current technological trends by accessing the online resources to update their domain knowledge.

Course Contents

Unit I	Optical Fibers for Telecommunication	8 Hrs.

Fundamentals of Optical Communication: EM spectrum - Optical Spectral bands, Shannon channel capacity, power units (watts, dB & dBm), Block diagram of optical fiber communications link, advantages of optical fibers.

Optical Fiber Waveguides: Introduction, Total internal reflection, acceptance angle, numerical aperture, fiber types, mode theory for circular waveguides: overview of modes & key modal concepts (V number, number of modes, power in clad), single mode fibers, cutoff wavelength

Transmission characteristics of optical fibers: attenuation - material absorption, scattering losses, fiber bend loss, loss due to fiber misalignment, splices and connectors; **signal distortion** - intermodal delay, intramodal dispersion or chromatic dispersion, modal delay, bit rate-distance product, plot of material & waveguide dispersions for standard single mode, dispersion shifted and dispersion flattened fibers; optical fibers for 5G networks, comparison.

Mapping of Course Outcomes for Unit I	**CO1: Explain the working of components and measurement equipments in optical fiber networks.** **CO2: Calculate the important parameters associated with optical components used in fiber optic telecommunication systems.** **CO3: Compare and contrast the performance of major components in optical links.**

Unit II	**Optical Sources**	**7 Hrs.**

Optical Sources: Introduction, wavelength and material consideration (direct & indirect bandgap semiconductors); requirements from optical sources for telecommunication.

LED: principle of working, quantum efficiency, optical output power characteristics, spectral width, effect of temperature on characteristics, modulation bandwidth, analog modulation, digital modulation, LED analog transmitter;

Semiconductor Laser Diodes: absorption, spontaneous emission, stimulated emission, concept of population inversion and optical feedback, output power characteristics of LASER; Bias point and amplitude modulation range for analog applications of LEDs & laser diodes, comparison of LEDs & Lasers.

Mapping of Course Outcomes for Unit II:	**CO1: Explain the working of components and measurement equipments in optical fiber networks.** **CO2: Calculate the important parameters associated with optical components used in fiber optic telecommunication systems.** **CO3: Compare and contrast the performance of major components in optical links.**

Unit III	**Photodetectors**	**6 Hrs.**

Introduction, requirements from optical detectors, material considerations, types: p-n, pin, Avalanche photodiode, photo transistor, principle of working, quantum efficiency, responsivity, long cutoff wavelength, detector response time, comparison of photodetectors, thermal noise, dark current noise, quantum noise and receiver sensitivity, bit error rate

Mapping of Course Outcomes for Unit III	**CO1: Explain the working of components and measurement equipments in optical fiber networks.** **CO2: Calculate the important parameters associated with optical components used in fiber optic telecommunication systems.** **CO3: Compare and contrast the performance of major components in optical links.**

Unit IV	**Fiber Optic Link Design & WDM Systems**	**8 Hrs.**

Point to point optical link: Choice of components, system design considerations, optical power budget, rise time budget, bit rate for RZ and NRZ pulse format. Optical system design and performance analysis using software tools.

WDM Concepts & Components: Overview of WDM, WDM components: 2 x 2 fiber coupler, isolator, circulator, basics of fiber grating filters, optical add/drop multiplexer, architecture of optical amplifiers (SOA, EDFA & FRA), Noise figure, OSNR & system impact of ASE.

Mapping of Course Outcomes for Unit IV	**CO1: Explain the working of components and measurement equipments in optical fiber networks.** **CO4: Evaluate the performance viability of optical links using the power and rise time budget analysis.** **CO5: Design digital optical link by proper selection of components and check its viability using simulation tools.**

Unit V	**Optical Networks**	**7 Hrs.**

Optical Network concepts: fundamentals, network terminology, desirable properties, elements of an optical network, optical network topology types, advantages of optical network.
Overview of Optical Networks: FDDI, SONET/SDH, FTTX, FTTP, FTTH, PON, **GPON,** Long haul, Metro, Access, Submarine optical networks, role of fiber optic network in the 5G networks. Current technology trends, standards and challenges.

Mapping of Course Outcomes for Unit V	**CO6: Compile technical information related to the state of art components, standards, simulation tools and current technological trends by accessing the online resources to update their domain knowledge.**

Unit VI	**Optical Fiber Measurements**	**6 Hrs.**

Overview of Measurement Standards for fiber optics:
Test Equipments for field work: Test support lasers, visual fault indicator, optical power meter, Optical Time Domain Reflectometry (OTDR), optical spectrum analyzer (OSA), BER test equipment
Measurements: measurement of: optical power, numerical aperture of fiber, fiber attenuation (cutback method, insertion loss method, OTDR), macrobending loss, fiber dispersion
System performance evaluation: Eye Diagram Test, study of OTDR.

Mapping of Course Outcomes for Unit VI	**CO1: Explain the working of components and measurement equipments in optical fiber networks.** **CO6: Compile technical information related to state of art components, standards, simulation tools and current technological trends by accessing the online resources to update their domain knowledge.**

Learning Resources

Text Books:

1. Gerd Keiser, "Optical Fiber Communications" 4th Edition, Tata McGraw Hill.
2. John M Senior, "Optical Fiber Communications" 2nd Edition, PHI.

Reference Books:

1. Djafar K Mynbaev and Lowell L Scheiner, "Fiber Optic Communications Technology", 1st Edition, Pearson Education.
2. Uyless Black, "Optical Networks- Third Generation Transport Systems", Pearson Education.
3. Govind P Agrawal, "Fiber Optic Communication Systems", 3rd Edition, Wiley India.
4. Fredrick C Allard, "Fiber Optics Handbook for Engineers & Scientists", MH International

MOOC / NPTEL Courses:

1. NPTEL Course on "**Advanced Optical Communication***",* by Prof R K Shevgaonkar, IIT Madras

   Link of the Course: https://nptel.ac.in/courses/117101002

2. NPTEL Course on "Fiber Communication Technology", by Prof Deepa Venkitesh, IIT Madras

   Link of the Course: https://nptel.ac.in/courses/108106167

3. NPTEL Course on "Fiber- Optic Communication Systems & Techniques", by Dr Pradeep Kumar K, IIT Kanpur

   Link of the Course: https://nptel.ac.in/courses/108104113

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404191 (A): Biomedical Signal Processing (Elective - V)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End-Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Digital Signal Processing

Companion Course, if any:

1. Lab Practice -3

Course Objectives:

1. To understand the basic biomedical signals .
2. To study origins and characteristics of most commonly used biomedical signals, including ECG, EEG, Evoked potentials, and EMG.
3. To Study the signal acquisition and preprocessing of physiological signals.
4. To study the extraction of meaningful information to identify patterns and trends within the signals.
5. To understand the Sources and characteristics of noise and artifacts in bio signals

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

CO1: Describe the origin of various biomedical signals and Interpret the meaning of various parameters associated with biomedical signals

CO2: Analyze ECG Signals with extraction of meaningful information

CO3: Explain Processing of EEG signals for Diseases of Central Nervous System

CO4: Analyze EMG signals for understanding Neuromuscular Diseases

CO5: Analyze various Biomedical Signals

CO6: Process the biomedical signals to remove adaptive interference and noise

Course Contents

Unit I	Introduction to Biomedical Signals	7 Hrs.

Introduction and Overview, Ion Transport in Biological Cells, Trans membrane Potential, Electric Characteristics of Cell Membrane, Membrane Resistance, Membrane Capacitance , Cell Membrane's Equivalent Electric Circuit, Action Potential, Electric Data Acquisition, Propagation of Electric Potential as a Wave , Some Practical Considerations on Biomedical Electrode Summary

Mapping of Course Outcomes for Unit I	CO1: Describe the origin of various biomedical signals and Interpret the meaning of various parameters associated with biomedical signals

Unit II	Cardiological Signal Processing	7 Hrs.

