Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

T.E (Electronics Engineering)

(Course 2019)

(w.e.f. June 2021)

Savitribai Phule Pune University, Pune
T.E. (Electronics 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
304201	Power and Industrial Electronics	03	-	-	30	70	-	-	-	100	03	-	-	03
304202	Electromagnetic Waves and Propagation Theory	03	-	01	30	70	25	-	-	125	03	-	01	04
304183*	Database Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304204	Microcontrollers and Applications	03	-	-	30	70	-	-	-	100	03	-	-	03
304205	Elective - I	03	-	-	30	70	-	-	-	100	03	-	-	03
304206	Power and Industrial Electronics Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304187*	Database Management Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
304208	Microcontroller and Applications Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304209	Elective I Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304190*	Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
304211 A	Mandatory Audit Course 5 &	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**10**	**01**	**150**	**350**	**50**	**125**	**25**	**700**	**-**		-	-
Total Credit											**15**	**05**	**01**	**21**

Elective 1

304205	Instrumentation systems	304205	Data Communication
304185*	Fundamentals of JAVA Programming	304205	Computer Networks
304205	Machine Learning		

* Subjects common with TE E&TC 2019 Course

Savitribai Phule Pune University, Pune T.E. (Electronics 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**
304212	Fundamentals of HDL	03	-	-	30	70	-	-	-	100	03	-	-	03
304213	Embedded Processors and Applications	03	-	-	30	70	-	-	-	100	03	-	-	03
304214	Industrial Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304215	Elective 2	03	-	-	30	70	-	-	-	100	03	-	-	03
304216	FHDL Lab	-	02	-	-	-	-	-	50	50	-	01	-	01
304217	Embedded Processors and Applications Lab	-	02	-	-	-	-	50	-	50		01		01
304218	Elective 2 Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304199*	Internship	-	-	-	-	-	100	-	-	100	-	-	04	04
304200*	Mini Project	-	04	-	-	-	25	-	50	75	-	02	-	02
304211B	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) have to opt any one of the audit courses from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

Elective 2:

304215	PLC & Automation
304215	Digital Signal Processing
304195*	Advanced JAVA Programming
304215	Fiber Optic Communication
304215	e Mobility

* Subjects common with TE E&TC 2019 Course

SEMESTER – I

304201: Power and Industrial Electronics

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:

1. To understand construction, switching characteristics and protection of power devices
2. To understand protection circuits and triggering circuits for power devices.
3. To give an exposure to students of working & analysis of controlled rectifiers, Inverters, choppers, AC voltage controllers for different loads

Course Outcomes:

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

1. Select power devices for different power conversion applications.
2. Design & Implement gate drive circuits for power devices
3. Understand the operation of Controlled rectifiers & Single phase AC voltage controller. Analyze performance parameters of Controlled rectifiers
4. Understand the operation of Choppers and Analyze performance parameters of choppers
5. Understand the operation of Inverters and Analyze performance parameters of Inverters
6. Utilize Power Electronics Converters in various industrial applications

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Unit I: Power Devices 6L

SCR: Construction, Operation & characteristics, different ratings.
Power MOSFET: Construction, Operation, Static characteristics, Switching characteristics, Breakdown voltages, Safe Operating Area.
IGBT: Construction, Operation, Steady state characteristics, Switching characteristics, Safe operating area, applications.
Performance overview of Silicon, Silicon Carbide & GaN based MOSFET and IGBT.
Comparison of SCR, Power MOSFET and IGBT.

Unit II: Gate drive circuits and Protection circuits for Power Devices 6L

Gate/Base drive circuits: for Power MOSFET, IGBT, SCR, Need & requirements of Isolation of Gate and base drives using pulse transformers and Opto-coupler, Synchronized UJT triggering for SCR, Microprocessor based triggering circuit.
Protection circuits for Power Devices: Cooling and heat sinks. Snubber circuits, Voltage protection by Selenium diodes and MOVs. Current protections using fuse

Unit III: Controlled Rectifiers 6L

Single phase Semi & Full converters for R, R-L load, Performance parameters
Three phase Semi & Full converters, Single Phase PWM Rectifier using IGBT, Three Phase Controlled Rectifier Using IGBT, and Difference between SCR based conventional rectifiers and IGBT based rectifiers.
Power factor improvement techniques, Supply side filters for harmonic eliminations, Load side filters for ripple reduction
Overview of applications of Controlled rectifies in DC drives

Unit IV: Choppers & AC Voltage Controllers **6L**

Step down chopper for R/RL load, Step up chopper, Control strategies. 2-quadrant & 4 quadrant choppers, Performance parameters, Design of control circuit using PWM IC LM3524. Applications of choppers, SMPS, SMPS topologies: Flyback converter, Buck regulator using IC TPS40200, Overview of applications of Choppers in DC drive

AC Voltage Controllers: Single phase AC Voltage Controller for R load

Unit V: Inverters **6L**

Single phase full bridge inverter for R & R-L loads, performance parameters, three phase voltage source inverter for balanced star R load. Variable frequency and Voltage control of inverters, Need of PWM inverters. Design of control circuit for single phase inverters using PWM IC LM3524, Overview of applications of three phase PWM inverters for three phase variable frequency drives (VFDs)

Unit VI: Industrial Applications of Power Electronics **6L**

Electric Vehicles & Traction applications, HVDC transmission system, UPS: ON-line and OFF line. Battery Charging Applications, Induction heating applications

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Text Books:

1. Power Electronics – M. H. Rashid, Prentice Hall of India Pvt. Ltd.
2. Power Electronics: Converters, Applications and Design – Ned Mohan, Tore M. Undeland and William P. Robbins, 3rd Edition, John Wiley and Sons

Reference Books

1. Power Electronics- M. D. Singh and Khanchandani K. B., Tata McGraw Hill Publishing Company Limited
2. Power Electronics – Cyril W. Lander

MOOC / NPTEL Courses:

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

Link of the Course:

1. https://nptel.ac.in/courses/108/105/108105066/
2. https://nptel.ac.in/courses/108/102/108102145/
3. https://nptel.ac.in/courses/108/107/108107128/
4. https://nptel.ac.in/courses/108/108/108108077/
5. https://batteryuniversity.com/

304202: Electromagnetic Waves and Propagation Theory

Teaching Scheme:
Lectures: 3Hrs/Week
Tutorial: 1/Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:

1. To impart the knowledge of Basic Electrostatics, Laws and their applications.
2. To impart the knowledge of Magnetostatics concepts, magnetic flux density, scalar and vector potential and its applications.
3. To understand Maxwell's Equation in different forms for time varying electromagnetic fields.
4. To learn the fundamentals of electromagnetic wave propagation theory, transmission lines and basics of antenna.
5. To expose students to the complete fundamentals and essential features of waveguides, resonators and microwave components

Course Outcomes:

After successfully completing the course learner will be able to:

1. Apply the principles of electrostatics to solve the problems related to the electrostatic field.
2. Apply the principles of magnetostatics to solve the problems on magnetic fields.
3. Interpret and apply Maxwell's equations to solve problems in Time varying electromagnetic fields.
4. Apply Maxwell's equations to formulate the uniform plane wave equation in different mediums and describe different types of wave propagation.
5. Analyze the transmission lines and their parameters using the Smith Chart.
6. Describe the various types and modes of operation of waveguides, cavity resonators and various striplines.

Unit I: Electrostatics **6L**

Coulomb's Law & Electric Field Intensity, Electric Flux Density, Gauss's Law and its Application, Divergence theorem, Electric potential, Relationship between E & V, Potential Gradient, an electric dipole, Poission's and Laplace's equation, Application of Poission's and Laplace's equations, Boundary Condition.

Unit II: Magnetostatics **6L**

Biot-Savart's Law, Ampere's Circuital Law and its Applications, magnetic flux density, Magnetic Scalar and Vectors potentials, Derivations of Biot-savart's law and Ampere's law based on Magnetic Potential, Forces due to magnetic field, magnetic dipole, Magnetic boundary condition.

Unit III: Time Varying Fields & Maxwell's Equations **6L**

Faraday's Law, Transformer and Motional Electromotive Forces, Displacement Current, Maxwell's Equations in Point Form and Integral Form, Time-Varying Potentials, Time Harmonic Fields, Maxwell's Equations in Phasor Form, Boundary Conditions for Time varying Field.

Unit IV: Uniform Plane Waves **6L**

Wave Equation, Wave Propagation in Lossy Dielectrics, Plane Waves in Lossless Dielectrics, Free Space and Good Conductors, Skin Depth, Electromagnetic Power and Poynting Theorem,

Polarization of Wave: Linear, Circular and Elliptical, Reflection of a Plane Wave at Normal Incidence and Oblique Incidence, Fundamental Equation for Free-Space Propagation, Modes of Propagation: Ground, Sky & Space Wave Propagations, Introduction to Antenna, Types of Antenna.

