KBTCOE

Maratha Vidya Prasarak Samaj's

Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering

An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune

Udoji Maratha Boarding Campus, Gangapur Road, Nashik - 422 013,

Maharashtra, India

Syllabus

Third Year B.Tech. Electronics and Telecommunication Engineering (2024 Pattern)

(As per NEP 2020)

Academic Year 2026-27

(Copy for Student Circulation Only)

25.03.2026

Program Specific Outcomes (PSOs).

PSO1: Academics: Apply fundamentals of electronics/course in analog and digital domains.

PSO2: Interdisciplinary: Use of technique, skill & engineering tool necessary for engineering practices.

PSO3: Social Aspect: Demonstrate engineering knowledge, interpersonal skills for societal responsibilities.

Program Educational Outcomes (PEOs).

PEO1: To impart state-of-the-art technical education in Electronics & Telecommunication Engineering.

PEO2: To promote society beneficial projects and activities.

PEO3: To develop soft skill, team work, professional ethics and multidisciplinary approach for the career enhancement.

PEO4: To bridge the gap between Industry-Institute through collaboration with Industries, Institutions and Universities.

PEO5: To provide suitable infrastructure and facilities in tuned with advancing technological evaluation.

Program Outcomes (POs)

PO1: **Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 to develop to the solution of complex engineering problems.

PO2: **Problem Analysis:** Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development (WK1 to WK4).

PO3: **Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required (WK5).

PO4: **Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions (WK8).

PO5: **Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).

PO6: **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5 and WK7).

PO7: **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) Independent and life-long learning, ii) Adaptability to new and emerging technologies and iii) Critical thinking in the broadest context of technological change. (WK8).

Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas is the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Third Year B.Tech. Electronics and Telecommunication Engineering
Curriculum Structure (2024 Pattern) Semester – V

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
104501	**PCC-8**	Microcontroller	3	2	-	40	60	25	25	**150**	3	1	-	**4**
104502	**PCC-9**	Electromagnetics	2	2	-	40	60	25	25	**150**	2	1	-	**3**
104503	**PCC-10**	Digital Communication	2	2	-	40	60	25	25	**150**	2	1	-	**3**
104504	**PEC-1**	Program Elective Course-1	3	2	-	40	60	25	-	**125**	3	1	-	**4**
170505	**MDM-3**	Multi-Disciplinary Minor-3	3	2	-	40	60	25	-	**125**	3	1	-	**4**
104506	**VSEC-4**	Electronics Skill Development	-	4	-	-	-	50	-	**50**	-	2	-	**2**
Total			**13**	**14**	**0**	**200**	**300**	**175**	**75**	**750**	**13**	**7**	**0**	**20**

Course Code	PEC Course – 1
104504A	Integrated Circuits
104504B	Digital Signal Processing
104504C	Computer Networks
104504D	Object-Oriented Programming

Note: MDM-3 Courses are Listed on Page 6.

Third Year B.Tech. Electronics and Telecommunication Engineering
Curriculum Structure (2024 Pattern) Semester – VI

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
104601	PCC-11	Power Electronics	3	2	-	40	60	25	25	150	3	1	-	4
104602	PCC-12	Fundamentals of VLSI	3	2	-	40	60	25	25	150	3	1	-	4
104603	PEC-2	Program Elective Course-2	3	2	-	40	60	25	25	150	3	1	-	4
104604	PEC-3	Program Elective Course-3	3	2	-	40	60	25	25	150	3	1	-	4
170605	MDM-4	Multi-Disciplinary Minor-4	3	-	1	40	60	50	-	150	3	-	1	4
Total			15	8	1	200	300	150	100	750	15	4	1	20

Course Code	PEC Course – 2	Course Code	PEC Course – 3
104603A	Industrial Drives and Automation	104604A	Electronics Circuit Design
104603B	Speech and Language Processing	104604B	Digital Image Processing
104603C	Antenna and Wave Theory	104604C	Cellular Networks
104603D	Operating System	104604D	Web Technology

Note: MDM-4 Courses are Listed on Page 6.

Third Year B.Tech. Multi-Disciplinary Course – 3 and 4
List of Courses (2024 Pattern) Semester – V and VI

S #	Offered by Department	Streams (Choose One Stream Only)	Semester-V		Semester-VI		Semester-VIII		Eligible Student
			MDM – 3 Code	MDM – 3 Courses	MDM – 4 Code	MDM – 4 Courses	MDM – 5 Code	MDM – 5 Courses	
1.	Mechanical Engineering	Automobile Engineering	**170505A**	Systems in Mechanical Engineering	**170605A**	Automotive Technology	**170805A**	Automotive Control System	All, except Mech. Engg. Dept
2.	Computer Engineering	Software Development	**170505B**	Data Structures and Algorithms	**170605B**	Database Systems	**170805B**	Software System Design	All, except Computer Engg., Information Tech. and AI&DS Dept.
3.	Instru. & Control Engg.	Measurement and Control	**170505C**	Engineering Measurements	**170605C**	Industrial Control Components	**170805C**	Industrial Control Applications	All, except Instru. Control Engg. Dept.
4.	Electronics & Tele. Engg.	Internet of Things	**170505D**	Sensors and Actuators	**170605D**	Embedded System in IoT	**170805D**	Applications of IoT	All, except E&TC Department
5.	Civil Engineering	Infrastructure Planning	**170505E**	Infrastructure and Planning	**170605E**	Governing Policies	**170805E**	Transportation Systems	All, except Civil Engg. Department
6.	Information Technology	Web Technology	**170505F**	Web Development	**170605F**	Application Development	**170805F**	Digital Governance	All, except Info. Tech., Computer and AI&DS Dept.
7.	AI&DS	Data Analytics	**170505G**	Applied Data Science	**170605G**	Data Visualization	**170805G**	Business Analytics	All, except AI&DS, Computer and Information Tech. Dept.
8.	Electrical Engineering	Electrical Machines & Drives	**170505H**	Electrical Machines	**170605H**	Drives and Controls	**170805H**	Industrial Applications	All, except Electrical Engg. Dept

- **Summary of Credits and Total Marks:**

Semester	Credits	Marks
V	20	750
VI	20	750
Total	**40**	**1500**

• Definition of Credit :

The Under Graduate (U.G.) programmes will have credit system. The details of credit will be as follow. 1 Credit = 1 hour/week for lecture = 2 hours/week for practical = 1 hour/week for tutorial

- **Description of Various Courses:**

Type of Course	Description
PCC	Programme Core Course
PEC	Programme Elective Course
MDM	Multidisciplinary Minor Course
VSEC	Vocational and Skill Enhancement Course (Skill Courses)

Semester - V

Course Code: 104501	Course Name: Microcontroller	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Electronics Engineering, Fundamentals of Programming, Digital Electronics.

Course Objectives:

- To introduce students to the architecture and operation of microprocessors.
- To bridge microprocessor concepts with microcontrollers by explaining system design aspects.
- To develop a strong foundation in 8051 microcontroller architecture, programming memory/peripheral organization.
- To enable students to configure and interface microcontroller peripherals.
- To provide hands-on understanding of real-world interfacing.

Course Outcomes:

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

CO1: Differentiate the architecture, memory organization, and system bus structure of microprocessors.

CO2: Differentiate between microprocessor and microcontroller systems.

CO3: Illustrate the internal architecture of the 8051 Microcontroller.

CO4: Construct and debug programs in assembly language and embedded C for the 8051 Microcontroller peripherals.

CO5: Design and analyze real-world embedded interfacing systems using digital and analog I/O.

Course Contents:

Unit-I: Fundamentals of Microcontroller **08 Hours**

Evolution: Microprocessor family, Microcontroller family, SoC; Architecture of a basic microprocessor: CPU organization, System bus structure; Memory organization: Memory map, stack, segmentation, I/O mapped vs memory-mapped I/O; 8086 Microprocessor: Architecture

block diagram, register set, flags, interrupts, Addressing modes & simple instruction categories.

Unit-II: Microprocessor and Microcontroller 08 Hours

Memory interfacing of 8086; Bus organization, glue logic, wait states; Harvard vs Von Neumann architecture, RISC vs CISC architecture; Microprocessor vs Microcontroller; Basic Block diagram of microcontroller, general features; Embedded system basics: domains, constraints, design flow, Firmware vs hardware roles; Function of Assembler, compiler, linker, HEX file.