Function and Structure of the Heart- Cardiac Muscle, Cardiac Excitation Process

Electrocardiogram: Signal of Cardiovascular System - Origin of ECG, ECG Electrode Placement, Modeling and Representation of ECG, Periodicity of ECG Heart Rate, Cardiovascular Diseases and ECG- Atrial Fibrillation, Ventricular Arrhythmias, Ventricular Tachycardia, Ventricular Fibrillation, Myocardial Infarction, Atrial Flutter, Cardiac Reentry, Atrioventricular Block, Wolf–Parkinson–White Syndrome, Extrasystole Processing and Feature Extraction of ECG- Time-Domain Analysis, Frequency-Domain Analysis, Wavelet-Domain Analysis

Mapping of Course Outcomes for Unit II	**CO 2: Analyze ECG Signals for extraction of meaningful information**	
Unit III	**Neurological Signal Processing**	**7 Hrs.**
Brain and Its Functions **Electroencephalogram:** Signal of the Brain- EEG Frequency Spectrum, Significance of EEG, Evoked Potentials- Auditory-Evoked Potentials, Somatosensory-Evoked Potentials, Visual-Evoked Potentials, Event-Related Potentials, Diseases of Central Nervous System and EEG- Epilepsy, Sleep Disorders, Brain Tumor Processing and Feature Extraction of EEG- Sources of Noise on EEG, Frequency-Domain Analysis, Time-Domain Analysis, Wavelet-Domain Analysis		
Mapping of Course Outcomes for Unit III	**CO 3: Explain use of EEG signals for Diseases of Central Nervous System.**	
Unit IV	**Electromyogram (EMG)**	**7 Hrs.**
Muscle- Motor Unit, Muscle Contraction, Muscle EMG: Signal of Muscles- Significance of EMG Neuromuscular Diseases and EMG- Abnormal Enervation, Pathological Motor Units, Neuromuscular Transmission in Motor Units, Defects in Muscle Cell Membrane Processing and Feature Extraction of EMG- Sources of Noise on EMG, Time-Domain Analysis, Frequency- and Wavelet-Domain Analysis		
Mapping of Course Outcomes for Unit IV	**CO 4: Analyze EMG signals for understanding Neuromuscular Diseases.**	
Unit V	**Other Biomedical Signals**	**6 Hrs.**
Introduction and Overview, Blood Pressure and Blood Flow, Electrooculogram, Respiratory Signals Magneto encephalogram,		
Mapping of Course Outcomes for Unit V	CO5: Analyze the various Biomedical Signals.	
Unit VI	**Adaptive interference / Noise Cancellation**	**6 Hrs.**
Types of noise in bio signals: **Digital filters:** IIR and FIR, Notch filters , Optimal and adaptive filters, Weiner filters. LMS adaptive algorithm, Steepest descent algorithm **Adaptive noise canceller:** Cancellation of 50 Hz signal in ECG		
Mapping of Course Outcomes for Unit VI	**CO6: Process the biomedical signals to remove adaptive interference and noise.**	
Learning Resources		
Text Books: 1. Kayvan Najarian, Robert Splinter, "Biomedical Signal and Image Processing", 2nd Edition, CRC Press 2. R. Rangayan, "Biomedical Signal Analysis", Wiley		

Reference Books:

1. R.S.Khandpur, “Handbook of Biomedical Instrumentation”, 2nd Edition,Tata McGraw Hill,
2. C.Reddy “Biomedical Signal Processing: Principles and techniques”, Tata McGraw Hill.
3. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th Edition, Prentice Hall.

MOOC / NPTEL Courses:

1. NPTEL Course on “**Biomedical Signal Processing***”,* by Prof Sudipta Mukhopadhyay, IIT Kharagpur

   Link of the Course: https://nptel.ac.in/courses/108105101

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404191 (B): Industrial Drives & Control (Elective - V)

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

Prerequisite Courses, if any:

1. Basic Electrical Engineering
2. Electronic Circuits
3. Electrical Circuits
4. Power Devices and Converters

Companion Course, if any:

1. Lab Practice -3

Course Objectives:

1. To introduce components of electrical drives and its parameters .
2. To understand working, design and performance analysis of DC motor drives, Induction motor and stepper motor drives.
3. To know various protections circuit required for motor drives.

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

CO1: Understand significance and design of various components of electrical drives.

CO2: **Develop**, evaluate and analyze the performance of DC motor drives.

CO3: Design, estimate and examine the performance of chopper controlled DC drives.

CO4: Adapt, choose and categorize performance of PWM inverter drives for Induction motors.

CO5: **Elaborate**, interpret and analyze the performance of Synchronous motor drive.

CO6: **Develop**, explain and examine performance of stepper motor control.

Course Contents

Unit I	Components of Electrical Drives	6 Hrs.

Electric machines, Power converter, Controllers, Dynamics of electric drive - torque equation - equivalent values of drive parameters- components of load torques types of load – four-quadrant operation of a motor – steady state stability – load equalization – classes of motor duty determination of motor rating.

Mapping of Course Outcomes for Unit I	CO1: Understand significance and design of various components of electrical drives.

Unit II	DC Motor Drives	6 Hrs.

DC motors & their performance (shunt, series, compound, permanent magnet motor, universal motor, dc servomotor) – braking – regenerative, dynamic braking, plugging –Transient analysis of separately excited motor – converter control of dc motors – analysis of separately excited & series with 1-phase and 3-phase converters ,soft start and field failure protection in DC drives, BLDC motor drive

Mapping of Course Outcomes for Unit II	CO2: Develop, evaluate and analyze the performance of DC motor drives.

Unit III	Chopper Controlled DC Drives	6 Hrs.
Closed loop control – transfer function of self, separately excited DC motors – linear transfer function model of power converters – sensing and feeds back elements – current and speed loops, P, PI and PID controllers – response comparison – simulation of converter and chopper fed DC drive		
Mapping of Course Outcomes for Unit III	**CO3: Design, estimate and examine the performance of chopper Controlled DC drives.**	
Unit IV	**PWM Drives for Induction Motors**	**6 Hrs.**
Multi quadrant drives – rotor resistance control – slip torque characteristic – torque equations, constant torque operation – slip power recovery scheme – torque equation – torque slip characteristics – power factor – methods of improving power factor – limited sub synchronous speed operation – super synchronous speed operation		
Mapping of Course Outcomes for Unit IV	**CO4: Adapt, choose and categorize performance of PWM inverter drives for Induction motors.**	
Unit V	**Synchronous Motor Drives**	**6 Hrs.**
Synchronous motor drives – speed control of synchronous motors – adjustable frequency operation of synchronous motors – principles of synchronous motor control – voltage source inverter drive with open loop control		
Mapping of Course Outcomes for Unit V	**CO5: Elaborate, interpret and analyze the performance of Synchronous motor drive.**	
Unit VI	**Stepper Motors**	**6 Hrs.**
Constructional features, principle of operation, modes of excitation, single phase stepping motors, torque production in variable Reluctance (VR) stepping motor, Dynamic characteristics, Drive systems and circuit for open loop control, Closed loop control of stepping motor, microprocessor based controller.		
Mapping of Course Outcomes for Unit VI	**CO6: Develop, explain and examine performance of stepper motor control.**	

Learning Resources

Text Books:

1. R. Krishnan, “Electrical Motor Drives: Modeling, Analysis, and Control”, PHI
2. G. K.Dubey, “Fundamentals of Electrical Drives”, Narosa Publishers

Reference Books:

1. K.Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall.
2. S.A. Nasar, Boldea, “Electrical Drives”, 2nd Edition, CRC Press.
3. M. A. ElSharkawi , “Fundamentals of Electrical Drives” , Thomson Learning.
4. W. Leohnard, “Control of Electric Drives”, Springer.
5. Murphy and Turnbull, “Power Electronic Control of AC motors”, Pergamon Press.
6. Vedam Subrahmaniam, “Electric Drives: Concepts and Applications”, McGraw Hill

MOOC / NPTEL Courses:

1. NPTEL Course on "**Power Electronics***",* Prof. D.Prasad, Prof. N.K. De, Dr. D.Kastha, Prof. Sabyasachi Sengupta, IIT Kharagpur
   Link of the Course: https://nptel.ac.in/courses/108105066

2. NPTEL Course on "**Power Electronics***",* Prof. G.Bhuvanseshwari, IIT Delhi
   Link of the Course: https://nptel.ac.in/courses/108102145

3. NPTEL Course on "**Advanced Power Electronics and Control***",* Prof. Avik Bhattacharya, IIT Roorkee
   Link of the Course: https://nptel.ac.in/courses/108107128

4. NPTEL Course on "**Industrial Drives: Power Electronics***",* Prof. K.Gopakumar, IISc Bangalore
   Link of the Course: https://nptel.ac.in/courses/108108077

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404191 (C): Android Development (Elective - V)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End-Sem (Theory): 70 Marks**

Prerequisite Courses, if any:

1. Object Oriented Programming

Companion Course, if any:

Course Objectives:

1. To understand the Android Operating System.
2. To study Android Apps Development Cycle.
3. To learn to create Android Applications.

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

CO1: Describe the process of developing mobile applications.

CO2: Create mobile applications on the different android platform.

CO3: Design and implement mobile applications involving data storage in databases.

Course Contents

Unit I	Introduction to JAVA and Android	5 Hrs.

Overview of Java, XML and SQL, History of Android, Android Stack, Android Project Structure, Android OS, Features of Android, Android Architecture and building blocks, Android App build process, Android UI– resources, themes, threads etc,

Mapping of Course Outcomes for Unit I	CO1: Describe the process of developing mobile applications.

Unit II	**Introducing Android**	**5 Hrs.**

SDK Overview, Android Emulator, Android Installation, setting up development environment using Eclipse/ Android Studio, DDMS, Activity Lifecycle, Manifest File, Locales, Drawable, Listeners, Supporting Multiple Screens.

Mapping of Course Outcomes for Unit II	CO1: Describe the process of developing mobile applications.

Unit III	**Android Application Structure**	**8 Hrs.**

Android basic building blocks: Activities, Services, Broadcast Receivers & Content providers, UI Components - Views & notifications, Components for communication -Intents & Intent Filters, Android API levels (versions & version names) AndroidManifest.xml, Uses-permission & uses-sdk, Dalvik Virtual Machine & .apk file extension, Resources & R.java, Assets, Layouts & Drawable Resources, Activities and Activity lifecycle, First sample Application.