Unit V: Transmission Lines **6L**

Equations of Voltage and Current on Transmission Line, Propagation constant, characteristic Impedance, Reflection Coefficient, VSWR, Impedance Transformation on Lossless and Low Loss Transmission Line, Power Transfer on Transmission Line, Applications of Transmission Lines: Impedance Matching, Use of Transmission Line Sections as Circuit Elements, Problems solving using Smith chart

VI: Waveguides **6L**

Microwave Frequency Bands, Advantages and Applications of Microwaves, Waveguide & Its Types, TE modes, TM modes, Rectangular Waveguide: Cutoff Frequency, Cutoff Wavelength, Guide Wavelength, Phase Velocity, Group Velocity and Wave Impedance, Cavity Resonator, Striplines: Structural Details, Types and Applications.

Text Books:

1. Matthew N. O. Sadiku, "Principles of Electromagnetics", 6th Edition, Oxford University Press.
2. J. D. Ryder, " Networks, Lines and Fields", 2nd Edition, PHI
3. K. D. Prasad, "Antenna & Wave Propagation", Satya Prakashan, New Delhi
4. M. Kulkarni, "Microwave and Radar Engineering", 4th Edition, Umesh Publications

Reference Books:

1. W. H. Hayt and John A. Buck, " Engineering Electromagnetics", 7th Edition, Tata McGraw Hill
2. Jordan and Balmain, " Electromagnetic Waves and Radiating Systems", PHI
3. David M. Pozar, "Microwave Engineering", Wiley India

MOOC / NPTEL Courses:

1. NPTEL Course **"**Electromagnetic Theory"
   Link of the Course: https://nptel.ac.in/courses/108/104/108104087/
2. 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/

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, ρL, ρS
2. Gauss's Law, Electric flux Density(D) & Electrical Potential (V) : Due to Q, ρL, ρS ,
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

304183*: Database Management
(Subject common with TE E&TC 2019 Course)

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
InSemester Examination Phase I:30
End Semester Examination Phase II:70

Course Objectives:

1. To understand fundamental concepts of database from its design to its implementation.
2. To analyze database requirements and determine the entities involved in the system and with one another.
3. To manipulate database using SQL Query to create, update and manage Database.
4. To be familiar with the basic issues of transaction processing and concurrency control.
5. To learn and understand various Database Architectures and Applications.
6. To learn advances in Databases

Course outcomes:

After successfully completing the course learner will be able to

1. Understand the underlying concepts of a database system.
2. Design a database schema for a given problem-domain using data model.
3. Formulate, using SQL/DML/DDL commands, solutions to a wide range of query and update problems.
4. Implement transactions, concurrency control, and be able to do Database recovery.
5. Understand various Database Architectures and its applications.
6. Understand Data Warehousing, Data Mining, Big data and Hadoop.

Unit I: Introduction to DBMS **7L**

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.

Unit II: Relational Database Design **6L**

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.

Unit III: Basics of SQL **7L**

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

Unit IV: Database Transactions Managementt **7L**

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.

Unit V: Parallel Database **6L**

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.

Unit VI: Distributed Databases **7L**

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.

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

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MOOC / NPTEL Courses:

NPTEL Course **“Database Management System”**

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

304204: Microcontrollers and Applications

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:

1. To understand the applications of Microprocessors & Microcontrollers.
2. To understand the need of microcontrollers in embedded systems.
3. To understand architecture and features of a typical Microcontroller.
4. To learn interfacing of real world input and output devices
5. To study various hardware & software tools for developing applications

Course Outcomes:

After successfully completing the course learner will be able to

1. Understand internal architecture of 8051 Microcontroller and its Instruction set.
2. Develop embedded C programs using 8051 microcontrollers for real world applications.
3. Understand PIC18Fxx Microcontroller Architecture and its Instruction set.
4. Develop embedded C programs of PIC18Fxx Microcontroller to various peripherals.

Unit I: Fundamentals of Microcontrollers **6L**

Comparison of microprocessor and microcontroller. Introduction to the general structure of 8 bit Microcontrollers Harward & Von Neumann architecture, RISC & CISC processors. Role of microcontroller in embedded systems. Selection criteria of microcontroller Block diagram and explanation of 8051, Port structure, memory organization, Interrupt structure, timers and its modes, serial communication modes. Overview of Instruction set, Sample programs (assembly): Delay using Timer and interrupt, Programming Timer 0&1, Data transmission and reception using Serial port.

Unit II: Interfacing with 8051 PART I **6L**

Software and Hardware tools for development of microcontroller based systems such as assemblers, compliers, IDE, Emulators, debuggers, programmers, development board, DSO, Logic Analyzer.Interfacing LED with and without interrupt, Keypads, Seven Segment multiplexed Display, LCD, ADC Interfacing. All programs in Embedded C.

Unit III: Interfacing with 8051 PART II **6L**

8051 timer programming, serial port and its programming, interrupt programming, DAC interfacing, Temperature sensors, Stepper motor, Motion detectors, Relay, Buzzer, Optoisolators. All programs in Embedded C.

Unit IV: PIC Microcontroller Architecture **6L**

PIC 10, PIC12, PIC16, PIC18 series comparison, features and selection as per application. PIC18FXX architecture, registers, memory Organization and types, stack, oscillator options, BOD, power down modes and configuration bit settings, timer and its programming. Brief summary of Peripheral support, Overview of instruction set, MPLAB IDE & C18 Compiler.

Unit V: Real World Interfacing Part I **6L**

Port structure, Interrupt Structure of PIC18F. Interfacing of LED, LCD, Sensor interfacing using ADC and Keyboard, use of timers with interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP: All programs in embedded C

Unit VI: Applications using 8051 and PIC18Fxx Microcontrollers **6L**

Design of DAS, Design of frequency counter with display on LCD and Design of Digital Multimeter using 8051 microcontroller. Home protection System, Design of environment monitoring system, Design of water level monitoring and control using PIC18Fxx microcontroller. All programs are in embedded C.

Text Books:

3. Mahumad Ali Mazadi, The 8051 microcontroller & embedded systems 3rd Edition,PHI
4. Mahumad Ali Mazadi, PIC Microcontroller & Embedded System 3rd Edition, Pearson
5. The 8051 Microcontroller Architecture, Programming and Applications Kenneth J. Ayala, Cengage

Reference Books:

1. PIC18Fxx reference manual www.microchip.com

MOOC / NPTEL Courses:

NPTEL Course **"Microcontrollers and Applications"**

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

304205: Elective I
A. Instrumentation Systems

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
InSemester Examination Phase I:30
End Semester Examination Phase II:70

Course Objectives:

1. Explain the operation/working of different sensors.
2. To get fundamental knowledge of sensors and transducers and their operating principles, for measurement of mechanical parameters.
3. To impart interdisciplinary knowledge regarding transducers, pneumatic actuators, hydraulic actuators.
4. Describe advantages, disadvantages, and applications of limit switches,
5. Photoelectric sensors, inductive sensors, capacitive sensors, and ultrasonic sensors, operation of pressure, flow, and level transducers in context with applications.
6. Explain the advanced sensor fabrication techniques like MEMS.
7. To provide comprehensive knowledge of the concept of final control elements in various applications.

Course Outcomes:

After successfully completing the course learner will be able to:

1. Explain fundamentals of Instrumentation Systems
2. Explain and select type of temperature and chemical sensors for specific applications and design signal conditioning circuit for temperature sensor.
3. Explain and select type of flow and level sensor for specific applications
4. Explain and select type of motion, light and radiation detectors for specific applications
5. Distinguish conventional sensors with smart sensor; PC based measurements as well as various MEMS fabrication techniques.
6. Select appropriate switches, actuators and final control elements for specific applications.

Unit I : Fundamentals of Sensors & Transducer 6L

Definitions sensors & transducer, Classification of sensors & transducers, Sensor systems, Performance & Terminology: Range/Span, Errors & Accuracy, Non linearity, Dead band & saturation, output impedance, repeatability, reliability, Sensitivity, Resolution, Frequency response, Response time, Calibration. Advantages, disadvantages & applications of sensors & transducers, Block diagram & description of Instrumentation system

Unit II: Temperature & Chemical sensors 6L

Temperature: Resistance temperature detectors, thermistors, thermocouples and pyrometers. Acoustics sensors, Semiconductor temperature sensing – LM75 block diagram, temperature compensated integrated phototransistor, Signal conditioning circuit for RTD & Thermocouple. Humidity Sensor. Interfacing technique of Temperature sensors with microcontroller. Chemical sensors: classes of chemical sensors, Characteristics of chemical sensors, biochemical sensors, electronics noses.

Unit III: Flow and Level Sensing **6L**

Flow: Bernoulli Equation, Differential head type flow meters (orifice, venture tube and flow nozzle), Pitot static tube, Variable area type flow meter – rotameter, vortex shedding, electromagnetic, ultrasonic flow meters. open channel flow measurement – anemometers. Level: Float, DP Cell, chain balanced float type, Ultrasonic, Capacitance probe type, Hydrostatic pressure and Nuclear level detection techniques.