Unit-III: 8051 Microcontroller Architecture & Programming 08 Hours

Overview of MCS-51 family; Architecture of 8051: ALU, Registers, SFRs, I/O Port structure, Internal & External memory organization; On-chip ROM/Flash, on-chip RAM; Programming in Assembly Language: Instruction Set of 8051; Programming in Embedded C: Delay programs, arithmetic operations, bit-level programs, Lookup tables.

Unit-IV: Peripheral Interfacing 08 Hours

Timers and counters: modes, programming timers; Interrupts & vectored interrupts, priority, nested interrupts, ISR writing and context saving; Serial communication fundamentals: UART (asynchronous), framing, baud rate generation, polling vs interrupt driven comms; Serial peripheral protocols: SPI and I^2C basics.

Unit-V: IO Interfacing with Real World 08 Hours

Digital I/O interfacing: Switches, LED, Relays, seven-segment displays, Keypad, 16x2 LCD; Analog interfacing: ADC(0809), DAC(0808); PWM concept; DC motor control; Stepper motor control.

Learning Resources:

Text Books:

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Application, PENRAM, Sixth Edition.
2. Mahumad Ali Mazadi, Janice Gillispie Mazadi, Rolin D McKinlay, “The 8051 Microcontroller & Embedded Systems (Using Assembly and C)”, PHI, 2nd Edition.

Reference Books:

1. Douglas Hall, Microprocessor and Interfacing, Tata McGraw Hill, Revised Second Edition.
2. Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming and Applications, Cengage Learning, 3rd Edition.
3. Ajay Deshmukh, Microcontrollers Theory and Applications, Tata McGraw Hill, 4th Edition.

4. Datasheet of ATMEGA 8051.

Web link for MOOC / NPTEL Links:

1. Microcontroller and Applications
   https://nptel.ac.in/courses/117/104/117104072/
   https://nptel.ac.in/courses/108/105/108105102/

List of Practicals:

Group A: Microprocessor 8086 using Open-Source Software [Any Three]

1. Study of 8086 Architecture Using Simulator.
   a. Run MOV, ADD, SUB instructions.
   b. Observe result in register window.
2. Arithmetic & Logical Operations using 8086 Simulator.
   a. Addition, subtraction, logical AND/OR/XOR.
   b. Signed/unsigned operations.
   c. Status flag observation.
3. Memory Access & Addressing Modes.
   a. Demonstrate direct, register indirect, indexed addressing.
   b. Store & retrieve array elements.
   c. Observe effective address generation.
4. 8086 String Instructions Simulation.
   a. Execute MOVSB, LODSB, STOSB.
   b. String copy and compare operations.
   c. Analysis of DS, ES register movement.

Group B: 8051 Microcontroller Assembly Programming [Any Two]

5. Develop 8051 Assembly Program for Arithmetic Operations.
   a. 8-bit addition, subtraction.
   b. Carry/borrow handling in PSW.
6. Develop 8051 Assembly Program for Logical & Bit Manipulation.
   a. AND, OR, XOR, CPL.
   b. Bit set/clear instructions using SETB/CLR.
   c. Bit-level operations on P1.0–P1.7.
7. Design 8051 Assembly Program for Lookup Table & Delay Generation.
   a. Create lookup tables in code memory.
   b. Call table using MOVC instruction.
   c. Generate software delays using DJNZ loops.

Group C: 8051 Microcontroller Assembly Programming [Any Five]

8. Write & Verify the Switch, LED & Buzzer Control Using Embedded C program.

a. Switch debouncing logic.
b. Turn ON/OFF LEDs.
c. Buzzer beep patterns.

9. Generate square wave using different modes in timers of 8051 microcontroller.
    a. Generate accurate delay.
    b. Measure execution time.
10. Write & Verify Embedded C program for the 7-Segment Display Interfacing.
    a. Display digits 0 - 9 & A - Z.
    b. Multiplexed mode.
11. Interfacing serial port with PC both side communication.
    a. Send “Hello” from 8051 to PC.
    b. Receive character from PC and display on LCD.
12. Interfacing of 4X4 keypad and displaying key pressed on LCD.
    a. Display string, integer values.
    b. Display key’s pressed.
13. Interface analog voltage 0-5V to internal ADC and display value on LCD.
    a. Read analog voltage.
    b. Display value on LCD or serial terminal.
14. Control the DC motor using 8051 Microcontroller. (Part-I)
    a. Use transistor/MOSFET/L293D.
    b. Control motor ON/OFF & speed using PWM.
15. Control the DC motor using 8051 Microcontroller. (Part-II)
    a. Full-step and half-step sequence.
    b. Control rotation angle and direction.

Course Code: 104502	Course Name: Electromagnetics	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week	**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Vector calculus: Cartesian, Cylindrical and spherical co-ordinate systems, differential lengths, surfaces and volumes.

Course Objectives:

- To develop an understanding of electrostatic and magnetostatic field concepts through the application of vector calculus principles.
- Apply Maxwell's equations to time-varying fields and solve electromagnetic wave propagation problems.
- To examine the behavior of electromagnetic waves in different media, including reflection, transmission, and polarization phenomena.
- To analyze transmission lines using distributed parameters, Smith chart, and understand practical signal behavior in engineering systems.
- To develop problem-solving skills to model and interpret electromagnetic phenomena in practical engineering scenarios.

Course Outcomes:

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

CO1: Apply Gauss's law and divergence theorem to electrostatic fields, and evaluate electric potential and energy associated with electric fields.

CO2: Apply magnetostatic laws and Maxwell's equations to characterize time-varying electromagnetic fields.

CO3: Analyze and solve uniform plane wave equations in different media, and determine intrinsic impedance, propagation velocity, wavelength, losses, and power flow characteristics.

CO4: Evaluate EM wave reflection, standing waves, and boundary behavior under normal incidence.

CO5: Analyze transmission line behavior and apply EMC design techniques such as grounding, shielding, and filtering for interference-free system performance.

Course Contents:

Unit-I: Electrostatics 06 Hours

Coulomb's law, Electric field intensity, Electric flux density, Gauss's law and applications, Divergence and Divergence Theorem, Potential and potential gradient, Electric dipole and dipole moment, Energy stored in electric fields.

Unit-II: Steady Magnetic Fields 06 Hours

Biot–Savart law, Ampere's Circuital law and applications, Curl and Stokes' Theorem, Magnetic flux and flux density, Scalar and vector magnetic potentials, Maxwell's equations for time-varying fields, Faraday's law, displacement current, Maxwell's equations in point and integral form, Retarded potentials.

Unit-III: Uniform Plane Waves 06 Hours

Maxwell's equations in phasor form, Wave equation in general media and perfect dielectrics, Solution of wave equations, Intrinsic impedance, phase velocity, wavelength, Conductor and dielectric losses, Depth of penetration (skin depth), Poynting vector theorem.

Unit-IV: Reflection of Electromagnetic Waves 06 Hours

Reflection of EM waves under normal incidence, Standing waves, Reflection coefficient, Reflection loss, Boundary behavior of EM waves.

Unit-V: Transmission Line and EMI/ EMC 06 Hours

Transmission line parameters, skin effect, general transmission line equation, Physical significance, Input impedance of lossless lines, Smith Chart and its applications to transmission line calculations.

Electromagnetic Interference (EMI): Types of EMI, conducted and radiated noise, EMI sources in electronic systems.

Electromagnetic Compatibility (EMC): Definition, grounding, shielding, filtering, and EMI reduction techniques; EMC design considerations.

Learning Resources:

Text Books:

1. M.N.O. Sadiku and S.V. Kulkarni, Principles of Electromagnetics, 2015, Sixth Int'l Ed., Oxford University Press.
2. William H. Hayt and John A. Buck, "Engineering Electromagnetics", Tata McGraw-Hill, 8th Ed.

Reference Books:

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

3. M. Gopal, Control Systems, Principles and Design, McGraw-Hill, 3rd Ed.

Web link for MOOC / NPTEL Links:

1. Transmission Lines and EM Waves -Video course Prof. R.K. Shevgaonkar
   https://nptel.ac.in/courses/117/101/117101056/
2. Electromagnetic theory - Video course" Dr. Pradeep Kumar K
   https://nptel.ac.in/courses/108/104/108104087/
3. David Staelin. 6.013 Electromagnetics and Applications. Spring 2009. Massachusetts Institute of Technology: MIT Open Course Ware
   https://ocw.mit.edu/courses/6-013-electromagnetics-and-applications-spring-2009/

List of Practicals: (Any Ten)

Use MATLAB/Python or Any Simulation Tool.