Mapping of Course Outcomes for Unit III	CO2: Create mobile applications on the different android platform.

Unit IV	Activities, Fragments, Intents and Android User Interface	8 Hrs.
Introduction to Activities, Activity Lifecycle, Introduction to Intents, Linking Activities using Intents, calling built-in applications using Intents, Introduction to Fragments, Adding Fragments Dynamically, Lifecycle of Fragment, Toast, Understanding the components of a screen, Adapting to Display Orientation, Split Screen / Multi-Screen Activities.		
Mapping of Course Outcomes for Unit IV	**CO2: Create mobile applications on the different android platform.**	
Unit V	**Designing User Interface with Widgets**	**8 Hrs.**
Using Basic Views: Text View, Button, ImageButton, EditText, CheckBox, Switch, ToggleButton, Radio Button, and Radio Group Views, ProgressBar View, AutoCompleteTextView View, Using Picker Views, Using RecyclerView to Display Long Lists, Understanding Specialized Fragments, Displaying Pictures and Menus, VideoView. **Multimedia, Animation and Graphics:** Playing Audio, Playing Video, Rotate Animation, Fade In / Fade Out Animation, Zoom Animation, Scale Animation, 2D and 3D Graphics.		
Mapping of Course Outcomes for Unit V	**CO3: Design and implement mobile applications involving data storage in databases.**	
Unit VI	**Databases, Location-Based Services and Google Map**	**8 Hrs.**
Data Storage: Shared Preferences, Internal Storage, External Storage, SQLite Databases, Content provider. and Remote Databases. Introduction to SQLite and Room library, SQLite Open Helper and SQLite Database, Creating, opening and closing database, Creating, opening and closing database, Building and executing queries, SMS Messaging, Sending E-mail, Web App**,** JSON Parsing, JSON Web Service, Display Google Maps, Getting Location Data, Monitoring a Location. Accessing Phone services (Call, SMS, MMS), Network connectivity services, Sensors, Bluetooth/Wi-Fi Connectivity.		
Mapping of Course Outcomes for Unit VI	**CO3: Design and implement mobile applications involving data storage in databases.**	

Learning Resources

Text Books:

1. David Griffiths and Dawn Griffiths, “Head First Android Development: A Brain-Friendly Guide”, 2nd Edition, Shroff / O’Reily Publication
2. Barry Burd, “Java Programming for Android Developers for Dummies”, 2nd Edition, Dummies.
3. Wei-Meng Lee, “Beginning Android 4 Application Development”, WROX Publication

Reference Books:

1. Herbert Schildt, “Java: The Complete Reference”, 9th Edition, Tata McGraw Hill
2. Reto Meier, “Professional Android 4 Application Development”, John Wiley and sons
3. John Horton, “Android Programming for Beginners”, 3rd Edition, Packt Publication

MOOC / NPTEL Courses:

1. NPTEL Course on "**Introduction to Mobile Application Development***",* by Prof. G.Raina, T.Gopal , IIT Madras
   Link of the Course: https://nptel.ac.in/courses/106106156

2. Swayam Course on "**Android Mobile Application Development**", by Dr. Himanshu.N.Patel, Dr. Babasaheb Ambedkar Open University Ahmedabad.
   Link of the Course: https://onlinecourses.swayam2.ac.in/nou21_ge41/preview

Ebooks:

1. https://enos.itcollege.ee/~jpoial/allalaadimised/reading/Android-Programming- Cookbook.pdf.
2. https://www.programming-book.com/download/?file=10988
3. https://www.programmer-books.com/professional-android-4th-edition-pdf/

Websites:

1. https://developer.android.com
2. https://www.javatpoint.com/android-tutorial

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404191 (D): Embedded System Design (Elective - V)

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

Prerequisite Courses, if any:

Companion Course, if any:

1. Lab Practice -3

Course Objectives:

1. To define design considerations of the embedded system.
2. To utilize specific resources of embedded processor.
3. To integrate embedded hardware and software.
4. To design embedded system as per the application

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

CO1: Apply the design aspects of Embedded system.
CO2: Create and debug a firmware for the Embedded System using ARM Cortex M4.
CO3: Develop a specific software code for the functionality of the Embedded System.
CO4: Utilize an open source RTOS for embedded system design.
CO5: Design an advanced embedded system.
CO6: Explore Embedded Android system.

Course Contents

Unit I	Introduction to Embedded System Design	6 Hrs.

Embedded System fundamental, Design Technology, Design challenges, Design productivity gap. Classification and Characteristics of Embedded System, Design Process and Skills required. Designer. Processor to be embedded into a system**:** Microprocessors and Microcontrollers, Embedded system hardware components and software architecture**:** Round Robin, FQS, RTOS, and selection of architecture. Integration of embedded hardware and software. Embedded software development tools and debugging techniques. Embedded system design cycle.

Mapping of Course Outcomes for Unit I	CO1: Apply the design aspects of Embedded system.

Unit II	**Embedded Processor ARM Cortex M4**	**8Hrs.**

Comparison of STM32F family and MCU selection criteria for specific application, Architectural review of STM32F4XX MCU**:** Pin diagram, CPU, Memory, GPIO, Clock and Timer module, ADC-DAC module, Study of STM32F4 Development board, Software development tool SM32CubeIDE IDEs for STM32; Interfacing requirements issues, GPIO configuration of STM32F4, interfacing of input switch, heavy loads (sample program mapping with any application), Concept of Watchdog timer and RTC, Configure an UART Setup with the STM32F4 Microcontroller. Debugging with SM32CubeIDE.

Mapping of Course Outcomes for Unit II	CO2: Create and debug a firmware for the Embedded System using ARM Cortex M4.

Unit III	GPIO and HAL	6 Hrs.
Overview of Hardware Abstraction Layer (HAL) drivers; HAL data structure, API classification, naming rules, Configuration, GPIO HAL API, Driving a GPIO.GPIO ports function and their relationship to HAL, , Use of HAL library for SPI, I2C and CAN module, USB Modules in the STM32F4Microcontroller.		
Mapping of Course Outcomes for Unit III	**CO3: Develop a specific software code for the functionality of the Embedded System.**	
Unit IV	**RTOS for STM32F4**	**8 Hrs.**
Reviewing the concepts underlying an RTOS, Introduction to FreeRTOS. Configure FreeRTOS Using STM32CubeMX, Thread Management, FreeRTOS and the C stdlib, Synchronization Primitives, Debugging features of FreeRTOS, debugging with STM32CubeIDE. Alternatives open source RTOS to FreeRTOS: ChibiOS and Contiki OS. Create a FreeRTOS project in STM32CubeIDE. Write C code for any task/event/thread with FreeRTOS		
Mapping of Course Outcomes for Unit IV	**CO4: Utilize an open source RTOS for embedded system design.**	
Unit V	**Embedded System Design with STM32**	**6 Hrs.**
Interfacing with SPI based graphical LCD with STM32F4, interfacing the Touch Screen with STM32F4, Installing TouchGFX for Graphical User Interface (GUI), GUI Formation with TouchGFX for any two applications. Design an embedded system for any two applications like Image transfer between PC and STM32F4, PID speed control of DC motor, Transferring the Digital Signal Between the PC and STM32F4 Microcontroller.		
Mapping of Course Outcomes for Unit V	**CO5: Design an advanced embedded system.**	
Unit VI	**Embedded Android**	**6 Hrs.**
Features and characteristics of Android, different android platforms, requirements of android, App development tools, Overall architecture of Android, Linux Kernel, Hardware Abstraction Layer, Loading and interfacing methods. Device hardware methods and interfaces, File system layout, Libraries: within AOSP and imported into the AOSP(Android Open Source Project)		
Mapping of Course Outcomes for Unit VI	**CO6: Explore Embedded Android system.**	

Learning Resources

Text Books:

1. Frank Vahid, Tony-Givargis, “Embedded System Design”, 3rd Edition Wiley India Publications.
2. David Simon, “An Embedded Software Primer”, 2nd Edition, Pearson Publication.
3. Cem Unsalan, Huseyin Deniz Gurhan, Mehmet Erkin Yucel, “Embedded System Design with Arm Cortex-M”, Spinger.

Reference Books:

1. Carmine Noviello, “Mastering STM32”, 2nd Edition, Lean Publisher.
2. Muhamad Ali Mazidi, Shujen Chen, Eshragh, “STM32 ARM Programming for Embedded Systems”.
3. Donald Norris, “Programming with STM32”, Mc Graw Hill Publication,
4. KarimYagbmour, “Embedded Android”, 1st Edition, O’Reilly publishers.
5. RM0390 Reference manual, STM32F446xx advanced Arm®-based 32-bit MCUs

MOOC/NPTEL Courses:

1. NPTEL Course on, **“Introduction to Embedded System Design”**, by Prof. D.V.Gadre, Prof.B.N. Subudhi IIT Jammu

Link of the course: https://nptel.ac.in/courses/108102169

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404191 (E): Mobile Computing (Elective - V)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Basics of Communication Technologies.
2. Fundamental of Networking

Companion Course, if any:

Course Objectives:

1. To learn Wireless technologies and planning Ad-hoc Network.
2. To study the basics of wireless, cellular technology and the working of Mobile IP, ad hoc network, features of mobile operating systems.
3. To understand the use of M-Commerce application.