Unit IV: Motion, Light & Radiation Detectors **6L**

Motion detectors: Ultrasonic, capacitive detectors, LVDT, optoelectronics motion sensors, Acceleration sensors – Accelerometer characteristics, capacitive accelerometers, piezoelectric accelerometer, Piezo resistive accelerometer, thermal accelerometer. Tachometers – Optical tachometer, rotary detectors. Light & Radiation detectors: Photo diodes, phototransistor, CCD, CMOS image sensors – advanced APD sensors, gas flame detectors, Radiation detectors – ionization detectors.

Unit V : MEMS & Smart sensors **6L**

Magnetic field sensors – Hall effect and magneto-resistive elements (MRE), magneto-transistors, piezoelectric (PZT) sensors and actuators. Microelecromechanical systems (MEMS) - Bulk micromachining, micro-machined absolute pressure sensor, Surface Micromachining-Hot wire anemometer micro-miniature temperature sensor, surface micro machined accelerometer and SMART sensors.

Unit VI: Actuators and Final Control Elements **6L**

Pneumatic and hydraulic actuators- Directional control valves, Pressure control valves, Cylinders, Process control valves - Electrical actuators- Mechanical switches, Solid state switches, Solenoids, DC motors, AC motors and Stepper motors

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Text Books:

1. Mechatronics, Electronic Control Systems in Mechanical and Electrical Engineering , W. Bolton, Pearson Education, 3rd Edition
2. Introduction to Instrumentation, Sensors, and Process Control, William C. Dunn ,Artech House Sensors Library

Reference Books:

1. Intelligent Instrumentation George C. Barney, Prentice Hall of India, 2nd Edition
2. Process Control Instrumentation Technology , Curtis Johnson, Prentice Hall of India Pvt. Ltd, 7th Edition
3. Sensors Handbook, Sabri Soloman, MacGraw Hill, 2nd Edition

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MOOC / NPTEL Courses:

1. NPTEL Course **"Industrial Instrumentation"**
Link of the Course: https://nptel.ac.in/courses/108/105/108105064/

304205: Elective I
B. Machine Learning

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination : 70

Course Objectives:

1. To learn various AI agents used in AI application.
2. To learn various types of algorithms useful in Artificial Intelligence
3. To understand the concepts of learning

Course Outcomes:

After successfully completing the course learner will be able to,

1. Identify and apply suitable intelligent agents for various AI applications.
2. Design system using different informed search / uninformed search or heuristic approaches
3. Apply knowledge representation and learning to solve AI problem
4. Apply Knowledge to build AL application in electrical machines and drives

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Unit I: Foundation of AI **6L**

What is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Agents and Environments, The Concept of Rationality, The Nature of Environments, The Structure of Agents: Simple reflex agent, Model-based reflex agent, Goal-based agent, utility-based agent and learning agent.

Unit II: Problem Solving by Searching **6L**

Problem solving agents, Example problems: Toy (Roomba), 8-puzzle and 8-queens, Searching for solution, Uninformed search: breadth first search, depth first search, Iterative deepening depth first search, Informed search: Greedy best first search, A* search, genetic algorithm, compare informed and uninformed search.

Unit III: Knowledge Representation **6L**

First order logic, representation revisited, Syntax and semantics for first order logic, Using first order logic, Knowledge engineering in first order logic, Inference in First order logic, prepositional versus first order logic, unification and lifting, forward chaining, backward chaining, Resolution, Knowledge representation, Uncertainty and methods, Bayesian Probability and Belief network, probabilistic Reasoning, Bayesian networks, inferences in Bayesian networks, Temporal models, Hidden Markov models.

Unit VI: Natural Language Understanding **6L**

Why NL, Formal grammar for a fragment of English, Syntactic analysis, Augmented grammars, Semantic interpretation, Ambiguity and disambiguation, Discourse understanding, Grammar induction, Probabilistic language processing, Probabilistic language models

Unit V: Learning **6L**

Learning from observation: forms of learning, inductive learning, learning decision tree, Reinforcement learning: Introduction, passive reinforcement learning, active reinforcement learning, and generalization in reinforcement learning

Unit VI: Artificial Intelligence applications in electrical machines and drives 6L

Fuzzy logic principle and applications: Introduction, Fuzzy sets, Fuzzy system, Fuzzy control, and Fuzzy logic based induction motor speed control, Neural network principle and applications: Introduction, Neural network in identification and control, AI Applications in electrical machines and drives, neural network based PWM controller.

Text Books:

1. Artificial Intelligence: A Modern Approach, Stuart Russel, Peter Norvig.
2. Elaine Rich and Kevin Knight, ―Artificial Intelligence‖, Tata McGraw-Hill.
3. Artificial-Intelligence-Based Electrical Machines and Drives: Application of Fuzzy, Neural, Fuzzy-Neural, and Genetic-Algorithm-Based Techniques, by Peter Vas

Reference Books:

1. Artificial Intelligence, 2nd Edition, Rich and Knight
2. Artificial Intelligence and Machine Learning, by Chandra S.S.V, PHI

MOOC / NPTEL Courses:

1. NPTEL Course **" Introduction to Artificial Intelligence"**
Link of the Course: https://nptel.ac.in/courses/106/102/106102220/

304185*: Elective I
C. Fundamentals of JAVA Programming
(Subject common with TE E&TC 2019 Course)

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:

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

Course Outcomes:

After successfully completing the course learner will be able to,

1. Understand the basic principles of Java programming language
2. Apply the concepts of classes and objects to write programs in Java
3. Demonstrate the concepts of methods & Inheritance
4. Use the concepts of interfaces & packages for program implementation
5. Understand multithreading and Exception handling in Java to develop robust programs
6. Use Graphics class, AWT packages and manage input and output files in Java

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Unit I: JAVA Fundamentals **8L**

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.

Unit II: Classes and Objects **6L**

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.

Unit III: Methods & Inheritance in JAVA **6L**

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.

Unit IV: Interfaces & Packages **6L**

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

Unit V: Multithreading & Exception Handling **6L**

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.

Unit VI: Graphics Programming and File Handling **6L**

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.

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/

304205: Elective I
D. Data Communication

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
InSemester Examination Phase I: 30
End Semester Examination : 70

Course Objectives:

1. To provide an in-depth introduction to all aspects of data communication system.
2. To define different data formats for better data transmission
3. To introduce various digital bandpass modulation schemes
4. To identify the need of data coding and error detection/correction mechanism
5. To provide knowledge of various multiplexing schemes.

Course Outcomes:

After successfully completing the course, learner will be able to

1. Define and explain terminology of data communications
2. Apply various network layer techniques to analyse packet flow on basis of routing protocols
3. Get exposure to entropy and other coding techniques
4. Identify and explain error detection and correction using appropriate techniques
5. Understand the impact and limitations of bandpass modulation techniques
6. To acknowledge the need of spread spectrum schemes.

Unit I: Data Transmission Fundamentals 8L

Data transmission concepts and terminology, analog and digital data transmission, Transmission modes (simplex, half duplex, full duplex), Transmission Impairments and Channel Capacity, transmission media : Guided (UTP, STP, Optical, coaxial) & wireless(Radio wave, Microwave, Infrared), Data Transmission(parallel and serial synchronous and asynchronous transmission), analog and digital signal properties, Bandwidth, bit rate, baud rate data rate limits, Connecting devices: Hubs/Repeaters, Switches, Bridges, Routers, Layered Architecture (OSI Model), ISDN

Unit II: Noise 6L

Sources of Noise, Types of Noise, White Noise, Thermal noise, shot noise, partition noise, Low frequency or flicker noise, burst noise, avalanche noise, Signal to Noise Ratio, SNR of tandem connection, Noise Figure, Noise Temperature, Friss formula for Noise Figure, Noise Bandwidth, Behavior of Baseband systems and Amplitude modulated systems i.e.DSBSC and SSBSC in presence of noise.

Unit III: Error Control Coding 8L

Linear block codes, Hamming code, Hamming distance, CRC, syndrome detection, convolution code, trellis diagram, coding gain, Veterbi algorithm for detection Error control systems: FEC, ARQ Stop and Wait, Hybrid ARQ, go back N, selective repeat.

Unit IV: Information Theory 6L

The concept of Information, Information rate, entropy, mutual information, channel capacity, Bandwidth-SNR tradeoffs, use of orthogonal signals to achieve Shannon‟s limit. Entropy coding: overview of BSC, Huffman coding, Shannon-Fano coding, code efficiency, channel through put

Unit V: Bandpass Digital Signalling **8L**

Generation, detection, signal space diagram ASK, FSK, PSK, QPSK, OQPSK, QAM schemes, comparison. M-ary signalling: MPSK, MFSK signalling, OFDM.