1. Study of electric field and potential due to point charges
2. Verification of Gauss's law for symmetrical charge distributions.
3. Analysis of electric field and capacitance of a parallel-plate capacitor.
4. Study of magnetic field using the Biot–Savart law.
5. Verification of Ampere's circuital law
6. Study of electric field lines and equipotential surfaces.
7. Study of boundary conditions for electric and magnetic fields.
8. Study of wave propagation in lossless and lossy media.
9. Study of skin depth and current distribution in conductors.
10. Analysis of reflection and standing-wave patterns in transmission lines.
11. Perform at least five Virtual Lab (VLab) practicals.

Course Code: 104503	Course Name: Digital Communication	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 2 Hours/Week **Practical :** 2 Hours/Week	**2** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Concept of Analog Communication system.

Course Objectives:

- To acquire knowledge of signal representation in graphical manner and to develop the different digital modulation techniques.
- To understand the principles and importance of spread spectrum and multiple access in the context of communication.
- Analyse basics of source and channel coding / decoding techniques & the linear and convolution block codes.
- To have knowledge of the wireless communication system.
- To build the Mathematical and computational skills and foundations needed in areas like, 5G, Cognitive Radio Networks.

Course Outcomes:

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

CO1: Analyze the generation and reception techniques of various digital modulation schemes such as QPSK, QAM and MSK.

CO2: Design and analyze wireless and mobile communication systems using the spread spectrum and multiple access concepts.

CO3: Analyze source coding approaches to improve information representation and transmission.

CO4: Analyze the architecture and functioning of cellular mobile communication systems, including their essential functional components.

CO5: Assess the influence of wireless and IoT technology in fields such as smart cities and industrial automation.

Course Contents:

Unit-I: Digital Modulation Techniques **06 Hours**

Components of a digital communication system, Generation, Reception, Signal Space

Representation and Probability of Error Calculation (without derivation of probability of error equation) for Quadrature Phase Shift Keying (QPSK), M-ary Phase Shift Keying (MPSK), MSK, Quadrature Amplitude Shift Keying (QASK), M-ary FSK (MFSK), Minimum Shift Keying (MSK), Pulse Shaping to reduce Inter-channel and Inter-symbol Interference.

Unit-II: Multiple Access Techniques and Spread Spectrum 06 Hours

Multiple access techniques - TDMA, FDMA, CDMA, SDMA,OFDM,OFDMA.

Principles of spread spectrum - Generation of PN sequence and its properties, Direct Sequence Spread Spectrum (DSSS), Processing gain, Probability of error, Anti-jam characteristics, Frequency- Hop Spread Spectrum (FHSS).

Unit-III: Information Theory & Coding 06 Hours

Introduction to Information Theory: Measure of information, Average information content of symbols, Entropy, mutual information.

Source Coding: Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon-Fano Encoding Algorithm, Huffman coding.

Linear Block Codes: Coding, Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding. Cyclic Codes: Coding & Decoding.

Unit-IV: Wireless Communication System 06 Hours

History and evolution of mobile radio systems, Types of mobile wireless services / systems – Cellular, WLL, Paging, Satellite systems, Standard, Future trends in personal wireless systems.

Unit-V: Recent Wireless Technologies & applications 06 Hours

Features, architecture, frequency band of Wi-Fi, IEEE 802.11.

Features, architecture, frequency band of Bluetooth- BLE (Bluetooth 4.0, Bluetooth Low Energy), IEEE 802.15.1.

NFC services, Introduction to 3GPP.

Applications such as Vehicular communication: V2V, Industrial Automation Application (in detail) & other application such as Media and entertainment, Retail Industry, Education, Industrial Automation, Smart Cities, Internet of Things (IoT) Application.

Learning Resources:

Text Books:

1. S. Haykin, Communication Systems, Wiley, 4th Ed., 2001.
2. J. G. Proakis, Digital Communication, Tata McGraw-Hill, 4th Ed., 2001.

Reference Books:

1. B. Sklar, Digital Communications: Fundamentals & Applications, Pearson Education, 2nd Ed., 2001.
2. A. B. Carlson, Communication Systems, McGraw Hill, 3rd Ed., 2002.
3. R. E. Zimer & R. L. Peterson, Introduction to Digital Communication, PHI, 3rd Ed., 2001.

Web link for MOOC / NPTEL Links:

1. Digital Communications
   https://nptel.ac.in/courses/108/102/108102096/

List of Practicals:

1. Study of BPSK transmitter & receiver using suitable hardware setup/kit.
2. Study of QPSK transmitter & receiver using suitable hardware setup/kit.
3. Study of BFSK transmitter & receiver using suitable hardware setup/kit.
4. Study of DSSS transmitter and receiver using suitable hardware setup/kit.
5. Study of FHSS transmitter and receiver using suitable hardware setup/kit.
6. Simulation study of Performance of PSK.
7. Simulation study of Performance of QAM.
8. Simulation study of random processes. Find various statistical parameters of the random process.
9. Simulation Study of performance of BPSK receiver in presence of noise.
10. Simulation Study of CDMA technique.
11. Simulation study of Source Coding technique.
12. Simulation study of various Entropies and mutual information in a communication system.
13. Simulation Study of Linear Block codes.
14. Simulation Study of cyclic codes.
15. Simulation Study of Convolutional codes.
16. Simulation Study of Performance of Digital communication system with error control coding.

Course Code: 104504A	Course Name: Integrated Circuits	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Prerequisite Courses:

- Fundamentals of Electronics Engineering, Electronic Devices and Circuits..

Course Objectives:

- To evaluate the characteristics and parameters of operational amplifiers.
- To design a wide variety of linear circuits.
- To analyze a wide variety of comparator circuits.
- To develop the ability to design filters using Op-Amps.
- To explore the use of unregulated and regulated power supply.

Course Outcomes:

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

CO1: Analyze the internal functional blocks, characteristics and parameters of operational amplifiers.

CO2: Design a variety of linear application circuits using Op-Amps.

CO3: Elucidate OPAMP based waveform generating circuits and comparators.

CO4: Design active filters for specific engineering applications.

CO5: Identify the needs and use of unregulated and regulated power supply.

Course Contents:

Unit-I: OPAMP & Multivibrator 08 Hours

Overview of OPAMP, advantages and disadvantages of open loop and close loop configurations, ideal and practical performance parameters, gain-bandwidth product in open loop and close loop configurations, significance of gain in dB. Overview of IC555, Monostable and Astable Multivibrator. **Numerical:** IC555 based applications.

Unit-II: Linear Applications of OPAMP 08 Hours

Buffer, Attenuator, Adder and summing amplifier, subtractor and difference amplifier, Ideal and practical Integrator, Ideal and practical Differentiator. Numerical: based on all above applications.

Unit-III: Comparators **08 Hours**

Square and triangular waveform generator, comparator, zero crossing detector, Schmitt trigger, peak detector, precision rectifier with its advantages and disadvantages.

Unit-IV: Converters and Active Filters **08 Hours**

V to I converters, V to F converters, D to A and A to D converters, basics of filters, first order active LPF, HPF, BPF and Notch filters.

Unit-V: Voltage Regulators **08 Hours**

Selection criteria of diodes, transformer and filter capacitor in unregulated power supply, Linear Voltage regulators using ICs 78xx, 79xx, dual regulated power supply using 78xx & 79xx, adjustable voltage regulators using LM317 & LM337.

Learning Resources:

Text Books:

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

Reference Books:

1. Salivahan and Kanchana Bhaskaran, Linear Integrated Circuits, Tata McGraw-Hill
2. D. Roy Choudhury and Shail B. Jain, Linear Integrated Circuits, New Age International Publishers.

Web link for MOOC / NPTEL Links:

1. Analog Electronic Circuits. https://nptel.ac.in/courses/108/105/108105158/
2. Analog Circuits. https://nptel.ac.in/courses/108/101/108101094/

List of Practicals:

Group – A [(Any Two) (Any One by using Open-Source Simulation Software)]

1. Implement, test & compare the various characteristics with the data sheet of µA741 & LF351/LF356 OPAMP
2. Implement, test & compare the gain-bandwidth product in open loop and close loop configurations of OPAMP
3. Implement & test the theoretical and practical results of IC555 as a Monostable Multivibrator.
4. Implement & test the theoretical and practical results of IC555 as an Astable Multivibrator.

Group – B [(Any Three) (Any one by using Open Source Simulation Software)]

5. Implement & test the theoretical and practical results of OPAMP based – Summing Amplifier, Attenuator, Buffer and Difference Amplifier circuits.
6. Implement & test the theoretical and practical results of OPAMP based Integrator circuit.