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

CO1: Understand concepts of Mobile Communication.

CO2: Analyse next generation Mobile Communication System.

CO3: Understand network layers of Mobile Communication.

CO4: Understand IP and Transport layers of Mobile Communication.

CO5: Study of different mathematical models.

CO6: Understand different mobile applications.

Course Contents

Unit I	Introduction to Mobile Computing	6 Hrs.

Introduction to Mobile Computing: Applications of Mobile Computing- Generations of Mobile Communication Technologies, Multiplexing: Spread spectrum, MAC Protocols: SDMA, TDMA, FDMA, and CDMA.

Mapping of Course Outcomes for Unit I	CO1: Understand concepts of Mobile Communication.

Unit II	Mobile Telecommunication System	7 Hrs.

Introduction to Cellular Systems, GSM architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, GPRS and UMTS: Architecture, Handover, Security.

Introduction to 5G: Introduction, 5G network architecture, Applications, 5G enable technologies, Recent trends in Telecommunication Industries.

Mapping of Course Outcomes for Unit II	CO2: Analyse next generation Mobile Communication System.

Unit III	Network Layer	6 Hrs.
Mobile IP, DHCP, AdHoc, Proactive protocol-DSDV, Reactive Routing Protocols: DSR, AODV, Hybrid routing: ZRP, Multicast Routing: ODMRP, Vehicular Ad Hoc networks (VANET), MANET Vs VANET: Security.		
Mapping of Course Outcomes for Unit III	**CO3: Understand network layers of Mobile Communication.**	
Unit IV	**Mobile IP and Transport Layer**	**8 Hrs.**
Mobile IP: Need of mobile IP, IP packet delivery, Agent Discovery, Registration, Tunnelling and encapsulation, Route optimization, IP Handoff. **Transport Layer:** Overview of Traditional TCP and implications of mobility control. Improvement of TCP: Indirect TCP, Snoop TCP, Mobile TCP, Fast Retransmit/fast recovery, Time-out freezing, Selective retransmission, Transaction-oriented TCP.		
Mapping of Course Outcomes for Unit IV	**CO4: Understand IP and TCP layers of Mobile Communication.**	
Unit V	**Fading Channels**	**7 Hrs.**
Rayleigh Fading and Statistical Characterization, Properties of Rayleigh Distribution, BER in Fading, Narrowband vs Wideband Channels, Characterization of Multipath Fading Channels, Choice of Modulation, Coherent versus Differential Detection, BER in Fading , Ricean Fading.		
Mapping of Course Outcomes for Unit V	**CO5: Study of different mathematical models.**	
Unit VI	**Operating System & Applications of Mobile Computing**	**8 Hrs.**
Operating System: A Few Basic Concepts, Special Constraints and Requirements of Mobile OS, A Survey of Commercial Mobile Operating Systems, Windows Mobile, Palm OS, Symbian OS, iOS, Android, Blackberry OS, A Comparative study of Mobile OS, OS for sensor Network. **Applications:** M-Commerce, Business to Consumer (B2C) Applications, Business to Business (B2B) Applications. Structure of M-Commerce, Pros and Cons of M-Commerce, Mobile Payment System, Mobile Payment Schemes, Desirable properties of a Mobile Payment system, Mobile Payment solutions, Process of Mobile Payment, Security Issues.		
Mapping of Course Outcomes for Unit VI	**CO6:** Understand different mobile applications.	

Learning Resources

Text Books:

1. Clint Smith, Daniel Collins, “Wireless Networks”, 3rd Edition, McGraw Hill Publications,
2. Share Conder, Lauren Darcey, “Android Wireless Application Development”, Volume I, 3rd Edition, Pearson.

Reference Books:

1. Jochen Schiller, "Mobile Communications", 2nd Edition, Pearson.
2. Paul Bedell, "Cellular networks: Design and Operation – A real world Perspective", Outskirts Press.
3. Zigurd Mednieks, Laird Dornin, G, Blake Meike and Masumi Nakamura, "Programming Android", O"Reilly.
4. Alasdair Allan, "iPhone Programming", O"Reilly.
5. Donny Wals, "Mastering iOS 12 Programming".
6. Reza B"Far, "Mobile Computing principles", Cambridge University Press.

MOOC / NPTEL Courses:

1. NPTEL Course **"**Mobile Computing**"b**y Prof. Sridhar Iyer and Prof. Pushpendra Singh IIT Madras

   Link of the Course: https://nptel.ac.in/courses/106106147

2. NPTEL Course **"Funadamentals of MIMO Wireless Communication"** by Prof. Suvra Sekhar Das IIT Kharagpur
   Link of the Course: https://nptel.ac.in/courses/117105132

3. NPTEL Course **"Principles of Modern CDMA/MIMO//OFDM Wireless Communications"** by Prof. Aditya. K. Jagannatham IIT Kanpur
   Link of the Course: https:// nptel.ac.in/courses/117104115

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404192 (A): System on Chip (Elective - VI)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Theory: 03 hrs. / week	**03**	**In-Sem (Theory): 30 Marks** **End-Sem (Theory): 70 Marks**

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:

1. To understand the basic concepts and architecture of SOC.
2. To understand the basic terminology of Verilog HDL programming.
3. To apply the various Verilog modeling styles in writing the design and testbench codes.
4. To understand the basic steps used in the VLSI Physical Design.
5. To understand the basic architecture of various processors used in SOC.
6. To understand the working principle of various Buses and memory used in SOC.

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

CO1: Understand the basic concepts and architecture of SOC.
CO2: Understand the basic terminology of Verilog HDL programming.
CO3: Apply the various Verilog modeling styles in writing the design and testbench codes.
CO4: Understand the basic steps used in the VLSI Physical Design.
CO5: Understand the basic architecture of various processors used in SOC.
CO6: Understand the working principle of various Buses and memory used in SOC.

Course Contents

Unit I	Introduction to SOC	6 Hrs.

System Architecture; System Complexity; Components of the system; Hardware & Software; An approach for SOC Design; SOC definition, benefits, and challenges; Application of SOC; SOC components: Processor, Accelerators, Memory and Peripherals, On-chip interconnects, and various signal processing units.

Mapping of Course Outcomes for Unit I	CO1: Understand the basic concepts and architecture of SOC.	

Unit II	Verilog HDL - I	8 Hrs.

Evolution and need of CAD tools; HDL tools; Why Verilog; Verilog: datatypes, system tasks, compiler directives; Hierarchical Modeling Concepts: Top-down and bottom-up design methodology; modules and module instances; Modules and Ports: Module definition, port declaration, connecting ports, hierarchical name referencing, and timescale.

Mapping of Course Outcomes for Unit II	CO2: Understand the basic terminology of Verilog HDL programming.	

Unit III	Verilog HDL-II	8 Hrs.
Gate-level modeling: Modeling using basic Verilog gate primitives, description of AND/OR and BUF/NOT type gates; Dataflow Modeling: Continuous assignments, delay specification, expressions, operators; Behavioral Modeling: Structured procedures, initial and always blocks, blocking and non-blocking statements, delay control, conditional statements, multiway branching, loops, sequential and parallel blocks; Tasks and Functions: tasks vs functions, declaration, invocation, automatic tasks and functions; testbench		
Mapping of Course Outcomes for Unit III	**CO3: Apply the various Verilog modeling styles in writing the design and testbench codes.**	
Unit IV	**Physical Design**	**8 Hrs.**
Floor planning: Abutted and Non-abutted floorplan techniques, floorplan control parameters, input and outputs of the floorplan; Partitioning; need of partitioning, rules of partitioning, methods of partitioning; Placement: goal of placement, coarse placement, legalization, placement blockage, keep-out margin; Routing: netlist, congestion, fixed-die routing, variable-die routing.		
Mapping of Course Outcomes for Unit IV	**CO4: Understand the basic steps used in the VLSI Physical Design.**	
Unit V	**SOC Processors**	**6 Hrs.**
Introduction to SOC processors; Processor selection for SOC; Basic concepts in processor architecture and processor micro architecture; Basic elements in Instruction handling; Buffers: minimizing pipeline delays, Branches; More Robust Processors: Vector processors and vector instructions extensions, VLIW Processors, Superscalar Processors.		
Mapping of Course Outcomes for Unit V	**CO5: Understand the basic architecture of various processors used in SOC.**	
Unit VI	**SOC Buses and Memory**	**6 Hrs.**
AMBA: Generation of AMBA (ASB, AHB, APB), Architecture of AMBA, Specification; Core Connect bus: PLB, OPB, DCR; ST bus protocols: Type I, II, III; SOC memory; Cache memory: performance, partitioning, multi-level cache; Memory chip technology: On die or Off die.		
Mapping of Course Outcomes for Unit VI	**CO6: Understand the working principle of various Buses and memory used in SOC.**	

Learning Resources

Text Books:

1. Michael J. Flynn, Wayne Luk, “Computer System Design: System on Chip”, John Wiley and sons.
2. Samir Palnitkar, “Verilog HDL: A Guide to Digital Design and Synthesis”,2nd Edition, Prentice Hall.