Unit VI: Multiple Access Techniques **6L**

Introduction to Multiple Access Techniques – TDMA, FDMA, CDMA Spread spectrum techniques DSSS and FHSS, introduction to orthogonal codes and their properties; suitable example of orthogonal code and its autocorrelation, random access, Pure and slotted ALOHA, Media access control protocol (CSMA)

Text Books:

1. Bernard Sklar, Digital Communication,2/E, Pearson Education India, 2009
2. Willam Stallings, Data and Computer Communications,8/E, Pearson, 2007

Reference Books

1. Behrouz A. Forouzan, Data Communications and Networking, 4/E, McGraw-Hill, 2006Leon W. Couch II, Digital and Analog Communication Systems, 6/E, Pearson Education Asia, 2002
2. Taub Schilling, Principals of Communication Systems, 2/E, Tata McGraw Hill, 2004
3. John J Proakis, Digital Communications, 3/E, McGraw-Hill Higher Education, 2001 Computer Networks,A.S.Tanenbaum,4th edition,Pearson education.

MOOC / NPTEL Courses:

1. NPTEL Course **"Modern Digital Communication Techniques"**
Link of the Course: https://nptel.ac.in/courses/117/105/117105144/

304205: Elective I
E. Computer Networks

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:

1. Build an understanding of the fundamental concepts of computer networking
2. Preparing the student for entry Advanced courses in computer networking.
3. Acquire the required skill to design simple computer networks.

Course Outcomes:

1 Design, implement, and analyze simple computer networks.
2 Identify, formulate, and solve network engineering problems.
3 Use techniques, skills, and modern networking tools necessary for engineering practice.
4 Understand the congestion control mechanism to improve Quality of service of Networking application.
5 Understand and Design application layer protocols and Internet applications such as E-mail, DNS etc.
6 Build an understanding of the fundamental concepts of Network administrator & simulation.

Unit I: Introduction to Computer Networks **6L**

Definition & Uses of computer Network, Network Hardware-LAN, WAN, MAN & Internet, Network Software-design Issues for layers, Service primitives and relationship of services to Protocols, Reference models-OSI &TCP/IP, network architectures introduction, Addressing types-Physical, Logical & port address, Protocols and Standards.

Unit II: Physical Layer **6L**

Physical layer-Data rate limits, Transmission media-guided and Unguided, Switching systems Circuit switching, Datagram Switching & Virtual circuit switching, Example of networksX.25, Frame Relay & ATM, Structure of circuit and packet switch networks, cable modem and DSL technologies, Communication satellites (LEO/MEO/GEO), Introduction to physical layer in 802.11 LAN & 802.15 WPAN.

Unit III: Data link layer **6L**

Data link layer: Framing, Flow & Error control Protocols, noiseless channels, Noisy channels, HDLC, PPP, Multiple access techniques-random access, controlled access & Channelization, Ethernet types-bridged, Switched, Full duplex, Fast & gigabit Ethernet. Introduction to Data link layer in 802.11 LAN, Connecting devices like passive hubs, repeaters, Active hubs, Bridges, Two-layer Switches, Routers, three layer switches, Gateway etc., Backbone networks, Virtual LANs.

Unit IV: Network Layer and Transport Layer **6L**

Network Layer: IPv4 address, IPv6 address, Address mapping-ARP, RARP & DHCP, IPv4 datagram detail format, IPv6 datagram detail format, ICMP, IGMP, Network layer issues like Delivery, forwarding, intradomain and Interdomain routing, Routing algorithms like Shortest path routing, Flooding, Distance Vector Routing, Link State Routing, Path vector routing etc.,

Simple Router architecture. Transport layer-Process to process delivery, Connection **oriented** & Connectionless Transport, UDP, TCP, congestion control and Quality of Service.

Unit V Application Layer **6L**

Application layer protocols and applications like Ping, FTP, telnet, http (www), SMTP, SNMP, Trace route, TFTP, BOOTP, DNS, NFS, RPC, X-server, E-mail, Introduction to streaming Audio/Video,P2P file sharing, Introduction to socket & Socket Interface, Introduction to HTML programming)

Unit VI: Basics of Network administration and Simulation **6L**

Network Administration: UTP Cabling for PC to PC communication & their standards, Network tester, network monitoring, Protocol Analyzer, Network Simulation, internet access through Dialup/DSL/Leased Line/Mobile handset, Cisco packet tracer,NS2.

Text Books:

1. Behrouz A. Forouzan, Data Communications and Networking, 4th Edition, TATA McGraw Hill
2. Andrew Tenenbaum, Computer Networks, 4th Edition, Pearson Education.

Reference Books:

1. William Stallings, Computer Networks and Cryptography, 3rd edition, Pearson Education
2. Behrouz A. Forouzan, TCP/IP protocol Suit, 3rd edition, TATA McGraw Hill
   Stevens, TCP/IP illustrated Volume - I & II, Pearson education.
3. Kurose & Ross, Computer Networking: A top Down Approach featuring the Internet. 3rd edition, Pearson Education

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MOOC / NPTEL Courses:

1. NPTEL Course **"Computer Networks"**
   Link of the Course: https://nptel.ac.in/courses/106/105/106105081/#

304206: Power and Industrial Electronics Lab

Teaching Scheme
Practical: 2 Hours/Week

Examination scheme
Practical: 50 Marks

Perform any 8 experiments

1. V-I Characteristics of MOSFET / IGBT
2. V-I Characteristics of SCR & measurement of holding & latching current
3. Triggering circuit for MOSFET / IGBT.
4. Triggering circuit for thyristor (Using UJT or specialised IC)
5. Single phase Semi / Full Converter with R & R-L load
6. Three phase Semi / Full Converter with R load
7. Single/Three Phase PWM bridge inverter for R load
8. Load and Line Regulation of SMPS
9. Simulation of Three phase Semi/Full converter for R and RL load.
10. Simulation of Three phase PWM inverters for R and RL load

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Link of the Virtual Lab:
http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/power_electronics/labs/index.php
Note: Two experiments to be performed using the virtual labs.

304187*: Database Management Lab
(Subject common with TE E&TC 2019 Course)

Teaching Scheme:
Practical: 2 Hrs/ Week

Examination Scheme:
Oral: 25

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

10. Implement MYSQL/Oracle database connectivity with PHP/python/Java Implement Database navigation operations (add, delete, edit,) using ODBC/JDBC.

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.

304208: Microcontrollers and Applications Lab

Teaching Scheme
Practical: 2Hours/Week

Examination scheme
Practical: 50 Marks

All experiments of group A and group B are compulsory.

Group A

1. Interfacing LED bank to 8051 microcontroller using timer with interrupt.
2. Interfacing Seven Segment Display to 8051 microcontroller
3. Interfacing of DAC to 8051 microcontroller to generate various waveforms.
4. Interfacing of LCD with 8051 microcontroller.
5. Interfacing of Stepper motor to 8051microcontroller.

Group B

6. Write a program for interfacing button, LED, relay & buzzer to PIC18FXX as follows:

a) when button 1 is pressed, relay and buzzer is turned ON and LED"s start chasing from left to right

b) when button 2 is pressed, relay and buzzer is turned OFF and LED start chasing from right to left

7. Interfacing 4X4 keypad and displaying key pressed on LCD OR on HyperTerminal for PIC18Fxx.
8. Generate square wave using timer with interrupt for PIC18Fxx.
9. Serially transfer the data on PC using serial port of PIC18Fxx.
10. Generation of PWM signal from PIC18Fxx for DC Motor control.
11. Interface analog voltage 0-5V to internal ADC and display value on LCD.

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

Note: Two experiments to be performed using the virtual labs.

304209: Elective I
A. Instrumentation Systems lab

Teaching Scheme
Practical: 2 Hours/Week

Examination scheme
Practical: 25 Marks

Perform any 8 experiments

1. Weight measurement using load cell and strain gauges
2. Measurement of vibration
3. Liquid level measurement using Capacitive transducer
4. Speed Measurement
5. Determine RTD (PT100) characteristic
6. Determine Thermocouple characteristic
7. Simulation of temperature measurement using Any simulation tool
8. Study of I/V & V/I signal converter
9. Study of Pneumatic cylinder sequencing
10. Flow Measurement using Ultrasonic technique

Virtual LAB Links:
http://sl-coep.vlabs.ac.in/

Note: Two experiments to be performed using the virtual labs.

304209: Elective I
B. Machine Learning Lab

Teaching Scheme
Practical:2Hours/Week

Examination scheme
Practical: 25 Marks

1. Program for generating Fibonacci series
2. Implement Depth first search algorithm
3. Implement breadth first search algorithm
4. Implement A* approach for any suitable application.
5. Implement genetic algorithm for any suitable application
6. Write a python program that computes the truth table of a statement in propositional logic along with several functions that reason about those tables.
7. Implement forward chaining algorithm for suitable application
8. Implement backward chaining algorithm for suitable application
9. Implementation of Unification algorithm.
10. Write a program to implement Single Player Game (Using Heuristic Function)

304189*: Elective I
C. Fundamentals of JAVA Programming Lab
(Subject common with TE E&TC 2019 Course)

Teaching Scheme
Practical:2Hours/Week

Examination scheme
Practical: 25 Marks

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

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

Note: Two experiments to be performed using the virtual labs.