7. Implement & test the theoretical and practical results of OPAMP based Differentiator circuit.
8. Implement & test the theoretical and practical results of OPAMP based Square and Triangular Waveform Generator circuits.
9. Implement & test the theoretical and practical results of OPAMP based Zero Crossing Detector circuit.
10. Implement & test the theoretical and practical results of OPAMP based Schmitt trigger circuit.
11. Implement & test the theoretical and practical results of OPAMP based Peak Detector circuit.
12. Implement & test the theoretical and practical results of OPAMP based Precision Half Wave Rectifier circuit.
13. Implement & test the theoretical and practical results of OPAMP based Precision Full Wave Rectifier circuit.

Group – C [(Any Three) (Any one by using Open Source Simulation Software)]

14. Implement & test the theoretical and practical results of OPAMP based V to I converter with grounded load.
15. Implement & test the theoretical and practical results of OPAMP based V to I converter with floating load.
16. Implement & test the theoretical and practical results of OPAMP based D to A converter.
17. Implement & test the theoretical and practical results of OPAMP based A to D converter.
18. Implement & test the theoretical and practical results of OPAMP based Band Pass Filter circuit.
19. Implement & test the theoretical and practical results of OPAMP based Notch Filter circuit.

Group – D [(Any One) (Compulsory using Hardware Only)]

20. Implement & test the theoretical and practical results of dual regulated power supply using ICs 78xx & 79xx.
21. Implement & test the theoretical and practical results of adjustable voltage regulated power supply using LM317.
22. Implement & test the theoretical and practical results of adjustable voltage regulated power supply using LM337.

Course Code: 104504B	Course Name: Digital Signal Processing	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Signals and Systems.

Course Objectives:

- To understand the fundamentals of digital signal processing, sampling theorem, interpolation, and decimation techniques.
- To introduce DFT and FFT algorithms for frequency domain analysis of discrete-time signals.
- To study the principles and methods of Infinite Impulse Response (IIR) filter design and realization.
- To study the concepts and techniques for Finite Impulse Response (FIR) filter design and implementation.
- To study DSP processor architecture and applications of DSP in real-time systems.

Course Outcomes:

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

CO1: Apply the fundamentals of DSP, sampling, interpolation, decimation, and signal representation for processing discrete-time signals.

CO2: Analyze DFT and FFT for discrete-time signal processing applications.

CO3: Design and realize IIR digital filters using impulse invariance and bilinear transformation methods.

CO4: Design and implement FIR digital filters using windowing and frequency sampling techniques.

CO5: Apply DSP processor architecture concepts and DSP techniques for real-time applications such as speech, image, radar, and medical signal processing.

Course Contents:

Unit-I: Introduction to DSP **08 Hours**

Sampling theorem in time domain, recovery of analog signals, mapping between analog frequencies to digital frequency, Concept of Interpolation and decimation in signal processing,

Representation of signals as vectors, concept of Basis function and orthogonality, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

Unit-II: Computation of the Discrete Fourier Transform 08 Hours

Frequency domain sampling, DFT, Properties of DFT, circular convolution, Computation of linear convolution and circular convolution, Linear filtering using overlap-add and overlap save method. Fast Fourier Transform (FFT), decimation in time (DIT), and decimation in frequency (DIF) using the Radix-2 FFT algorithm for 4-point and 8-point sequences, DFT & FFT computation complexity.

Unit-III: Infinite Impulse Response IR Filter Design 08 Hours

IIR Filter Design by Impulse invariance method, bilinear transformation method, warping effect, Design of Butterworth low pass and high pass filter, realization of IIR Filter.

Unit-IV: Finite Impulse Response Filter Design 08 Hours

Introduction, Comparison between Analog and Digital Filters, FIR versus IIR filters, Design of FIR filters by windowing technique: Gibb's phenomenon, Use of different windows, Design of FIR filters using Frequency sampling techniques, Design of optimal linear phase FIR filters, Realization of IIR Filter.

Unit-V: DSP Architecture and Applications 08 Hours

Features of DSP architecture, Architecture, fixed and Floating-point formats, Introduction to DSP processor (TMS320XX6713).Medical, Speech, Image, Radar applications, underwater signal processing block diagrams, digital assistants like Amazon Echo and Google Home, Siri, Alexa.

Learning Resources:

Text Books:

1. Proakis & Manolakis, Digital Signal Processing- Principles, Algorithms & Applications, 4th Edition, Pearson Education, New Delhi, 2007.
2. Dr. Shaila Apte, Digital Signal Processing, Wiley India Publication, 2nd Edition.
3. Nagoor Kani, Digital Signal Processing. Tata McGraw-Hill, Second edition, 2012.
4. Venkataramani, B, Bhaskar, M, Digital Signal Processors, Architecture, Programming and Application, Tata McGraw-Hill, New Delhi, 2003.
5. S.Salivahanan, A. Vallavaraj, and C. Gnanapriya, Digital Signal Processing, Tata McGraw-Hill, First edition 2009.

Reference Books:

1. Sanjit K Mitra, 'Digital Signal Processing, A Computer-Based Approach, 4th Edition. McGraw-Hill Education, 2013

2. Avtar Singh, S. Srinivasan, DSP Implementation using DSP microprocessor with Examples from TMS32C54XX, Cengage Learning India Pvt. Ltd. 2004.
3. Oppenheim, Schafer, Discrete-time Signal Processing, Pearson Education, 1st Edition
4. Rulph Chassaing, Donald Relay, Digital Signal Processing and Applications with TMS3206713 and TMS320C6416 DSK, 2nd Edition, Wiley-IEEE Press, 2011
5. P. Ramesh Babu, Digital Signal Processing, Scitech Publ. Pvt. Ltd., 4th ed., 2006.

Web link for MOOC / NPTEL Links:

1. Digital Signal Processing
2. https://nptel.ac.in/courses/117102060
3. https://nptel.ac.in/courses/108105055
4. Virtual Laboratory: http://vlabs.iitkgp.ernet.in/dsp/#

List of Practicals:

Group A (Any Three)

1. Verify the sampling theorem and aliasing effects with various sampling frequencies. Also, implement the sampling theorem using VLAB
2. Verify the Sampling Theorem in the frequency domain using FFT for undersampled, Nyquist, and oversampled signals.
3. Implementation of Interpolation and Decimation for given rate conversion.
4. Find N-point circular convolution using the formula and verify its results
5. Implement linear filtering using circular convolution
6. Compute DFT and IDFT {e.g. x(n) = {1,2,3,4} using N=4 and N= 8}
7. Study the windowing effect (time and frequency) for rectangular, Hamming, Hanning, Blackman and Kaiser windows

Group B (Any Two)

8. Design a Butterworth filter using Bilinear Transformation, for the following conditions:

   $0.8 \leq |[H(e^{jw})]| \leq 1, 0 \leq \omega \leq 0.2\pi$

   $|[H(e^{jw})]| \leq 0.2, \quad 0.6 \leq \omega \leq \pi$

   OR

   Design a second-order band-pass Digital Butterworth filter with a pass band of 200 Hz to 300 Hz and sampling frequency of 2000 Hz using Bilinear Transformation.

   OR

   Evaluate the order and the poles of a Butterworth filter which has a 3 dB bandwidth of 1000 Hz and an attenuation of 20 dB at 2000 Hz. Determine the system function H(z) by Bilinear Transformation using T=1/10000
9. Design a Butterworth filter (IIR) using the bilinear transformation method and plot its frequency response
10. Design the symmetric FIR low-pass filter for which the desired frequency response is expressed as

Hd (w) = {(e^(-jwτfor|w|≤ wc) and 0 elsewhere

The length of the filter should be M = 7 and Wc=1 radians/sample.

Make use of the Rectangular/ Hamming/ Hanning/Blackman/ Kaiser window.

Group C (Any Two)

11. Implement the Block Convolution algorithms: a) Overlap-add b) Overlap-save
12. Find the pitch frequency of the given speech signal using the autocorrelation method
13. Implement the following ECG Signal Processing operations:
    a. Suppression of motion artifacts in ECG using N-point moving average filters.
    b. Peak detection of the ECG signal by using Band-limiting digital filters
14. 2D convolution for image filtering.

Course Code: 104504C	Course Name: Computer Networks	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Prerequisite Courses:

- Principles of Communication Systems, Digital Communication.