Reference Books:

1. M.Wolf, "Principles of Embedded Computing System Design",4th Edition, Morgan Kaufmann Publications.
2. Michael .D. Ciletti, "Advanced Digital Design with the Verilog(TM) HDL",2nd Edition, Pearson.
3. J.Bhasker, " A Verilog HDL Primer",3rd Edition, Star Galaxy Press.

MOOC / NPTEL Courses:

1. NPTEL Course on "**Hardware modeling using Verilog**", by Prof. Indranil Sengupta IIT Kharagpur

   Link of the course: https://nptel.ac.in/courses/106105165

2. NPTEL Course on "**VLSI Physical Design**", by Prof. Indranil Sengupta IIT Kharagpur

   Link of the course: https://nptel.ac.in/courses/106105161

3. NPTEL Course on "**Embedded Systems**", by Prof. Santanu Choudhary IIT Delhi

   Link of the course: https://nptel.ac.in/courses/106105161

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404192 (B): Nanoelectronics (Elective - VI)

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

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:

1. To understand the processes in Nanoelectronic devices manufacturing.
2. To understand the construction, characteristics, and operation of Nanoelectronic devices.
3. To get acquainted with Nano-CMOS technology.
4. To gain the concepts of Nanomaterial and Nanodevice fabrication.
5. To understand the Nanomachines and nanodevice fabrication.
6. To get acquainted with applications of Nanoelectronics in the electronics industry.

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

CO1: Understand the fundamental knowledge behind nanotechnology.
CO2: Understand to Nano-CMOS technology.
CO3: Explore various Nanoelectronics material.
CO4: Understand the importance of carbon nanotubes.
CO5: Understand Nanomaterial and Nanodevice fabrication.
CO6: Understand various applications of Nanotechnology in Electronics.

Course Contents

Unit I	Introduction to Nanotechnology	6 Hrs.

Introduction to Nanotechnology: Fundamental science behind Nanotechnology, Tools for measuring Nanostructures, Tools to make nanostructures and imagine nano behaviors, Limitations of Silicon Material

Mapping of Course Outcomes for Unit I	CO1: Understand the fundamental knowledge behind nanotechnology.

Unit II	Nano CMOS Devices	6 Hrs.

Silicon Nanocrystal non-volatile memories, Novel dielectric materials for future transistors, Nano-CMOS devices, andapplications, AFM, scanning probe instrument,nanoscale lithography.

Mapping of Course Outcomes for Unit II	CO2: Understand to Nano-CMOS technology

Unit III	Nanoparticles and Nanotubes	6 Hrs.

Properties of Nanoparticles: Metal nanostructures and semiconducting nanoparticles.

Carbon nanostructures: Carbon molecules, Clusters, Nanotubes.

Properties of Nanotubes: Strength and Elasticity, Applications of Nanotubes.

Mapping of Course Outcomes for Unit III	CO3: Explore various Nanoelectronics material. CO4: Understand the importance of carbon nanotubes.

Unit IV	Nanoelectronics	6 Hrs.
Introduction, the tools of manufacturing of micro and nano fabrication optical lithography, electron beam lithography, atomic lithography. Nano-Electronics for advanced computation and communication.		
Mapping of Course Outcomes for Unit IV	**CO3: Explore various Nanoelectronics material.** **CO4: Understand the importance of carbon nanotubes.**	
Unit V	**Nanomachine and Nanodevice Fabrications**	**6 Hrs.**
Nanomachines and Nanodevices, NEMS and MEMS and their fabrication, molecular and supermolecular switches, Lithography.		
Mapping of Course Outcomes for Unit V	**CO5: Understand Nanomaterial and Nanodevice fabrication.**	
Unit VI	**Applications of Nanotechnology**	**6 Hrs.**
Use of Nanotechnology in Electronics: Application of nanostructures in electronics, sensors, optics, energy capture, transformation, and storage. Application of nanotechnology in biomedical electronics.		
Mapping of Course Outcomes for Unit VI	**CO6: Understand various applications of Nanotechnology in Electronics.**	

Learning Resources

Text Books:

1. Anatoli Korkin, Jan Labanowski, Evgeni Gusev, Serge Luryi, "Nanotechnology for Electronic Materials and Devices", Springer.
2. Mark Ratner, Daniel Ratner, "Nanotechnology: A Gentle introduction to a next big Idea", 1st Edition, Pearson Education.
3. Gregory Timp, "Nanotechnology", Springer.
4. Charles P. Poole Jr., Frank J. Owens, "Introduction to Nanotechnology" John Wiley and sons

Reference Books:

1. K. Goser P. Glosekotter, J. Dienstuhl, "Nanoelectronics & Nanosystems"; Springer

MOOC / NPTEL Courses:

1. NPTEL Course on "**Nanostructured materials-synthesis,properties,self assembly and applications**", by Prof. A.K.Ganguli IIT Delhi

   Link of the course: https://nptel.ac.in/courses/118102003

2. NPTEL Course on "**Nanoelectronics: Devices and Materials**", by Dr. Navkanta Bhat, Dr. S.N.Shivashankar, Prof. K.N.Bhat IISc Bangalore

   Link of the course: https://nptel.ac.in/courses/117108047

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404192 (C): Remote Sensing (Elective - VI)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem (Theory): 30 Marks End-Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives:

1. To introduce the basic principles of remote sensing.
2. To be familiar with Indian space missions and satellite sensors characteristics.
3. To know the different types of satellite data products, visual interpretation and basics of digital processing of satellite images.
4. To provide exposure of the global navigation satellite system and its application.
5. To understand underlying concepts of microwave and lidar remote sensing

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

CO1: Describe the concepts of remote sensing and electromagnetic radiation interaction.

CO2: Explain the sensors characteristics and analyze its resolution.

CO3: Classify different types of satellite data products and design various color composites.

CO4: Describe the fundamentals of microwave remote sensing.

CO5: Analyze GNSS signal structure and augmentation systems.

CO6: **Demonstrate** and describe real life applications of remote sensing.

Course Contents

Unit I	Principles of Remote Sensing	7 Hrs.

Basic principles of Remote Sensing, Data and Information, Remote Sensing Data Collection, Types of Remote Sensing- Active and Passive remote sensing; Advantages and Limitations of Remote Sensing, Electromagnetic Energy- Electromagnetic Spectrum, Interaction of EMR: Interaction with Earth's Atmosphere and Atmospheric window, Spectral Signature:Interaction with Soil, Water and Vegetation

Mapping of Course Outcomes for Unit I	CO1: Describe the concepts of remote sensing and electromagnetic radiation interaction.

Unit II	Satellite Sensors and Resolution	7 Hrs.

Types of Remote Sensing Platforms, Types of Satellite Orbits - Geosynchronous and Geostationary, Polar and sun synchronous orbit, low earth, medium earth, highly elliptical orbits, Recent Trends in Remote sensing Earth Observation data, Indian & Global Space Missions : Indian & Global Satellites and Sensors Characteristics, Satellite Resolution : Spatial, Temporal, Spectral, Radiometric; Differences between Multispectral and Hyperspectral remote sensing

Mapping of Course Outcomes for Unit II	CO2: Explain the sensors characteristics and analyze its resolution.

Unit III	Satellite Data Products & Processing	7 Hrs.
Satellite Data Analysis: Data Products and Their Characteristics, Data Pre-processing – Atmospheric, Radiometric, Geometric Corrections - Basic Principles of Visual Interpretation, Equipment for Visual Interpretation, Ground Truth; Color Composite : False and True Color Composite;Image enhancements; Classifications - Supervised and Unsupervised, Normalized satellite Indices - NDVI, NDWI, GDVI, NDSI etc; Remote Sensing Data Sources : USGS, Bhuvan, ESA, Sentinel etc		
Mapping of Course Outcomes for Unit III	**CO3: Classify different types of satellite data products and design various color composites.**	
Unit IV	**Active Remote Sensing**	**6 Hrs.**
Microwave Remote Sensing: Active and Passive Systems, Advantages, Platforms and Sensors, Microwave Radiation and Simulation, Principles of Radar – Resolution, Range, Angular Measurements, Microwave Scattering, Imagery – characteristics and Interpretation; Definitions of LiDAR - Concepts and its applications.		
Mapping of Course Outcomes for Unit IV	**CO4: Describe the fundamentals of microwave remote sensing.**	
Unit V	**GNSS Technology**	**7 Hrs.**
Introduction of GNSS Technology : GNSS Signal Structures, GNSS Vulnerabilities, GNSS Applications, GNSS Market and Business, Indian Regional Navigation Satellite System (IRNSS), Ground Based Augmentation Systems,Space Based Augmentation Systems - GAGAN; Principles of satellite positioning - Principle of Satellite Positioning, GNSS Orbits, Navigation Message Details; Positioning Errors, Data Formats, Location-Based Services (LBS), Tools for GNSS data processing.		
Mapping of Course Outcomes for Unit V	**CO5: Analyze GNSS signal structure and augmentation systems.**	
Unit VI	**Applications of Remote Sensing**	**6 Hrs.**
Applications of Remote Sensing: Environmental and Disaster, Coastal and Near Shore, Forest and Agriculture, Water Resource, Urban Planning and Management, Land Use and Land Cover Analysis.		
Mapping of Course Outcomes for Unit VI	**CO6: Demonstrate and describe real life applications of remote sensing.**	

Learning Resources

Text Books:

1. John A. Richards, “Remote Sensing Digital Image Analysis - An Introduction” 5th Edition, Springer-Verlag Berlin Heidelberg.
2. Joseph, G., “Fundamentals of Remote Sensing”, Universities Press,
3. Roy. P.S., Dwivedi. R. S., “Remote Sensing Application”, Published by NRSC ISRO Hyderabad.