304209: Elective I
D. Data Communication Lab

Teaching Scheme
Practical:2Hours/Week

Examination scheme
Practical: 25 Marks

Any seven from 1 to 9

1. Experimental Study of PCM and Companded PCM.
2. Experimental study of Differential Pulse Code Modulation or delta modulation and signal reconstruction
3. Experimental study of basic line codes and Multi level line codes
4. Experimental study of ASK modulation and demodulation
5. Experimental study of PSK modulation and demodulation
6. Experimental study of FSK modulation and demodulation
7. Experimental study of QPSK and OQPSK modulation and demodulation
8. Design of PN sequence generator.
9. Experimental study of generation and detection of Spread Spectrum System (DSSS)

Software Assignments: (Any two from 10 to 12):

10. Implementation of linear block code
11. Implementation of Convolution code and Viterbi algorithm
12. Implementation of Shannon Fano and Huffman codes

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: Two experiments to be performed using the virtual labs.

304209: Elective I
E. Computer Networks Lab

Teaching Scheme
Practical:2Hours/Week

Examination scheme
Practical: 25 Marks

Perform any 8 experiments

1. Study of network commands & IP address configurations.
2. Study of Cable tester for fault detection of UTP-CAT5 Cross / Straight LAN cable.
3. Implementation of LAN using star topology and connectivity between two computers using crossover UTP CAT5 cable. (Cisco Packet Tracer)
4. Installation and configuration of Web Server and hosting web page using HTML programming.(Cisco Packet Tracer)
5. Installation and configuration of Proxy Server.
6. Installation and configuration of FTP server for FTP communication.
7. Installation and configuration of Telnet server for Telnet Communication.(Teamviewer)
8. Write a program in „C" for Shortest Path algorithm.
9. Connectivity of LAN computers to Internet using Dial-Up modem/leased line Modem /MobileHandset. (Installation and configuration).
10. Installation of Suitable Protocol Analyzing software and Analysis of Intranet activities. (Wireshark)

Virtual LAB Links:
Link of the Virtual Lab: http://vlabs.iitkgp.ernet.in/ant/

Note: Two experiments to be performed using the virtual labs.

304190*: Skill Development
(Subject common with TE E&TC 2019 Course)

Teaching Scheme
Practical: 2Hours/Week

Examination scheme
Term Work: 25 Marks

List of 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.

304211A: Mandatory Audit Course - 5

Teaching Scheme: -- **Examination Scheme: --**

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 learner 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 mark sheet.

SEMESTER – II

304212: Fundamentals of HDL

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:

1. Basic programming in VHDL.
2. Design combinational, sequential circuits and understand behavioral and RTL modeling of digital circuits using VHDL.
3. System design approach using programmable logic devices.
4. Concepts of Verilog HDL.
5. Design combinational, sequential circuits and understand behavioral and RTL modeling of digital circuits using Verilog HDL.
6. Advanced constructs like Procedure, Task & functions.

Course Outcomes:

1. After successfully completing the course students will be able to
   Learn the role of HDL in digital system design using the latest tools like VHDL.
2. Describe and test digital logic circuits in data flow description, structural description and behavioral description using VHDL.
3. Analyze digital system design using PLD.
4. Understand the basics of Hardware Description Languages, Program structure and basic language elements of Verilog.
5. Model digital systems in verilog HDL at different levels of abstraction. Understand the simulation techniques and test bench creation.
6. Apply advanced constructs like Procedure, Task & functions to make models of digital logic systems using VHDL & Verilog.

Unit I: Introduction to HDL **6L**

Introduction: Why HDL? A Brief History of HDL, Features of VHDL, Structure of HDL Module, Operators, Data types, Types of Descriptions, simulation and synthesis, Brief comparison of VHDL and Verilog.

Unit II: Modeling styles in VHDL **6L**

Data-Flow Descriptions: Highlights of Data-Flow Descriptions, Structure of Data-Flow Description, Data Type – Vectors. Behavioral Descriptions: Behavioral Description highlights, structure of HDL behavioral Description, The VHDL variable –Assignment Statement, sequential statements. Structural Descriptions: Highlights of structural Description, Organization of the structural Descriptions, state Machines.

Unit III: Programmable Logic Devices **6L**

Complex Programmable Logic Devices – Architecture of CPLD, Organization of FPGAs, FPGA Programming Technologies (SRAM, Antifuse), Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs

Unit IV: Introduction to Verilog HDL **6L**

Overview of Digital Design with Verilog HDL, Hierarchical Modelling Concepts, Program Structure of Verilog, Logic System, Nets, Variables, and Constants, Vectors and Operators, Arrays, Logical Operators and Expressions.

Unit V: Design Elements in Verilog **6L**

System Tasks and Compiler Directives, Gate-Level Modelling, Dataflow Modelling, Behavioral Modelling (Procedural Code), Useful Modelling Techniques.

Unit VI: Procedures, Task and Functions **6L**

Highlights of Procedures, tasks, and Functions, Procedure (VHDL) and task (verilog), VHDL Functions, Verilog Functions.

Text Books:

1. Nazeih M.Botros, "HDL Programming (VHDL and Verilog)", Dreamtech Press (Available through John Wiley – India and Thomson Learning), 2006 Edition.
2. John F Wakerly, "Digital Design- Principles and Practices", Pearson education, 4th Edition.

Reference Books:

1. Douglas Perry, "VHDL", TMH, 4th Edition, 2002.
2. Stephen Brown & ZvonkoVranesic, "Fundamentals of Digital Logic Design with
3. VHDL",Tata McGrw-Hill, New Delhi, 2nd Ed., 2007.
4. Samir Palnitkar, "Verilog HDL– A Guide to Digital Design and Synthesis", Pearson Education, 2nd Edition, 2003.
5. Stephen Brown & Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", TMH.

MOOC / NPTEL Courses:

1.NPTEL Course on "NPTEL **course on Hardware Modeling using verilog** "
Link: https://nptel.ac.in/courses/106/105/106105165/

304213: Embedded Processors and Applications

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:

1. To learn MSP430 Microcontroller and peripheral interface.
2. To study the architecture of ARM series microprocessor
3. To study LPC2148 ARM7 microcontroller.
4. To study interfacing advanced peripherals to LPC2148 microcontroller
5. To learn about Embedded system for IoT application using ARM processors

Course outcomes:

1. Demonstrate MSP 430 architectures and its feature.
2. Demonstrate the ARM architectures and its feature.
3. Study of ARM7 Based Microcontroller LPC 2148
4. Interface the advanced peripherals to ARM based microcontroller
5. Study of ARM cortex architectures and its feature.
6. Design simple applications using ARM and IoT

Unit I: MSP430 Microcontroller Architecture and Real World Interfacing 6L

Low Power 16-bit MSP430x5xx microcontroller architecture, on-chip peripherals (analog and digital), and Register sets, GPIO and registers associated, Interrupts and interrupt programming, Timers, PWM, Interfacing and embedded C programming of MSP 430 with LEDs, Generating PWM to control speed of DC motor, Relay, motion sensors and buzzer**.**

Unit II: ARM7, ARM9, ARM11Processors 6L

ARM7 Based Microcontroller LPC2148: Features, Architecture its Description, System Control Block (PLL and VPB divider), GPIO, Pin Connect Block, timer, interfacing with LED, LCD, Relay, Buzzer, Motion sensor, soil moisture sensor.

Unit III: ARM7 Based Microcontroller LPC 2148 6L

ARM7 Based Microcontroller LPC2148: Features, Architecture its Description, System Control Block (PLL and VPB divider), GPIO, Pin Connect Block, timer, interfacing with LED, LCD, Relay, Buzzer, Motion sensor, soil moisture sensor..

Unit IV: Real World Interfacing with LPC 2148 6L

UART of LPC 2148, interfacing of LPC 2148 with PC using UART and embedded C program to send message to PC, interfacing the peripherals to LPC2148: GSM and GPS using UART (only algorithm and flow chart), on-chip ADC, temperature monitoring using on chip ADC, EEPROM using I2C, on-chip DAC and its applications for waveform generation.

Unit V: ARM CORTEX Processors 6L

Introduction to ARM CORTEX series, advantages over classical series and for embedded system design. CORTEX A, CORTEX M, CORTEX R processors series, versions, features and applications, ARM Cortex-M3 architecture, features and its functional description, advantages of ARM Cortex-M3 for embedded application, Comparison of ARM Cortex-M3 and ARM 7, Firmware development using CMSIS standard for ARM Cortex.