Course Objectives:

- To understand the networking architectures, layered models, transmission media, and addressing techniques used in computer networks.
- To build knowledge of data link layer protocols, framing, flow control, error control, and media access mechanisms.
- To develop analytical understanding of network layer services, IP addressing, routing algorithms, and multicast routing protocols.
- To understand the transport layer protocols, congestion control strategies, QoS techniques, and socket programming concepts.
- To develop understanding of application-layer protocols and emerging networking technologies such as cloud, IoT, 5G, AI, and edge computing.

Course Outcomes:

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

CO1: Apply networking architectures, topologies, transmission media, and addressing techniques in computer networks.

CO2: Analyze data link layer protocols, flow control, error control, and media access techniques for reliable communication.

CO3: Analyze network layer protocols, IP addressing schemes, routing algorithms and multicast techniques in computer networks.

CO4: Evaluate transport layer protocols, congestion control strategies, QoS techniques and socket programming concepts for efficient data transfer.

CO5: Evaluate application-layer protocols and advanced networking technologies used in modern communication systems.

Course Contents:

Unit-I: Network and Physical Layer 08 Hours

Types of networks, Network topologies, Design issues for Layers, Network models, OSI model & TCP / IP protocol suite, Types of addressing ,Physical Media- Guided & Unguided transmission.

Unit-II: Data Link Layer 08 Hours

Data link control, Framing, Flow and error control, Protocols for Noiseless, and Noisy Channels, HDLC, Point to Point Protocol, Media Access Control: Random Access, Controlled Access- Reservation, Channelization protocols, switching concepts.

Unit-III: Network Layer 08 Hours

Introduction to Network Layer: Network-Layer Services, IPv4 Addresses, Forwarding of IP Packets, Network Layer Protocols: Internet Protocol (IP), ICMPv4, Next Generation IP: IPv6 Addressing, The IPv6 Protocol, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, IGMP Distance Vector, Link State, Path Vector, Routing in Internet: RIP, OSPF, BGP.

Unit-IV: Transportation Layer 08 Hours

Introduction to transport layer, User Datagram Protocol, Transmission Control Protocol, TCP Congestion Policy, Stream Control Transmission Protocol, Congestion control and QoS, socket programming.

Unit-V: Application Layer 08 Hours

Introduction to Application Layer, Standard Client Server Protocols: World Wide Web and HTTP, Telnet, FTP, Email, SMTP, IMAP, POP, DNS, BOOTP, DHCP. Need for advanced networking-Limitations of traditional networking, Trends driving advanced networks: Cloud, IoT,5G, AI, Edge computing, Concepts of scalability, flexibility, and programmability in networks.

Learning Resources:

Text Books:

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

Reference Books:

1. Andrew S. Tannenbaum, “Computer Networks”, Pearson Education,4thEdition, 2003

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

Web link for MOOC / NPTEL Links:

1. Computer Networks - https://onlinecourses.swayam2.ac.in
2. Introduction to Computer Networks & Internet Protocols.
   https://sl-courses.iiitb.ac.in/advanced-executive-program-cyber-security?
3. Computer Networks and Internet Protocol.
   https://onlinecourses.nptel.ac.in/e-learning/preview/noc22_cs19
4. Computer Networks.
   https://nptel.ac.in/courses/106/105/106105183/

List of Practicals:

1. Implementation of LAN using a suitable multiuser Windows operating System and demonstrating client-server and peer-to-peer modes of configuration.
2. Simulating various Networks (LAN, WAN) using relevant network devices on the simulator.
   a) Ping b) ipconfig / ifconfig c) Host name d) Whois.
   e) Netstat f) Route g) Tracert/Traceroute/ Tracepath.
   h) NSlookupi) ARP j) Finger k) Port Scan / nmap.
3. Observe and note the details of the live type of traffic (ARP, Frame analysis, Ethernet) from the interface using a packet capture and analysis tool.
4. Using a network simulator, and configure the router using RIP.
5. Capture and note the packet of HTTP /FTP /Telnet / DHCP Protocol using TCP-stream, learn the sequence of packets being sent and received.
6. Socket Programming in C++ on TCP Client ,TCP Server.
7. Write a program to simulate leaky bucket/token bucket.
8. Observe and note the working of protocols using PING / TRACEROUTE / PATHPING and capture packets in LAN using packet capture and analysis tool.
9. Configure servers like HTTP/FTP and understand packet sequence and data flowing between client-server using packet analysis tools.
10. Executing Proxy, web Server using simulator.
11. Executing Telnet, DHCP Server using simulator.

Note: All experiments should be conducted using open-source tools.

Course Code: 104504D	Course Name: Object-Oriented Programming	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Prerequisite Courses:

- Fundamental of Programming Language.

Course Objectives:

- To introduce the fundamentals of Java programming including syntax, data types, operators, and control structures.
- To develop problem-solving skills using object-oriented concepts such as classes, objects, methods, and constructors
- To enable the design of reusable and extensible programs using inheritance, polymorphism, abstract classes, and interfaces.
- To provide knowledge of advanced programming concepts including exception handling and multithreading for robust application development.
- To familiarize students with file handling, I/O streams, and the collections framework for efficient data processing and real-world applications.

Course Outcomes:

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

CO1: Illustrate OOP features and basic programming language constructs such as variables, data types, operators, and control statements.

CO2: Design and implement classes, objects, constructors, and methods to solve computational problems.

CO3: Apply inheritance, polymorphism, abstract classes, and interfaces to build extensible object-oriented solutions.

CO4: Develop robust programs using exception handling and multithreading techniques.

CO5: Use I/O streams and collections framework to manage data and implement real-world application logic.

Course Contents:

Unit-I: Introduction to Object-Oriented Programming Language 08 Hours

Evolution of programming methodologies. Features of OOP: Abstraction, Encapsulation,

Inheritance, Polymorphism, Classes and Objects: definition, attributes, behaviour, Object identity, state, and behaviour, Difference between OOP and Procedural programming. Introduction to basic Java structure, data types, variables, operators, Input/Output in Java Conditional statements and loops, Introduction to arrays, strings, immutability of String, Memory concept (String Pool basics), string buffer & string builder.

Unit-II: Classes, Methods & Constructors **08 Hours**

Class structure and object creation, Access specifiers and modifiers, Methods: definition, parameter passing, overloading, Constructors: default, parameterized, Constructor overloading, Static members: static variables, methods, blocks, this and final keywords, Memory management and garbage collection basics.

Unit-III: Packages, Inheritance & Interfaces **08 Hours**

Packages: Java API Packages, creating, accessing, and using a package, importing packages, adding a class to a Package. Types of inheritance, Method overriding, dynamic binding, Use of super, Polymorphism: compile-time and run-time. Abstract classes and methods, interfaces, and multiple inheritance through interfaces.

Unit-IV: Exception Handling, Multithreading **08 Hours**

Exception types, Exception handling: try, catch, finally, throw, throws, Creating user-defined exceptions. **Basics of Multithreading:** thread creation, life cycle, Synchronization, inter-thread communication.

Unit-V: Files, Streams, Collections **08 Hours**

File handling: streams, readers/writers, Serialization and deserialization, Collections overview lists, sets, maps, Iterators and enumerations. Case studies demonstrating OOP concepts.

Learning Resources:

Text Books:

1. E. Balagurusamy, Programming with JAVA, Tata McGraw-Hill, 6th Edition.
2. Herbert Schildt, Java: The Complete Reference, Tata McGraw-Hill, 13th 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, 12th Edition.
3. Cay Horstmann, Core Java Volume 1, Kindle, 12th Edition.

Web link for MOOC / NPTEL Links:

Programming in Java. https://nptel.ac.in/courses/106105191.

List of Practicals:

Group A (All Compulsory)

1. Write some simple programs such as:
    a. To find factorial of number.
    b. To display first 50 prime numbers.
    c. To find sum and average of N numbers
2. Write a program to implement a Calculator with simple arithmetic operations such as add, subtract, multiply, divide, factorial etc. using switch case and other simple statements. The objective of this assignment is to learn Constants, Variables, and Data Types, Operators and Expressions, Decision making statements.
3. Implementing Classes and Objects: Create a class with data members and methods. Create objects and demonstrate accessing class members.
4. Write a program to demonstrate the method and constructor overloading

Group B (Any Four)

5. Write Java programs to demonstrate the use of static variables, static methods, and static blocks. Show how static members are shared among all objects and how they are initialized and accessed.
6. Implement single or multilevel inheritance to show reusability of code.
7. Demonstrate runtime polymorphism using overridden methods in derived classes.
8. Implementation of Abstraction Using Abstract Classes
9. Implementation of Multiple Inheritance Using Interfaces
10. Write Java programs to illustrate the use of this keyword for referring to the current object and constructors, and the final keyword for defining constants, preventing method overriding, and restricting inheritance.
11. Demonstrate handling of built-in exceptions and creation of user-defined exceptions.
12. Perform reading from and writing to files, and demonstrate basic file operations.
13. Write a Java program that imports a user-defined package and uses the members of the classes contained in the package.