Reference Books:

1. Liu, J.-G., & Mason, P.J. "Image Processing and GIS for Remote Sensing: Techniques and Applications", 2nd Edition, Wiley-Blackwell.
2. Sabins, F. F.,"Remote Sensing: Principles and Interpretation", 4th Edition, Waveland Pr. Inc.
3. Navalgund, R. R. Ray, S. S., "Hyperspectral Data, Analysis Techniques Application", Indian Society of Remote Sensing.
4. Lillesand, T. M., Kiefer, R. W.,Chipman, J. W., "Remote Sensing and Image Interpretation", 7th Edition, John Wiley & Sons.
5. Bernhard Hofmann-Wellenhof, Herbert Lichtenegger, Elmar Wasle, "GNSS - Global Navigation Satellite Systems: GPS, GLONASS, Galileo, and more", Springer.
6. Pinliang Dong, Qi Chen, "LiDAR Remote Sensing and Applications", 1st Edition CRC Press.

MOOC / NPTEL Courses:

1. NPTEL Course "**Remote Sensing: Principal and Application**", by Prof. Eswar Rajasekaran, IIT Bombay
   Link of the Course: https://nptel.ac.in/courses/105101206

2. NPTEL Course "**Remote Sensing Essentials**", by Dr. Arun.K.Saraf, IIT Roorkee
   Link of the Course: https://nptel.ac.in/courses/105107201

3. NPTEL Course "**Global Navigation Satellite Systems and Applications**", by Dr. Arun.K.Saraf, IIT Roorkee
   Link of the Course: https://nptel.ac.in/courses/105107194

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404192 (D): Digital Marketing (Elective - VI)

Examination Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / Week	03	In-Sem: 30 Marks End Sem: 70 Marks

Prerequisite Courses, if any:

Companion Course, if any:

1. Digital Business Management

Course Objectives:

1. To understand digital marketing & process of website design.
2. To identify the keywords for a website & understand the SEO.
3. To study the various Digital Marketing Tools.
4. To learn the use of social media websites for Digital Marketing.
5. To be conversant with Linked In platform.
6. To know the recent trends in Digital Marketing.

Course Outcomes: On completion of the course, learner will be able to
CO1: Design websites using free tools like Wordpress and explore it for digital marketing.
CO2: Apply various keywords for a website & to perform SEO.
CO3: Understand the various SEM Tools and implement the Digital Marketing Tools.
CO4: Illustrate the use of Facebook, Instagram and Youtube for Digital Marketing in real life.
CO5: Use Linked in platform for various campaigning.
CO6: Understand the importance of recent trends in digital marketing.

Course Contents

Unit I	Digital Marketing Planning and Structure	7 Hrs.

Importance of Digital Marketing, Digital Marketing Vs. Traditional Marketing, Inbound vs Outbound Marketing, Understanding Demographics. WWW, Buying a Domain, Core Objective of Website and Flow, One Page Website, Strategic Design of Products & Services Page, Strategic Design of Landing Page, Segmentation & Targeting and Positioning to Digital Marketing, Portfolio, Gallery and Contact Us Page, Google Analytics Tracking Code, Designing Wordpress Website. Mobile Friendly Website, Payment Gateway like UPI, e-Commerce

Mapping of Course Outcomes for Unit I	CO1: Design websites using free tools like Wordpress and explore it for digital marketing.

Unit II	Search Engine Optimization (SEO)	7 Hrs.

Fundamentals; Keywords and SEO Content Plan; SEO & Business Objectives; Writing SEO Content; On-site & off-site SEO; Optimize Organic Search Ranking, Website SEO Auditing, Web Analytics: Data and Traffic Analysis. Study and analyze the Competitor's Website and their traffic sources.

Mapping of Course Outcomes for Unit II	CO2: Apply various keywords for a website & to perform SEO.

Unit III	Search Engine Marketing	7 Hrs.
Importance of Adwords, Google Ad Types, PPC Cost Formula, Ad Page Rank, Billing and Payments, Adwords User Interface, Keyword Planner, Creating Ad Campaigns, Creating Text Ads, Creating Ad Groups, Search Engine Marketing (SEM) Tools, Bidding Strategy for CPC, Case Studies. Conversion Tracking Code, Designing Image Ads, Creating Video Ads, Youtube Video Promotion, Hi-Jack Competitor's Video Audience, Case Studies. Remarketing Strategies, Remarketing Tracking Code, Website or Blog Linking Google Analytics, Designing Remarketing Images, Shared Budget, Mobile Advertising.		
Mapping of Course Outcomes for Unit III	**CO3: Understand the various SEM Tools and implement the Digital Marketing Tools.**	
Unit IV	**Social Media Marketing (SMM) Part 1**	**8 Hrs.**
B to C Perspective, B to B Perspective: Introduction; Major Social Media Platforms for Marketing; Developing Data-driven Audience & Campaign Insights; Social Media for Business; Facebook & Instagram Marketing: Understanding of Facebook Marketing, Types of Facebook Advertising, Creating first ad on Facebook, Setting Campaign and optimization, Facebook Power Editor, Facebook Video Marketing, Facebook App & Shopping Marketing Youtube Marketing: YouTube Account Setup (Create a business account with a personal account), YouTube Monetization, YouTube Ads, YouTube Analytics.		
Mapping of Course Outcomes for Unit IV	**CO4: Illustrate the use of Facebook, Instagram and Youtube for Digital Marketing in real life.**	
Unit V	**Social Media Marketing (SMM) Part 2**	**8 Hrs.**
LinkedIn Advertising: How to use Linkedin Professionally, Types of LinkedIn Advertising, LinkedIn New feed Advertising, LinkedIn Message Pitching, Traffic and Leads Generation, Billing and Report. **Email Marketing:** Email Software and Tools, Importing Email Lists, Planning Email Campaign, Email Templates and Designs, Sending HTML Email Campaigns, Web Forms Lead Importing, Integrating Landing Page Forms, Campaign Reports and Insights, Segmentation Strategy, Responder Tracker		
Mapping of Course Outcomes for Unit V	**CO5: Use Linked in platform for various campaigning.**	
Unit VI	**Upcoming Trends in Digital Marketing**	**6 Hrs.**
Podcast, OTT Platforms, Mob-Ad, No Click Searches, Google Verified Listing, Voice Search, Visual Search, Online Reviews, Automated and Smart Bidding, Chatbots, Affiliate Marketing		
Mapping of Course Outcomes for Unit VI	**CO6: Understand the importance of recent trends in digital marketing.**	

Learning Resources

Text Books:

1. Cory Rabazinsky, "Google-Ad words for Beginners: A Do-It-Yourself Guide to PPC Advertising"
2. Ian Brodie, "Email Persuasion: Captivate and Engage Your Audience, Build Authority and Generate More Sales With Email Marketing"
3. Jan Zimmerman and Deborah, "Social Media Marketing All-In-One for Dummies"
4. Dave Chaffey, Fiona Ellis-Chadwick, Kevin Johnston, Richard Mayer, "Internet Marketing", Pearson Education.
5. Oliver J Rich, "Digital Marketing"
6. Gerry T. Warner and Joe Wilson Schaefer "Online Marketing"

Reference Books:

1. Prof. Seema Gupta, "Digital Marketing", Mcgraw Hill Publications.
2. Judy Strauss, Adel Ansary, Raymond Frost, Prentice Hall, "E- Marketing"
3. Dr. Andy Williams ,"WordPress for Beginners 2020: A Visual Step-by-Step Guide to Mastering WordPress"
4. Cecilia Figueroa, "Introduction To Digital Marketing 101", BPB Publications.

MOOCs / NPTEL:

1. Digital Tools Certification- By Google
   Link of the Course: https://skillshop.exceedlms.com/student/catalog

2. Swayam Certification course on, "**Digital Marketing**", by Dr. Tejindarpal Singh Panjab University Chandigarh
   Link of the Course: https://swayam.gov.in/nd2_ugc19_hs26/preview

Savitribai Phule Pune University

Fourth Year of E & Tc Engineering (2019 Course)

404193: Innovation and Entrepreneurship

Examination Scheme:	Credit	Examination Scheme:
Tutorial: 02 Hrs. / Week	02	Term Work: 50 Marks

Prerequisite Courses, if any:

1. Project Management

Companion Course, if any:

Course Objectives:

1. To know innovation and entrepreneurship.
2. To be trained in design thinking.
3. To comprehend idea generation.
4. To gain knowledge of starting a venture.
5. To study about patents and patent filing.
6. To become skilled at digital marketing

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

CO1: Understand Innovation, Entrepreneurship and characteristics of an entrepreneur.