Unit VI: Embedded System Based Internet of Things **6L**

Introduction to Embedded System and its characteristics and architecture, introduction to Internet of Things and its architecture, Sensors and actuators, Basic block diagram of Embedded System with IoT, Case study using IoT: Smart Home automation, Smart energy meter , Waste Management for Smart City, Smart Car, Parking system, health monitoring system, Agriculture automation, Transportation management

Text Books:

1. MSP430 microcontroller basics 1st Edition by John H. Davies (Author), Newness Publication ISBN- 13:
2. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Develops Guide – Designing and Optimizing System Software", ELSEVIER
3. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Develops Guide – Designing and Optimizing

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Reference Books

1. LPC214xUser manual(UM10139):-www.nxp.com
2. ARM architecture reference manual:-www.arm.com
3. https://developer.arm.com/ip-products/processors/cortex-m/cortex-m3
4. ARM architecture reference manual : - www.arm.com
5. https://class.ece.uw.edu/474/peckol/doc/StellarisDocumentation/IntroToCortex-M3.pdf

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MOOC / NPTEL Courses:

NPTEL Course on " **Embedded System Design with ARM** "
Link: https://nptel.ac.in/courses/106/105/106105193/

304214: Industrial Management

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:

1. To provide a basis of understanding to the students with reference to working of business organization through the process of management.
2. To learn Human Resource Management as one of the major tasks in industry.
3. To understand concept of Quality Management and its tools.
4. Understanding of business concepts with a view to prepare them to face emerging challenge of managing business

Course outcomes:

After successfully completing the course learner will be able to

1. Understand Basic principles of management - will describe himself with management process, functions and principles
2. Understand the complexities associated with management of human resources in the organizations and integrate the learning in handling these complexities. Identify the quality standards relevant to the project and deciding how to meet them with the help of different tools.
3. Analyze and understand the environment of the organization.
4. Identify the idea about new developments in business and its management.
5. Get motivation for Entrepreneurship

Unit I: Principles of Management **6L**

Nature of Management: Meaning, Definition, it's nature purpose, importance & Functions, Management as Art, Science & Profession- Management as social System Concepts of management-Administration-Organization, Evolution of Management Thought: Contribution of F.W.Taylor, Henri Fayol , Elton Mayo, Functions of Management, Strategic Management

Unit II: Human Resource Development **6L**

Strategic importance HRM; objectives of HRM; challenges to HR professionals; role, Responsibilities and competencies of HR professionals; HR department operations; Human Resource Planning - objectives and process; human resource information system. Talent acquisition; recruitment and selection strategies

Unit III: Quality Management **6L**

Definition of quality, goalpost view of quality, continuous improvement definition of quality, types of quality – quality of design, conformance and performance, phases of quality management, Quality Management Assistance Tools: Five S (5S), Six sigma Quality Management Standards (Introductory aspects only), The ISO - Quality Management System Standard.

Unit IV: Business and Society **6L**

Changing Concepts and Objectives of Business, Professionalization, Business ethics, Business and culture, Technological Development and Social Change, Social Responsibility of Business, Social Audit

Unit V: Forms of business organizations **6L**

Private sector, Cooperative sectors, public sector, joint sector, Services sector, Various forms of business organizations – Sole Proprietorship, Partnership firms, Joint stock companies – their features, relative merits, demerits & suitability

Unit VI: Entrepreneurship Development **6L**

Concept of entrepreneurship, Identification of business opportunities, Generation of business idea, Business plan, Preparation of business proposal, Sources of finance – government and nongovernment agencies, Policies and incentives for small business development, Government policies and incentives

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Text Books:

1. Industrial Engineering & Management by O.P.Khanna
2. Industrial Organization Management: Sherlekar, Patil, Paranjpe, Chitale

Reference Books

1. Business organization and Management by Talloo, Tata McGraw Hill
2. Principles of Management, by Tripathi, Reddy, Tata McGraw Hill
3. Waman S. Jawadekar, "Management Information Systems", Mc-Graw-Hill Education (India) Pvt. Ltd.

MOOC / NPTEL Courses:

1.NPTEL Course on “Concept of Management and Evolution of Management thought“
Link: https://nptel.ac.in/courses/122/108/122108038/

304215: Elective II
A. PLC & Automation

Teaching Scheme:
Lectures: 3Hrs/Week

Examination Scheme:
InSemester Examination Phase I:30
End Semester Examination Phase II:70

Course Objectives:

1. Discuss importance, purpose, functions and operations of the PLC in industrial application.
2. To train the students to create ladder diagrams for industrial control applications.
3. Aware how to select the essential elements and practices needed to develop and implement the engineering automation using PLC.

Course outcomes:

After successfully completing the course learner will be able to

1. Apply concepts of PLC, its uses for industrial applications.
2. Demonstrate Relay logic instructions & PLC ladder programs for industrial applications.
3. Demonstrate timer, counter arithmetic, comparison functions & PLC ladder programs for industrial applications.
4. Identify the idea about new developments in business and its management.
5. Make use of knowledge of Installation, troubleshooting & maintenance of PLC to provide solution for industrial automation problems.
6. Describe fundamentals of process control, SCADA & HMI
7. Select appropriate interfacing technique & communication protocol to establish communication with field devices, HMI & SCADA.

Unit I: PLC Overview **6L**

Definition & History of PLC, Basic structure & Components of PLC, Principle of Operation, Selection of PLC, Why Use PLC, PLC I/O Modules, Memory & How it is used, PLC advantages &Disadvantages, PLC vs Computers, Overview of Micro PLCs. Conventional ladders vs PLC Ladder logic, What is Logic? Overview of Logic functions, Number systems & Codes, Hardwired Logic vs Programmed logic, Programming word level logic instructions, Relation of digital gate logic to contact/coil logic, Relay logic, Relay Sequencers

Unit II: Basics of PLC Programming –I **6L**

Processor memory organization, PLC Programming languages, Ladder diagrams, Relays, contactors, switches, sensors, output control devices, latching relays, ladder diagram elements. Instructions: Relay type instructions, Instruction addressing, Branch Instructions, Internal Relay Instructions, Programming. Write ladder logic for a) two switches labeled as A & B are wired in parallel controlling lamp, where two switches are separate inputs. b) That will cause output, pilot light PL, to be on when selector switch SS is closed, push button PB is closed and limit switch LS is open

Unit III: Basics of PLC Programming –II **6L**

Basic Functions : PLC Timer & Counter functions, Timer & Counter Industrial applications, Arithmetic functions, Comparison functions, Jump functions, Data handling functions, Digital Bit functions, PLC matrix Functions, Advanced PLC Functions: Analog PLC operation, PID control of Continuous processes. Write a PLC program for a) controlling lubricating oil being dispensed from a tank, b) Automatic water sprinkler system of a garden.

Unit IV: PLC Installation, Troubleshooting & Maintenance **6L**

Installation : Consideration of operating environment, Receiving test, check & assembly, Electrical Noise, Leaky inputs & outputs, Grounding, voltage variations & surges, Circuit protections & wiring, Program Editing& Commissioning. Troubleshooting: Processor module, Input & Output malfunctions, Ladder logic program. PLC Maintenance.

Unit V: Process control, HMI & SCADA **6L**

Types of processes, structure of control systems, on/off control, PID Control, Motion control, SCADA (Supervisory control and data acquisition): Block diagram, RTU (Remote terminal unit), Functions of RTU, MTU (Main terminal unit), functions of MTU, operating interfaces& applications, HMI (Human Machine Interface, Interfacing technique of PLC with HMI.

Unit VI: PLC Networking & Applications **6L**

Types of communication interface, Types of networking channels, Advantages of standard industrial network, Serial communication, Industrial network : CAN (Controller area network), Devicenet, Controlnet, Ethernet/IP, Modbus, Fieldbus, Profibus-PA/DP, SCADA (Supervisory control & data acquisition), HMI (Human Machine Interface), Two-axis, three axis robot control with PLC, Examples of some simple automated systems

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Text Books:

1. Programmable Logic Controllers, Frank D. Petruzella, McGraw-Hill Education, Fourth Edition,

Reference Books:

1. Programmable logic controllers & Industrial Automation- Madhuchandra Mitra, Samarjeet Sen Gupta Penram International Pvt. Ltd., Fourth reprint, 2012
2. Programmable Logic Controllers, W. Bolton, Elsevier, Fourth Edition,2015
3. Programmable Logic Controllers, Principles & Applications" John W. Wobb, Ronald, A. Rais, PHI publishing, Fifth Edition
4. Introduction to Programmable Logic Controllers, Garry Dunning, Thomson, Delmar Learning, 3rd Edition

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MOOC / NPTEL Courses:

1. NPTEL Course on "**Industrial Automation and Control** "
Link: https://nptel.ac.in/courses/108/105/108105062/

304215: Elective II
B. Digital Signal processing

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II:70

Course Objectives:

1. To understand DTFT and DFT.
2. To understand, analyze and design FIR and IIR filters.
3. To understand realization of FIR and IIR Filters.
4. To understand its hardware implementation using DSP Processor

Course Outcomes:

After successful completion of this course, the student will be able to:

1. Apply DFT as an analytical tool.
2. Analyze LTI Systems using FFT algorithms.
3. Design FIR and IIR systems.
4. Implement FIR and IIR Systems.
5. Implement various DSP Systems on DSP Processor

Unit I: Z-transform and its application to the analysis of LTI systems: 6L

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

Unit II: Discrete Fourier Transform 6L

Frequency domain sampling and reconstruction of discrete time signals – DFT, properties of the DFT, use of DFT in linear filtering, filtering of long data sequences, DFT as linear transformation, Efficient computation of the DFT- FFT Algorithms, Radix 2 DITFFT and DIFFFT, Goertzel Algorithm.