Group C (Any Two)

14. Create multiple threads or processes to demonstrate concurrent execution.
15. Use Array List and LinkedList for storing custom objects. Perform sorting, searching, removal, and iteration.
16. Write a Program in Java to add two matrices. The objective of this assignment is to learn Arrays in Java
17. Serialization and Deserialization Concepts: Store object data into a file and retrieve it back using serialization techniques (or equivalent object persistence concept).
18. Mini-Project Integrating OOP Concepts: Develop a small application using classes, objects , inheritance / interfaces / exception handling/ file operations, and other learned concepts.

Course Code: 170505A	Course Name: Systems in Mechanical Engineering	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Expected Prerequisite Courses:

- Engineering Physics, Engineering Chemistry.

Course Objectives:

- To identify the sources of energy and their conversions.
- To explain the basic concept of engineering thermodynamics and its application.
- To introduce proper manufacturing process applicable to produce components.
- To understand the basic concepts of mechanical engineering.

Course Outcomes:

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

CO1: Apply knowledge of thermodynamics concepts.

CO2: Explain basic laws of thermodynamics, heat transfer and their applications.

CO3: Select different materials for different applications.

CO4: Explain the basics of engineering components.

CO5: Describe and get exposure to the latest trends in manufacturing processes.

Course Contents:

Unit-I: Thermodynamic Concepts **08 Hours**

Introduction to thermodynamics, introduction to various thermodynamic properties, heat and work, thermodynamic laws. Power plant engineering and sources of energy : conventional thermal, nuclear, hydraulic power plant. Nonconventional- wind, solar, tidal, geothermal.

Unit-II: Heat Transfer **08 Hours**

Modes of heat transfer: conduction, convection and radiation. Fourier's law, Newton's law of cooling and Stefan-Boltzmann's law. Domestic appliances, viz., refrigerator, air-conditioner.

Unit-III: Material Science **08 Hours**

Classification of materials, their properties and applications, phase change material (PCM), composite material.

Unit-IV: Introduction to Transmission Devices 08 Hours

Study of shafts, belt drive, chain drive, gear and gear trains and clutches.

Unit-V: Manufacturing Processes 08 Hours

Metal casting, forging, sheet metal working, machining and machine tools, and metal joining processes.

Learning Resources:

Text Books:

1. Nag, P. K., “Engineering Thermodynamics" Tata McGraw-Hill Publisher Co. Ltd.
2. Chaudhari and Hajra, “Elements of Workshop Technology”, Volume I and II, Media Promoters and Publishers, Mumbai.
3. Rajput, R.K., “Basic Mechanical Engineering”, Laxmi Publications Pvt. Ltd.
4. Raghavan V.,“Materials Science And Engineering: A First Course”,Hall of India.

Reference Books:

1. Khan, B. H., “Non-Conventional Energy Sources, Tata McGraw-Hill Publisher Co Ltd.
2. Khurmi, R.S, and Gupta, J. K., “A Textbook of Thermal Engineering”, S. Chand & Sons.
3. Incropera, F. P.and Dewitt, D.P., “Fundamentals of Heat and Mass Transfer, John Wileyand Sons, USA.
4. Juvinal, R. C., Fundamentals of Machine Component Design, John Wiley & Sons, USA.
5. Kripal Sing, “Automobile Engineering”, Vol.1 and Vol.2.

Web link for MOOC / NPTEL Links:

1. Energy resources. https://www.youtube.com/watch?v=Zgp86PVXXuQ
2. Thermodynamic Concepts. https://nptel.ac.in/courses/112103275
3. https://www.youtube.com/playlist?list=PLbRMhDVUMngeVrxtbBzn8HvP8KAWBpI5

List of Practicals: (Any 5)

1. Study of laws of thermodynamics.
2. Study of laws of heat transfer.
3. Study of domestic appliances like the refrigerator and the air conditioner.
4. Study of materials used for different applications.
5. Study of power transmission devices.
6. Study of manufacturing processes.

Course Code: 170505B	Course Name: Data Structures and Algorithms	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Expected Prerequisite Courses:

- Fundamentals of Programming, Programming and Problem Solving.

Course Objectives:

- To learn the fundamentals of data structures.
- To understand how data can be logically organized using data structures.
- To illustrate the types of data structures and their use in engineering.
- To choose suitable data structures for real engineering problems.
- To learn system efficiency, such as time and memory usage, without mathematics or programming.

Course Outcomes:

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

CO1: Understand basic concepts of data structures.

CO2: Apply the concepts of stacks and queues.

CO3: Implement appropriate non-linear data structures.

CO4: Demonstrate searching and sorting techniques in engineering data handling.

CO5: Illustrate real-world engineering case studies using data structures.

Course Contents:

Unit-I: Introduction to Data Structures **08 Hours**

Need for data organization, Overview of Data structures: Types of data structures, **Abstract Data Types (ADT):** Concept and significance, **Arrays:** Characteristics and representation, types of arrays: 1D and 2D, use in storing engineering measurements and parameters.

Case Study: Engineering Data Management in a Weather Monitoring System.

Unit-II: Linear Data Structures **08 Hours**

Introduction to linear data structures, **Stack**: Concept, operations, and behavior (LIFO), Applications: undo operations and automation systems. **Queue**: Concept, operations, and behavior (FIFO), Applications: scheduling, buffering, and resource management, Conceptual comparison between stack and queue, **Linked Lists:** Introduction, need, types and applications.

Case Study: Smart Office Management System.

Unit-III: Non-Linear Data Structures **08 Hours**

Need for non-linear data representation, Trees: Terminology: root, node, parent, child, and level, Types of trees: Binary tree, Binary search tree, Tree traversal, Applications of Non-linear Data Structures, Graphs: Basic concepts, Concept of directed and undirected graphs, graph representation. Case Study: College Campus Management System.

Unit-IV: Searching and Sorting **08 Hours**

Importance of searching and sorting. **Searching Techniques:** Concept of linear and binary search, Use cases in engineering, **Sorting Techniques:** Concept of ordering and prioritization, Examples such as sorting by size, cost and priority using bubble sort, selection sort, merge sort, Time and Space Complexity Concepts. **Case Study:** Engineering Inventory and Component Management System.

Unit-V: Engineering Case Studies **08 Hours**

Data structures used in real time applications, Identification of case studies from Mechanical / Civil / Electrical systems etc., Selection of appropriate data structures for given engineering problems, and discussion on the benefits of proper data structuring.

Learning Resources:

Text Books:

1. Y. Kanetkar and A. Kanetkar, Let Us C++, New Delhi, India: BPB Publications.
2. E. Horowitz and S. Sahni, Fundamentals of Data Structures in C++, New York, NY, USA: W. H. Freeman, ISBN: 978-0716782926.

Reference Books:

1. M. A. Weiss, Data Structures and Algorithm Analysis in C++, 2nd ed., New Delhi, India: Pearson Education, ISBN: 81-7808-670-0.

Web link for MOOC / NPTEL Links:

1. Data Structures And Algorithms By Prof. Naveen Garg, IIT Delhi. https://nptel.ac.in/courses/106102064

List of Practicals:

1. The course instructor should design assignments by considering the required background knowledge, relevant technologies, practical applications, and current trends related to the subject.
2. Preferably, there should be multiple sets of assignments and distributed among batches of students.
3. Giving assignments based on real-life problems can help the students with future projects.

4. Students should be encouraged to use free and open-source software.
5. Instructors can also include an additional assignment or mini-project that goes beyond the syllabus but aligns with the course.

List of Suggested Assignments:

1. Implementation of an array.
2. Implementation of stack.
3. Implementation of queue.
4. Implementation of trees.
5. Implementation of graphs.
6. Implementation of searching techniques.
7. Implementation of sorting techniques.
8. Mini project.

List of Suggested Activity-based Learning:

1. Flipped Classroom.
2. Gamification.
3. Online Interactive Tool.
4. Collaborative and Individual Problem-based learning.
5. Quizzes/Assignments.
6. VLab.