CO2: Develop a strong understanding of the Design Process and its application in variety of business settings.

CO3: Generate sustainable ideas.

CO4: Explore various processes required to be an entrepreneur.

CO5: Understand patents and its process of filing.

CO6: Choose and use appropriate social media for marketing.

Course Contents

Unit I	Introduction to Innovation and Entrepreneurship	3 Hrs.

Role of innovation and entrepreneurship, what it takes to be an entrepreneur, Business fundamentals, Leadership & team building, relation between innovation and entrepreneurship.

Mapping of Course Outcomes for Unit I	CO1: Understand Innovation, Entrepreneurship and characteristics of an entrepreneur.

Unit II	Design Thinking	3 Hrs.

Introduction to Design Thinking, Design Research Strategies, Design Research - tools for observation and immersion, Visualizing ideas, Communicating ideas.

Mapping of Course Outcomes for Unit II	CO2: Develop a strong understanding of the Design Process and its application in variety of business settings.

Unit III	Idea Generation	3 Hrs.

The seed of innovation, Innovation domains, Innovation sustainable conditions, Design factors, Types of innovations and their market impact.

Mapping of Course Outcomes for Unit III	**CO3: Generate sustainable ideas.**	
Unit IV	**Becoming an Entrepreneur**	**4 Hrs.**
Creating a business plan, Preparing a Pitching presentation, Building business strategy		
Mapping of Course Outcomes for Unit IV	**CO4: Explore various processes required to be an entrepreneur.**	
Unit V	**Creating a Startup**	**3 Hrs.**
Types of companies, legal processes for registering companies, registering as startup		
Mapping of Course Outcomes for Unit V	**CO5: Understand patents and its process of filing.**	
Unit VI	**Indian Patents**	**2 Hrs.**
Fundamentals of IP, Patent basics, Patent analytics, Role in R&D and business planning, Patents to profits, IP asset management, Technology transfer.		
Mapping of Course Outcomes for Unit VI	**CO6: Choose and use appropriate social media for marketing.**	

Learning Resources

Reference Books:

1. Badhai, B, "Entrepreneurship for Engineers", Dhanpat Rai & Co. (p) Ltd.
2. "The Field Guide to Human-Centered Design", by IDEO.org
3. Kalyan C. Kankanala, A.K. Narasani, V. Radhakrishnan, "Indian Patent Law and Practice", Oxford Press.
4. Eric Ries, "The Lean Startup", Penguin Books Limited **(E-Book).**

MOOCs / NPTEL:

1. Swayam Course on "**Entrepreneurship**" by Prof. C. Bhaktvatsala Rao IIT Madras
   Link of the Course: https://onlinecourses.nptel.ac.in/noc21_mg70/preview

2. Swayam Course on "**Design Thinking-A Primer**" by Prof. A. Mahalingam, Prof. B. Ramadurai IIT Madras
   Link of the Course: https://onlinecourses.nptel.ac.in/noc22_mg32/preview

3. Swayam Course on "Patent Law for Scientists and Engineers" by Prof. Feroz Ali IIT Madras
   Link of the Course: https://onlinecourses.nptel.ac.in/noc20_hs55/preview

4. NPTEL Course on " Innovation, Business Models and Entrepreneurship" by Prof. Rajat Agarwal, Prof. Vinay Sharma IIT Roorkee
   Link of the Course: https://nptel.ac.in/courses/110107094

List of Tutorials to be carried out

1.	Design a strategy by writing steps to market the project you are building.
2.	Generate an idea having novelty.
3.	Prepare a business plan.
4.	Create a pitching deck.
5.	Preparing a business strategy.
6.	Write a patent draft.

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404194: Digital Business Management		
Examination Scheme:	**Credit**	**Examination Scheme:**
Tutorial: 02 Hrs. / Week	**02**	**Term Work: 50 Marks**

Prerequisite Courses, if any:
1. Project Management

Companion Course, if any:
1. Digital Marketing

Course Objectives:
1. To familiarize with digital business concept.
2. To acquaint with E-commerce.
3. To give insights into E-business and its strategies.

Course Outcomes: On completion of the course, learner will be able to
CO1: Identify drivers of digital business.
CO2: Illustrate various approaches and techniques for E-business and management.
CO3: Prepare E-business plan.

Course Contents

Unit I	Introduction to Digital Business	4 Hrs.

Introduction, Background and current status, E-market places, structures,mechanisms, economics and impacts. Difference between physical economy and digital economy.
Drivers of digital business: Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things (digitallyintelligent machines/services), Opportunities and Challenges in Digital Business,

Mapping of Course Outcomes for Unit I	CO1: Identify drivers of digital business.

Unit II	Overview of E-Commerce	8 Hrs.

E-Commerce: Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement, B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals. Other E-C models and applications, innovative EC System-From E- government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e- commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC

Mapping of Course Outcomes for Unit II	CO2: Illustrate various approaches and techniques for E-business and management.

Unit III	Digital Business Support Services	3 Hrs.

e-CRM, e-SCM, ERP as e –business backbone, Knowledge Tope Apps, Information and referral system:
Application Development: Building Digital business Applications and Infrastructure

Mapping of Course Outcomes for Unit III	CO2: Illustrate various approaches and techniques for E-business and management.

Unit IV	Managing E-Business	4 Hrs.
Managing Knowledge, Management skills for e- business, Managing Risks in e –business. Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications.		
Mapping of Course Outcomes for Unit IV	**CO2: Illustrate various approaches and techniques for E-business and management.**	
Unit V	**E-Business Strategy**	**3 Hrs.**
E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition		
Mapping of Course Outcomes for Unit V	**CO2: Illustrate various approaches and techniques for E-business and management.** **CO3: Prepare E-business plan.**	
Unit VI	**Materializing e-business:**	**2 Hrs.**
From Idea to Realization-Business plan, Case Studies.		
Mapping of Course Outcomes for Unit VI	**CO3: Prepare E-business plan.**	

Learning Resources

Text Books:

1. Urmi Dutta, Neha Somani, "E-Commerce & Business Communication", Oxford University Press
2. Elias M. Awad, "E-commerce from vision to fulfilment" 3rd Edition, Prentice Hall India
3. Dave Chaffey, "Digital Business and E-Commerce Management", 6th Edition, Pearson
4. Colin Combe, "Introduction to E-business: Management and Strategy", 1st Edition , Elsvier
5. Eloise Coupey, "Digital Business Concepts and Strategy", 2nd Edition , Pearson

Reference Books:

1. Vinocenzo Morabito,"Trend and Challenges in Digital Business Innovation" Springer
2. Erika Darics, "Digital Business Discourse", Palgrave Macmillan
3. "E-Governance-Challenges and Opportunities", Proceedings in 2nd International Conference theory and practice of Electronic Governance
4. "Perspectives the Digital Enterprise –A framework for Transformation", TCS Consulting Journal Vol. 5
5. "Measuring Digital Economy-A new perspective" , OECD Publishing
   DOI: 10.1787/9789264221796-en

MOOCs / NPTEL:

1. Coursera Course on "**Digital Business Specialization**"
   Link of the course: **www.coursera.org/specializations/digital-business**

2. NPTEL Course on "**E-Business**" by Prof. Mamta Jenamani IIT Kharagpur
   Link of the course: **https://nptel.ac.in/courses/110105083**

List of Tutorials to be carried out

1.	Compare conventional business with e- business based on structure, mechanisms and economics.
2.	Discuss the role of Big Data and Data Analytics in Digital Business Management.
3.	Review various Opportunities and Challenges in Digital Business.
4.	Prepare a report on societal impacts of Digital Business.
5.	Review various security aspects of Digital Business.
6.	Discuss the various steps for executing the business plan digitally.
7.	Develop a strategy for E-Business for selling a product online.
8.	Discuss a typical case study of any one Digital Business.

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404195: Fiber Optic Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 Hrs. / Week	**01**	**Term Work: 25 Marks** **Oral: 50 Marks**

Prerequisite Courses, if any: -

Companion Course, if any:

List of Laboratory Experiments (Hardware/Programs/Simulation Software)

Group A

1.	To estimate the numerical aperture of given MMSI optical fiber.
2.	To plot electrical and optical characteristics of any one optical source LED/Laser.
3.	To measure attenuation coefficient and bending losses in optical fibers.
4.	To plot characteristics of any one photo detector pn/pin/phototransistor.
5.	Tutorial on optical key components: numerical on optical fiber, optical source and photodetector.

Group B

1.	Establish a digital optical link.
2.	Simulate optical power budget and rise time budget analysis of optical fiber systems.
3.	Study of any one field instrument such as optical power meter, OTDR, splicing machine etc
4.	Tutorial on optical link budget: Optical power budget & rise time budget analysis to comment on the viability of the systems.