Unit III: Design of IIR filters & FIR Filter 6L

IIR:- Classical design by impulse invariance, bilinear transformation and matched Z transform, characteristics and design of commonly used filters – butter worth, Chebyshev and elliptic filters, Spectral transformations, Direct design of IIR filters.
FIR:- General considerations, Linear phase FIR Filters, Symmetric and anti-symmetric impulse response, Design using windows, frequency sampling design, Optimum design.

Unit IV: Implementation of Discrete time Systems 6L

Structures for FIR systems – Direct form, cascade form, Frequency sampling and lattice structures. Structures for IIR systems – Direct form, cascade and parallel form, lattice ladder structures. Finite word length effects.

Unit 5: Multi rate Signal processing 6L

Multi rate Signal Processing:-Sampling rate reduction: decimation by integer factors, Sampling rate increase: interpolation by integer factors, sampling rate conversion by non integer factors.

Unit 6: DSP Processors and Application of DSP **6L**

DSP Processors: -Need for Special architecture of DSP processor, Difference between DSP processor & microprocessor, a general DSP processor TMS320C54XX series,

Application of DSP: - Case study of Real Time DSP applications to Speech Signal Processing and Biomedical Signal Processing

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Text Books:

1. Proakis J.G and.Manolakis D.G. Mimitris D. (2003) ―Introduction to Digital Signal Processing‖ Prentice Hall, India

Reference Books:

1. Oppenheim A.V.and Schafer R.W. (2003) ―Discrete Time Signal Processing‖, Pearson education.
2. Ifeachar and Jervis (2003) ―Digital Signal Processing: A Practical approach‖ Pearson education, Asia
3. Rabiner L.R and Gold D.J (1988) ―Theory and applications of digital signal processing‖ Prentice Hall, India

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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/

304195: Elective II
C. Advanced JAVA Programming
(Subject common with TE E&TC 2019 Course)

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II:70

Course Objectives:

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

Course Outcomes:

1. Design and develop GUI applications using Applets.
2. Apply relevant AWT/ swing components to handle the given event.
3. Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
4. Learn to access database through Java programs, using Java Database Connectivity (JDBC)
5. Invoke the remote methods in an application using Remote Method Invocation (RMI)
6. Develop program for client /server communication using Java Networking classes.

Unit I: Applet **6L**

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

Unit II: Event Handling using AWT/Swing components **6L**

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

Unit III: GUI Programming

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.

Unit IV: Database Programming using JDBC **6L**

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

Unit V: Remote Method Invocation (RMI) **6L**

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.

Unit VI: Networking **6L**

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.

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

304215: Elective II
D. Fiber Optic Communication

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:
1. To lay the foundation for optical communication engineering.
2. To understand the applications of optical communication engineering.
3. To carry out the analysis of optical network

Course Outcomes:
After successfully completing the course learner will be able to,
1. Understand advantages and applications of optical communication.
2. Identify different optical devices with their operating principle.
3. Formulate optical communication problem for synthesis.
4. Explain the design consideration in optical links. Link power budget and multichannel transmission techniques.

Unit I: Overview of Optical Fiber Communication: 6L
Introduction, Historical development, general system, advantages, disadvantages, and applications of optical fiber communication, optical fiber waveguides, Ray theory transmission: TIR, Acceptance angle, Numerical aperture, Electromagnetic mode theory for optical propagation: phase and group velocity, cutoff wavelength & group delay.

Unit II: Fundamentals of FOC 6L
Basic block diagram of Optical Fiber Communication system, cylindrical fiber, single mode fiber, cutoff wave length, mode filed diameter. Optical Fibers: fiber materials, photonic crystal, fiber optic cables specialty fibers, Principles of light propagation through a fiber, Different types of fibers and their characteristics, Attenuation, Distortion, Pulse broadening in GI fibers, Mode coupling, Coupling losses

Unit III: Optical Fiber for Telecommunication 6L
Transmission characteristics of optical fibers: Attenuation due to absorption, scattering & bending, Signal Distortion in optical fibers: Intra modal Dispersion: Material & Waveguide dispersion; Intermodal dispersion: MMSI, MMGI & modal noise; Overall fiber dispersion: MM & SM fibers. Special use fibers: Dispersion shifted (DSF), NZDSF, Dispersion flattened, Polarization maintaining fibers, Fiber Nonlinearities. State of art: Fiber.

Unit IV: Optical Sources and Detectors 6L
Introduction to optical sources: Wavelength and Material Considerations, LEDs & semiconductor LASERs: principle of working & their Characteristics, Line coding. Introduction to optical detectors: Material Considerations, PIN, Avalanche photodiodes & photo transistors: Principle of working & characteristics, relative merits and demerits of photodiodes. Numericals based on above topics.

Unit V: Multichannel Systems 6L
Overview of WDM, WDM Components: 2 x 2 Fiber Coupler, Optical Isolators and Circulators, Multiplexers and De-multiplexers, fiber alignment and joint loss, single mode

fiber joints, fiber splices, fiber connectors, Fiber Bragg Grating, FBG applications for multiplexing and De-multiplexing function, Diffraction Gratings, Optical amplifiers - EDFA, Raman amplifier, and WDM systems. Concept of self-phase modulation optical networks: SONET/SDH.

Unit VI: Design considerations in optical links **6L**

Point to point Links: System design considerations, Link Power budget, Rise Time budget, Analog Links: CNR, Multichannel transmission techniques.

Text Book:

1. G. Keiser, “Optical fiber communication systems”, McGraw-Hill, 3rd Edition, New York, 2000.
2. Mishra and Ugale, “Optical Fiber Communication, As per AICTE: system and components”, John Wiley, India, 2019

Reference Books:

1. G. P. Agrawal, “Fiber optic communication systems”, 3rd Edition, John Wiley & Sons, New York, 2002.

MOOC / NPTEL Courses:

1. NPTEL course on optical Fiber communication

Link: https://nptel.ac.in/courses/108/106/108106167/

Link: https://nptel.ac.in/courses/108/104/108104113/

2. Udemy course: https://www.udemy.com/course/fiber-optics-network-design-and-maintenance/

304215: Elective II
E. e-Mobility

Teaching Scheme:
Lectures: 3 Hrs/ Week

Examination Scheme:
In Semester Examination Phase I: 30
End Semester Examination Phase II: 70

Course Objectives:

1. To introduce e-mobility and different types of power converters.
2. To make the students aware of different subsystems and types of electrical vehicle Technology.
3. To imbibe the importance and design of energy storage systems and charging circuits.

Course Outcomes:

After successfully completing the course students will be able to,
1. Design and implement different power converter circuits
2 Compare different types of electrical vehicles
3 Differentiate between different batteries and compare different energy storage systems.
4 Explain basic and advanced electrical vehicle charging systems and protocols.

Unit I: Introduction to e mobility and Power Converter: **6L**

Introduction: Introduction to electrical mobility, classification, need of electrical mobility, operating principle Power Converter: Introduction to power converter, Different types of power converter, construction, working, application, advantages and disadvantages of Power converters.

Unit II: Electric Vehicle (EV) Technology **6L**

Brief history of Electric Vehicle (EV), Components of EV, Benefits of EV
Types of EVs such as Battery EV, Hybrid EV, Plug-in EV, Fuel Cell EV and their comparison, Challenges faced by EV technology, Subsystems and configurations of EV, Subsystems of Hybrid EV, Configurations of series, parallel and series-parallel Hybrid EV
Impact of EV on grid, Vehicle to grid technology- block diagram

Unit III: ENERGY STORAGE SYSTEM **6L**

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zinc Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System.

Unit IV: EV Charging **6L**

Battery Chargers: Charge equalization, Conductive (Basic charger circuits, Microprocessor based charger circuit. Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Inductive (Principle of inductive charging, Soft-switching power converter for inductive charging), Battery indication methods.

Unit V: Charging Infrastructure and Connector **6L**

Charging Infra structure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.
Connectors- Types of EV charging connector, North American EV Plug Standards, DC Fast Charge EV Plug Standards in North America, CCS (Combined Charging System), CHAdeMO, Tesla, European EV Plug Standards.

Unit VI: Protocols **6L**

Advanced Metering Infrastructure Protocols aiding AMI IEEE 802.15.4, 6LoWPAN, ROLL, and RPL, IEEE 802.11 255, Modbus, DNP3, IEC 61850, Ethernet, Power line carrier, CAN Bus, I2C, LIN Bus protocol.