Course Code: 170505C	Course Name: Engineering Measurements	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Engineering Physics, Engineering Chemistry, Basic Electronics and Electrical Engineering.

Course Objectives:

- To explain the static/dynamic characteristics of measurement systems and the working principles of displacement, speed, vibration, and force/torque transducers.
- To impart knowledge on industrial pressure and vacuum measurement techniques along with standard calibration methods.
- To explain the construction, signal compensation, and operational characteristics of contact and non-contact temperature sensors.
- To introduce the mechanics, and selection criteria of various fluid level and flow monitoring instruments.
- To familiarize students with the principles of viscosity, density, humidity, and chemical sensors, alongside an introduction to intelligent SMART sensing systems.

Course Outcomes:

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

CO1: Evaluate the performance of transducers used for mechanical parameters like displacement, speed, vibration, force, and torque.

CO2: Calibrate pressure and vacuum measuring devices using standard dead-weight or vacuum testing rigs.

CO3: Select appropriate temperature sensors for precise thermal monitoring.

CO4: Evaluate the operational dynamics of industrial fluid flow and level sensors based on principles.

CO5: Demonstrate miscellaneous sensors according to their working principles.

Course Contents:

Unit-I: Fundamentals of Engineering Measurements **08 Hours**

Measurement system elements, static and dynamic characteristics.

Need for sensors and transducers, definition and classification of transducers.

Displacement Measurement: Resistive-potentiometers, inductive-LVDT, capacitive, piezoelectric, ultrasonic, and proximity sensors.

Speed measurement, vibration measurement, force and torque measurement.

Unit-II: Pressure Measurement **08 Hours**

Units and their relations, manometers, elastic sensors, piezoelectric secondary transducers, differential pressure sensors, capacitive (delta cell), vacuum gauges, dead weight tester.

Unit-III: Temperature Measurement **08 Hours**

Temperature scales, units and their relations, classification of temperature sensors, bimetallic thermometer, Resistance temperature detectors (RTD), types of RTD, lead wire compensation, thermistors, Thermocouples, thermopiles, thermos-well, cold junction compensation techniques, pyrometers, temperature IC sensor LM35.

Unit-IV: Flow Measurement **08 Hours**

Bernoulli's equation for incompressible flow, head type flow meters (orifice, venturi meter and pitot tube), variable area type (Rotameter), turbine, electromagnetic, ultrasonic, mass flow meter: Coriolis flow meter.

Unit-V: Level and Miscellaneous Measurement **08 Hours**

Level Measurement: Float, DP cell, ultrasonic, capacitive.

Viscosity: Saybolt, Searle's rotating cylinder, rotameter. Density: Hydrometers. Humidity: Resistive and capacitive type sensors. PH sensors, conductivity sensors.

Learning Resources:

Text Books:

1. Instrumentation Measurement and Analysis – B.C. Nakra, K.K. Chaudhry, 4th Edition, McGraw Hill, 2010, ISBN: 978-0070709868
2. Principles of Industrial Instrumentation" — D. Patranabis, ISBN (latest editions): 978 0070605502 (approximate for recent editions)
3. Transducers and Instrumentation – D.V.S. Murty, 3rd Edition, PHI Learning, 2011, ISBN: 978-8120346876.

Reference Books:

1. Industrial Instrumentation – A.K. Sawhney, 4th Edition, Dhanpat Rai & Co., 2010, ISBN: 978-8177000311
2. Measurement Systems: Application and Design – Ernst O. Doebelin, 5th Edition, McGraw Hill, 2003, ISBN: 978-0071223122.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/e-learning/preview/noc23_ee105
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc21_ee32

List of Practicals (Any 8):

1. Measure linear displacement using a Linear Variable Differential Transformer (LVDT).
2. Determine the characteristics of different proximity sensors.
3. Calibrate a load cell and determine its sensitivity for weight measurement.
4. Measure angular displacement using a shaft angle encoder.
5. Calibrate a Bourdon tube pressure gauge using a dead-weight tester.
6. Calibrate a vacuum gauge using a vacuum gauge tester.
7. Calibrate a Resistance Temperature Detector (RTD) and determine the temperature of an unknown liquid.
8. Determine temperature using LM35.
9. Flow measurement using DP transmitter.
10. Measure pH sensor output and calibrate it using standard buffer solutions.
11. Flow measurement using Orifice / Venturi flowmeter.

Course Code: 170505D	Course Name: Sensors and Actuators	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Electronic Engineering, Programming Language C.

Course Objectives:

- To enable students to apply IoT concepts, architectures (3-layer and 5-layer), and system components (sensors, actuators, devices) in designing basic IoT-based solutions for real-world applications.
- To analyse different types of sensors (such as temperature, pressure, proximity, and optical sensors) and their applications in real-world systems.
- To study various actuators (electrical, mechanical, hydraulic, and pneumatic) and understand their role in control systems.
- To develop the ability to interface sensors and actuators with microcontrollers and embedded systems for data acquisition and control.
- To apply knowledge of sensors and actuators in designing and implementing practical systems used in automation, robotics, and industrial applications.

Course Outcomes:

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

CO1: Apply knowledge of IoT building blocks, architectures, and components to develop and implement simple IoT applications for real-world applications.

CO2: Analyze sensor/transducer performance, signal conditioning, and data acquisition to assess measurement accuracy and errors.

CO3: Apply principles of temperature, pressure, force, flow, and level sensors to select and use appropriate sensors for measurement applications.

CO4: Examine the operating principles and performance characteristics of position, proximity, and motion sensors to compare and select appropriate sensors for specific measurement and control applications.

CO5: Evaluate performance, working principles and control mechanisms of electrical, fluid power, and specialized actuators for various automation and control system applications.

Course Contents:

Unit-I: Introduction to IoT and Architecture **08 Hours**

Definition, Need & Scope of IoT, Evolution of IoT, Industry 4.0, Basic Components of IoT: Sensors, Actuators, Devices, IoT System Building Blocks, IoT Architecture: 3-Layer, 5-Layer models (simple explanation), IoT Applications across various sectors, (healthcare, manufacturing, smart homes, agriculture, transport).

Unit-II: Introduction to Signal Conditioning **08 Hours**

Concepts: Sensors vs. Transducers, Sensor Classification (Active/Passive, Digital/Analog), Performance Characteristics (Static and Dynamic: Sensitivity, Linearity, Hysteresis, Response Time). **Signal Conditioning:** Bridge circuits, Amplifiers (Op-Amp), Filtering (Low-pass, High-pass), Data Acquisition (ADC/DAC). **Error Analysis:** Calibration, Sensitivity Analysis, and Uncertainty.

Unit-III: Thermal and Mechanical Sensors **08 Hours**

Temperature Sensors: Thermocouples (Seebeck effect), Resistance Temperature Detectors (RTDs), Thermistors (NTC/PTC), Bimetallic strips, Pyrometers.

Pressure Sensors: Manometer, Bourdon Tube, Diaphragm, Bellows, Piezoelectric and Strain Gauge.

Force & Weight Sensors: Strain Gauges (Bridge circuits, gauge factor), Load Cells.

Flow & Level Sensors: Ultrasonic, Capacitive, Float Sensors, Turbine Flowmeters, Venturi Tubes.

Unit-IV: Position, Proximity and Motion Sensors **08 Hours**

Position and Displacement Sensors: Potentiometers (Linear/Rotary), Linear Variable Differential Transformers (LVDT), Eddy current probes.

Proximity Sensors: Inductive (metallic), Capacitive (non-metallic), Optical/Photoelectric, Magnetic (Reed switches), Light Dependent Resistors (LDR), Fiber-optic sensors.

Motion & Acceleration Sensors: Accelerometers (1-3 axis), Gyroscopes, MEMS inertial sensors, Velocity sensors.

Unit-V: Actuation Systems **08 Hours**

Electric Actuators: DC Motors, AC Motors, Stepper Motors, Servo Motors, Solenoids, Relays.

Fluid Power Actuators: Hydraulic and Pneumatic Cylinders, Valves, Pumps.

Specialized Actuators: Piezoelectric actuators, Shape Memory Alloys.

Control Methods: PWM (Pulse Width Modulation) speed control.

Learning Resources:

Text Books:

1. Milan Milenkovic, “Internet of Things: Concepts and System Design”, Springer, 2020.
2. D. V. S. Murthy, “Transducers and Instrumentation” Prentice Hall of India, 2nd Edition, 2012.
3. Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley, 2014
4. Rolando Herrero, “Fundamentals of IoT Communication Technologies”, Springer, 2022.