Group C

1.	Simulation of WDM system to compute OSNR using *any* simulation software.
2.	Study of current trends in: optical sources, detectors, fibers for telecommunication, mux-demux, filters, isolators, circulators, couplers, connectors, optical amplifiers etc and the measuring instruments and standards.

Virtual LAB Links:

http://vlabs.iitb.ac.in/vlabs-dev/labs/physics-basics/labs/numerical-aperture-measurement- iitk/index.html

(**Physical Sciences Lab)**

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404196: Lab Practice – 3		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 Hrs. / Week	**01**	**Term Work: 25 Marks** **Practical: 50 Marks**

Prerequisite Courses, if any:

Companion Course, if any:

1. Biomedical Signal Processing (Elective - V)
2. Industrial Drives and Control (Elective - V)
3. Android Development (Elective - V)
4. Embedded System Design (Elective - V)
5. Mobile Computing (Elective - V)

Guidelines for Student's Lab Journal

The student's Lab Journal can be experimental write-ups. It should include following as applicable: Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

Guidelines for Lab /TW Assessment

The oral examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.

Subject: Biomedical Signal Processing (Elective - V)

Part A (All Compulsory)

1.	Use discrete Fourier transform (DFT) to describe the signals in the frequency domain. Determine the dominant frequency.
2.	Determine the PP interval and the RR interval for ECG signals. Use DFT to describe the signals in the frequency. Determine the heart rate using the ECG signal
3.	Import the EMG signal. Determine the dominant frequency in the signal.
4.	Import the EEG signal and plot the 10 channels. Determine the dominant frequency of channel 0 and compare this to the dominant frequency of channel 8

Part B (Any 2 to be performed)

1.	Import the EMG signal Calculate the AVR value of the EMG signal.
2.	Import the EMG signal Determine the frequency spectrum or power spectrum.
3.	Isolate one typical period of the signal, i.e., one cycle containing P-QRS-T. Calculate the duration of P, T, and QRS waves. For ECG signal.

Part C (Any 1 to be Performed)	
1.	Import the EEG signal and Determine the onset of the epileptic EEG pattern. Plot the power spectrum of the signal.
2.	Design a Filter to remove the noise in the ECG signal.
3.	Implement LMS adaptive algorithm for noise cancellation.

VIRTUAL LAB LINKS:

1. **https://bmsp-coep.vlabs.ac.in/List%20of%20experiments.html** (**Biomedical and Signal Processing Lab.)**

2. **https://bmi-iitr.virtuallabs.ac.in/** (**Biomedical Instrumentation Lab.)**

Subject: Industrial Drives and Control (Elective - V)	
List of Experiments	
1.	DC motor control using full singlephase converter.
2.	Dual converter single phase controlled dC drives
3.	Microprocessor/microcontroller based single phase controlled dc drives.
4.	Four quadrant chopper reversible dc drives.
5.	Three phase induction motor control using PWM inverters.
6.	Microprocessor/microcontroller based single phase control AC drive.
7.	Simulation of DC drives using of power SIM.
8.	Simulation of AC drives using of power SIM.
9.	Case study on drive application **(Industrial Visit)** Industrial visit to company dealing with Variable Speed DC Drive replacing an existing troublesome DC control system, resulting in increased production and reduced downtime.

Subject: Android Development (Elective - V)

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include prologue (about University/program/ institute/ department/foreword/ preface etc), University syllabus, conduction & Assessment guidelines, topics under consideration-concept, objectives, outcomes, set of typical applications/assignments/ guidelines, and references.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of prologue, Certificate, table of contents, and handwritten write-up of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign, Theory-Concept in brief, features of tool/framework/language used, Design, test cases, conclusion.

Program codes with sample output of all performed assignments are to be submitted as softcopy.

As a conscious effort and little contribution towards Green IT and environment awareness, attaching printed papers as part of write-ups and program listing to journal may be avoided. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints at Laboratory.

Guidelines for Assessment

Continuous assessment of laboratory work is done based on overall performance and lab assignments performance of student. Each lab assignment assessment will assign grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Guidelines for Laboratory Conduction

1. The instructor is expected to frame the assignments by understanding the prerequisites, technological aspects, utility and recent trends related to the topic.
2. The assignment framing policy need to address the average students and inclusive of an element to attract and promote the intelligent students.
3. The instructor may set multiple sets of assignments and distribute among batches of students.
4. It is appreciated if the assignments are based on real world problems/applications. Encourage students for appropriate use of Hungarian notation, proper indentation and comments.
5. Use of open source software is to be encouraged.
6. In addition to these, instructor may assign one real life application in the form of a mini-project based on the concepts learned.
7. Instructor may also set one assignment or mini-project that is suitable to respective branch beyond the scope of syllabus.

List of Laboratory Assignments (Any 10 to be Performed)	
1.	Download Install and Configure Eclipse / Android Studio on Linux/windows platform.
2.	Design a mobile application using implicit intent and explicit intent
3.	Design a mobile application to create two fragment and pass the data from one fragment to another
4.	Design a mobile application to create home page using grid layout
5.	Design a mobile application to create the login page using sqlite / firebase
6.	Design a mobile application to share data in the app.
7.	Design a mobile application to create registration application which having spinner (subject), radio button (gender), qualification (check box), first insert the value and then show the data in show activity.
8.	Design a mobile application to create different dialog boxes and menu (popup, option , context)
9.	Design a mobile application to show list using Recycler View
10.	Design a mobile application to Show any website using web view
11.	Design a mobile application to Activity using fragment
12.	Design a mobile application using imageslider to show images.
13.	Design a mobile application for media player.
14.	Design a mobile app to store data using internal or external storage.
15.	Design a mobile app using Google Map and GPS to trace the location.

Subject: Embedded System Design (Elective - V)	
Group A (Any 4 to be Performed)	
1.	Interface LED with STM32F4 and Toggle the LED by using delay functions
2.	Make the LED ON when the input switch interfaced with STM32F4 is pressed
3.	Interface LCD with STM32F4
4.	Transmit/Receive a string "SPPU" using interrupt
5.	Measure period and frequency using capture mode of PWM
Group B (Any 2 to be Performed)	
1.	Write TIMER drivers using HAL functions
2.	Write Analog-to-Digital Converter (ADC) drivers using HAL functions
3.	Write PWM drivers using HAL functions
4.	Displaying an image/graph on the SPI based LCD
Group C (Any 2 to be Performed)	
1.	Learn how to Configure FreeRTOS Using CubeMX.
2.	Examine the STM32F4 board thoroughly and prepare a detail report
3.	Study the interfacing of LoRaWAN with STM32F4
4.	Installation of android packages for embedded application

Virtual LAB Links:

1. **https://docs.simuli.co/getting-started/stm32/using-virtual-lab-and-theia**
2. **https://docs.jumper.io/docs/install.html**

Subject: Mobile Computing (Elective - V)	
List of Experiments (Any 8 to be performed)	
1.	Simulate to elaborate operation of multiple access techniques for CDMA.
2.	Study of GSM architecture and signaling techniques.
3.	Study of GPRS services.
4.	Simulate BER performance over Rayleigh Fading wireless channel with BPSK transmission for SNR 0 to 60 dB.
5.	Configuring a Cisco Router as a DHCP Server.
6.	To understand the handover mechanism. **http://vlabs.iitkgp.ernet.in/fcmc/exp8/index.html**
7.	To study the outage probability, LCR & ADF in SISO for Selection Combining and MRC (Flat Fading). **http://vlabs.iitkgp.ernet.in/fcmc/exp9/index.html**
8.	To Perform File Transfer in Client & Server Using TCP/IP.
9.	Case Study on different real time mobile computing services.

Virtual LAB Links:

1. **http://vlabs.iitkgp.ernet.in/fcmc/** (**Fading Channels and Mobile Communication Lab.)**

Savitribai Phule Pune University Fourth Year of E & Tc Engineering (2019 Course) 404197: Project Phase – II		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 10 Hrs. / Week	**05**	**Term Work: 100 Marks** **Oral: 50 Marks**

Project phase 2 is extension of Project phase 1 carried out in seventh semester. The student shall prepare the duly certified Fourth report of project work in standard format preferably in LATEX for satisfactory completion of the work by the concerned guide and head of the Department/Institute.

GUIDELINES

1.	The project TW/OR assessment shall be based on Live Project Demonstration and presentation by the students. The assessment parameters shall be Innovative Idea of selected project, literature survey, Depth of understanding, Applications, Individual contributions, presentations, project report, timely completion of work (Project review presentations), participation in project competition, publication of research work in journal/conference, publication in the form of patent and copyright etc. The college can prepare the rubrics based on these parameters
2.	Certified hard bound project report to be submitted by the students in prescribed format.
3.	Students must preferably publish at least one technical paper on project work in the conference or peer reviewed Journals or publish patent or copyright or should participate into one of the project competition at university/State/National/International level.
4.	A log book of work carried out during the semester should be maintained with weekly review remarks by the guide and committee.
5.	A certified copy of report preferably using LATEX is required to be presented to external examiner at the time of Fourth examination.
6.	The project report must undergo by plagiarism check and the similarity index must be less than 10%. The plagiarism report should be included in the project report.