Text Book

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. (used for experiment also) ebook available unit 3
3. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001

Reference Books

1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004. (ebook available)
2. Electric vehicles standards charging infrastructure and impact on grid integration A technological review
3. NPTEL Fundamental of electric vehicle course https://nptel.ac.in/courses/108/106/108106170/ Unit 2 and Unit 5
4. https://gomechanic.in/blog/electric-vehicles-types-explained Unit 2
5. Dominique Paret, "Multiplexed Networks for Embedded Systems: CAN, LIN, FlexRay, Safe-by-Wire", Wiley,2007 unit 6 ebook available
6. Monzer Al Sakka1, Joeri Van Mierlo1 and Hamid Gualous2, DC/DC Converters for Electric Vehicles Unit 1
7. https://www.udemy.com/course/charging-infrastructure-for-electric-vehicles/?referralCode=E2C6CE52421D6DF3D504

MOOC / NPTEL Courses:

1. Coursera course on Electric Vehicles and Mobolity

Link of the course: https://fr.coursera.org/learn/electric-vehicles-mobility

2. Udemy Course: https://www.udemy.com/course/charging-infrastructure-for-electric-vehicles/

304216: FHDL Lab

Teaching Scheme
Practical: 2Hours/Week

Examination scheme
Oral: 50 Marks

List of Experiments:

Group A: [Any 4 to be performed]

1. Simulate Half adder and Full Adder using VHDL .
2. Simulate 1-bit Comparator using VHDL.
3. Simulate 4:1 Mux using VHDL .
4. Simulate all types of Flip-Flops using VHDL .
5. Simulate Shift Register (Left and Right shift) using VHDL .

Group B: [Any 4 to be performed]

6. Simulate Half adder and Full Adder using Verilog.
7. Simulate 3:8 Decoder using Verilog.
8. Simulate Counter using Verilog.
9. Simulate ALU using Verilog.
10. Simulate Parity Generator using Verilog.

Virtual LAB Links:
Link of the Virtual Lab: http://mddl-iitb.vlabs.ac.in/sequence_detector/index.html

Note: Two experiments to be performed using the virtual labs

304217: Embedded Processor and Application Lab

Teaching Scheme:
Practical: 2 Hrs/ Week

Examination Scheme:
Practical: 50

GROUP A

Experiment 1 and 2 compulsory, conduct any 6 (Six) experiment form 3 to 11 and experiment 12 compulsory.

1. Learn and understand how to configure MSP-EXP430G2 digital I/O pins. Write a C program for configuration of GPIO ports for MSP430
   a. Blink LED using various delays
2. To make the green LED stay ON for around 1 second every time the button is pressed. In MSP-EXP430G2 implement Pulse Width Modulation to control the brightness of the on-board green LED. Observe the PWM waveform on a particular pin using CRO.
3. Interfacing LPC2148 to LCD and display message on LCD
4. Interfacing LPC 2148 to seven segment display and display a count form 0 to 9 with suitable delay.
5. Interfacing LPC2148 to RGB LED and display the possible color generated by RGB LED
6. Interfacing LPC2148 for internal ADC and program to display digital value on serial port or on LCD
7. Generation of PWM signal for motor control using LPC2148
8. UART Interfacing LPC2148 in embedded system (GSM/GPS)
9. Interface Motion sensor and buzzer with LPC2148 and turn on buzzer when motion sensor senses a motion by human being.
10. Interface IR sensor and buzzer with LPC2148 and turn on buzzer when intruder detected.
11. Interfacing EEPROM to LPC2148 using I2C protocol

GROUP B:

Develop a Real time application like smart home with following requirements: When user enters into house the required appliances like fan, light should be switched ON depend on person. Appliances should also get controlled remotely by a suitable web interface. The objective of this application is student should construct complete Smart application in group

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Virtual LAB Links:
Link of the Virtual Lab: http://vlabs.iitkgp.ernet.in/rtes/

Note: Two experiments to be performed using the virtual labs

304218: Elective II
A. PLC & Automation Lab

Teaching Scheme:
Practical: 2 Hrs/ Week

Examination Scheme:
Practical: 25

Any 8 to be performed

1. Simulate & implement basic logic gates ladder logic program
2. Simulate & implement simple start/stop ladder logic
3. Simulate & implement single push button on/off ladder logic
4. Simulate & implement PLC program example with on delay timer
5. Simulate & implement PLC program example with Off delay timer
6. Design & simulate PLC program example with Retentive Timer
7. Design & simulate ladder diagram for DOL Motor Starter
8. Design & simulate traffic light ladder logic diagram
9. Simulate ladder diagram for Bottle Filling Plant
10. Simulate PLC ladder diagram for Elevator Control
11. Implement traffic light ladder logic using PLC hardware

Virtual LAB Links:
Link of the Virtual Lab: http://plc-coep.vlabs.ac.in/

Note: Two experiments to be performed using the virtual labs

304218: Elective II
B. DSP and Applications Lab

Teaching Scheme:
Practical: 2 Hrs/ Week

Examination Scheme:
Practical: 25

Any 8 to be performed

Note: Experiments 1 to 8 can be performed in any appropriate software like C /MATLAB / Scilab etc. Minimum six experiments to be performed. Experiment no. 9 &10 are mandatory

1. To find Z and inverse Z transform and pole zero plot of Z-transfer function.
2. To solve the difference equation and find the system response using Z-transform.
3. To study the properties of DFT. Write programs to confirm all DFT properties.
4. Implementation of FFT algorithms
5. Program for finding linear convolution & circular convolution.
6. Program for finding linear convolution using circular convolution
7. To study the effect of different windows on FIR filter response.
8. Design and implement two stage sampling rate converter.
9. To plot the mapping function used in bilinear transformation method of IIR filter design.(assignment may be given)
10. Effect of coefficient quantization on the impulse response of the filter using direct form I and II realization and cascade realization.(theory assignment)

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

304198*: Elective II
C. Advanced JAVA Programming Lab
(Subject common with TE E&TC 2019 Course)

Teaching Scheme:
Practical: 2 Hrs/ Week

Examination Scheme:
Practical: 25

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

304218: Elective II
D. Fibre Optic Communication Lab

Teaching Scheme:
Practical: 2 Hrs/ Week

Examination Scheme:
Term Work: 25

Any 8 to be performed

1. V-I & I-P characteristics of LED.
2. Characteristics of light detector.
3. Measurement of Numerical Aperture.
4. Study of any two optical instruments: Optical Power Meter, OTDR, OSA etc.
5. Measurement of attenuation of optical Fiber Cable of Various lengths.
6. To plot the frequency response of detectors with different values of load resistor
7. To estimate the bandwidth of given fiber.
8. Design, build and test a simple fiber optic link for transmission of analog signal.
9. Design, build and test a simple fiber optic link for transmission of digital signal.
10. Study of any two optical instruments: Optical Power Meter, OTDR, OSA etc

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Virtual LAB Links:
Link of the Virtual Lab: http://vlabs.iitb.ac.in/vlabs-dev/labs/physics-basics/labs/numerical-aperture-measurement-iitk/simulation.html

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

304218: Elective II
E. e Mobility Lab

Teaching Scheme:
Practical: 2 Hrs/ Week

Examination Scheme:
Practical: 25

1. Implement Single Phase Half controlled converter with R load. Explain the output waveforms.
2. Simulate Single Phase fully controlled bridge converter with R and RL loads using simulation software.
3. Study different energy storage systems and their comparison.
4. Perform survey on CAN bus protocol and application.
5. Design and implement a battery charger circuit.
6. Design and simulation of microcontroller based battery charger

304200*: Mini Project
(Subject Common with TE E&TC 2019 course)

Teaching Scheme:
Practical: 4 Hrs/ Week

Examination Scheme:
Term Work: 25
Oral: 50

Course Objectives:

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

Course Outcomes:

After successfully completing the course students will be able to

1. Understand, plan and execute a Mini Project with team.
2. Implement electronic hardware by learning PCB artwork design, soldering techniques, testing and troubleshooting etc.
3. Prepare a technical report based on the Mini project.
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

304199*: Internship
(Subject Common with TE E&TC 2019 course)

Teaching Scheme:
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Examination Scheme:
Term Work: 100 Marks

Course Objectives:

1. Will expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
2. Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
3. Exposure to the current technological developments relevant to the subject area of training.
4. Experience gained from the **'Internship'** will be used in classroom discussions.
5. Create conditions conducive to quest for knowledge and its applicability on the job.
6. Learn to apply the Technical knowledge in real industrial situations
7. Gain experience in writing Technical reports/projects.
8. Expose students to the engineer's responsibilities and ethics.
9. Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
10. Promote academic, professional and/or personal development.
11. Expose the students to future employers.
12. Understand the social, economic and administrative considerations that influence the working environment of industrial organizations.
13. Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Course Outcomes:

After successfully completing the course students will be able to

1. To develop professional competence through internship.
2. To apply academic knowledge in a personal and professional environment.
3. To build the professional network and expose students to future employees.
4. Apply professional and societal ethics in their day to day life.
5. To become a responsible professional having social, economic and administrative considerations
6. 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 around 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:
- Students are required to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions
- Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation/ innovation /entrepreneurship cell of the institute; participation in conferences/ workshops/ competitions etc.
- Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop.
- During the vacation after 5th semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Innovation / Entrepreneurship related activities.
- Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.
- 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.

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 and 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
- Team work
- Leadership

304211 B: Mandatory Audit Course- 6

Teaching Scheme: -- **Examination Scheme: --**

List of Courses to be opted (Any one) under Mandatory Audit Course 6

- Patent Law for Engineers and Scientists
- English language for competitive exam
- 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 courses 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 mark sheet.