Reference Books:

1. Ian Sinclair & John Dunton, “Sensors and Transducers”, Newnes (Elsevier) 3rd Edition, 2016.
2. Samayveer Singh, Manju, Aruna Malik, Pradeep Kumar Singh, “IoT-enabled Sensor Networks: Architecture, Methodologies, Security, and Futuristic Applications”, Bentham Science Publishers, 2024.
3. C.S. Rangarajan, “Instrumentation Devices and Systems”, Tata McGraw-Hill, 1st Edition, 2010.
4. Mohan Lal Kolhe, Kailash J. Karande, Sampat G. Deshmukh, “Artificial Intelligence, Internet of Things (IoT) and Smart Materials for Energy Applications”, CRC Press (Taylor & Francis), 2023.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc25_ee76/preview
2. https://onlinecourses.nptel.ac.in/noc25_ee82/preview
3. https://onlinecourses.nptel.ac.in/noc26_ee41/preview

List of Practicals: (Any 8)

1. Interfacing of an LED with Arduino board.
2. Display real-time temperature & humidity values on serial monitor using DHT11.
3. IoT-Based Motion Detection / Security System (Interface PIR Motion Sensor. Send alert notification (app pop-up, buzzer or LED indicator).
4. IoT-Based Gas/Smoke Detection System. (Interface MQ-2 Gas sensor (or simulator). Trigger buzzer/alert message when gas level exceeds a threshold. Send alert notification to mobile using cloud app (Blynk/MQTT).
5. IoT-Controlled Servo Motor / Door Lock System. (Interface a servo motor. Control angle/position remotely using a cloud dashboard or mobile app.)
6. Heartbeat / Pulse Monitoring System (IoT-Based). (Interface pulse sensor or simulated heartbeat data. Send health parameters to cloud for real-time monitoring.)

7. Water Level Monitoring & Alert System. (Use ultrasonic sensor to measure water tank level. Send water-level data to cloud and generate alerts when level is low or high.)
8. Fire Detection and Alert System. (Flame sensor or temperature sensor combination. Trigger instant alerts and send real-time fire detection signals to mobile/cloud.)
9. Voice-Controlled IoT Device (Google Assistant/Alexa Integration). Control LED/Fan simulation using voice commands through Google Assistant + IFTTT or Alexa IoT skills.
10. IoT-Based Smart Street Lighting System. Automatically control a street light (LED) using an LDR sensor and send status (ON/OFF) to an IoT dashboard.
11. Smart Energy Monitoring System. Measuring and visualizing electrical parameters (current/voltage simulation allowed) and uploading data to cloud.
12. IoT-Based Weather Station (Multi-Sensor System). Interfacing two or more sensors (temperature, humidity, light, pressure) and publishing combined data to the cloud.

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Course Code: 170505E	Course Name: Infrastructure and Planning	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Building Technology and Architectural Planning.

Course Objectives:

- To understand and analyze urban infrastructure systems, including their types, planning data, standards, and the roles of stakeholders in urban development.
- To apply concepts of water supply, sanitation, stormwater, solid waste, and transport planning to propose sustainable and efficient urban infrastructure solutions.
- To develop knowledge of rural planning principles and government schemes to improve village infrastructure, housing, livelihoods, and social services.
- To use modern planning tools and technologies (GIS, remote sensing, drones) for the implementation, monitoring, management of urban and rural infrastructure projects.

Course Outcomes:

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

CO1: Explain the role and types of urban infrastructure, key planning data and standards, and the planning process with stakeholder roles.

CO2: Apply concepts of water supply, sanitation, stormwater, and solid waste management to plan and propose basic urban infrastructure improvements.

CO3: Apply transport and land-use planning concepts to improve urban mobility, accessibility, and sustainability

CO4: Develop rural planning strategies using government schemes to improve village infrastructure, housing, and livelihoods.

CO5: Implement rural infrastructure and connectivity solutions using GIS and other planning tools.

Course Contents:

Unit-I: Introduction to Urban Planning and Infrastructure 08 Hours

Role of infrastructure in urban development, Types of infrastructure: physical (water, power, transport), social (education, health), utilities Planning data, resource analysis, norms and standards Infrastructure planning process and stakeholder roles layouts.

Unit-II: Water, Sanitation and Stormwater Systems 08 Hours

Water supply sources, treatment, storage, distribution, Water demand forecasting, leakage, reuse, rainwater harvesting, Sanitation systems: sewage generation, collection, treatment, greywater management, Stormwater drainage, natural drainage, stormwater harvesting Institutional and management issues, Municipal solid waste: generation, collection, treatment, recycling.

Unit-III: Transport and Mobility Planning 08 Hours

Importance of transport infrastructure in urban form transport modes (public, private, non-motorized), and mobility demand land use–transport integration, accessibility, TOD (Transit-Oriented Development) transport modeling basics, pricing, congestion and sustainable mobility.

Unit-IV: Principles and Strategies of Rural Planning 08 Hours

Introduction to rural planning: need, scope, and objectives, rural settlement patterns and typologies, planning strategies for rural development central and State government schemes: MGNREGA, PMAY-G, Swachh Bharat Mission, PMGSY, Jal Jeevan Mission, role of planning in livelihood, housing, and social infrastructure.

Unit-V: Rural Infrastructure Management 08 Hours

Physical infrastructure: water supply, sanitation, drainage, roads, energy, solid waste management, social infrastructure: schools, healthcare, community centers, Transport and connectivity: rural road hierarchy, public transport, traffic management, Tools and technology: GIS, remote sensing, drones for rural planning, Implementation, monitoring, and governance of rural projects.

Learning Resources:

Text Books:

1. Town Planning, G. K. Hiraskar, Dhanpat Rai Publications.
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.
3. Rural Development: Planning Strategy & Policy Imperatives - Vivek Saurath & Manoj Agarwal).

Reference Books:

1. Urban Planning by Chris Couch.
2. Urban Infrastructure and Governance by G. Ramesh, Vishnu Prasad Nagadevara, Gopal Naik, Anil Suraj.
3. Urban and Regional Planning Education: Learning for India (edited by Ashok Kumar, Diwakar S. Meshram, Krishne Gowda.

4. MRTP Act 1966 : The director, government printing, stationary and publications, Maharashtra state, Mumbai.
5. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India.
6. Role of Edge Analytics on Sustainable Smart City Development: Challenges and Solutions by G. R. Kanagachidambaresan.
7. Sustainable Smart Cities in India: Challenges and Future Perspectives (The Urban Book Series) by Poonam Sharma and Swati Rajput.
8. Rural Development: Principles, Policies and Development by Katar Singh and Anil Shishodia. Atlantic Publications.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/cec20_ar01/preview
2. https://www.edx.org/certificates/professional-certificate/delftx-inclusive-and-sustainable-cities?index=product&queryId=2d5f1360201b4959787e19d485c4178e&position=3
3. https://www.coursera.org/learn/smart-cities
4. https://onlinecourses.nptel.ac.in/noc25_ar27/preview
5. https://onlinecourses.nptel.ac.in/noc26_ar08/preview
6. https://onlinecourses.nptel.ac.in/noc25_ar25/preview
7. https://onlinecourses.nptel.ac.in/noc26_ce48/preview

List of Practicals:

1. Prepare a case study for any infrastructure project of India and give presentation. (Group Activity).
2. Design a practical rainwater harvesting solution for any building. (Individual work).
3. Prepare a land-use map for a neighborhood with classification (residential, commercial, industrial, etc.) by calculation. (Group Activity)
4. Identify the major causes of congestion on any busy road in the city and suggest practical improvements to reduce traffic delays. Present your findings with brief observations and supporting photos or sketches. (Group work)
5. Draw a simple O–D diagram of your route from home to college, marking key points like home, major junctions, bus stops, and the college gate. Include the approximate distance and travel time with neat sketch map with brief travel details. (Individual work)
6. Select one rural development scheme (MGNREGA, PMAY-G, SBM, PMGSY, or JJM) and prepare a brief report covering its objectives, beneficiaries, key components, impact on rural livelihood or infrastructure, and a simple implementation flowchart (Individual work)

7. Prepare a village infrastructure improvement proposal for a hypothetical village of 1,000–1,500 people, listing existing issues, suggesting improvements in water supply, sanitation, housing, livelihood, and roads, and identifying relevant government schemes for implementation. (Group work)
8. Site visit to any urban infrastructure or rural infrastructure management project.

Course Code: 170505F	Course Name: Web Development	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Expected Prerequisite Courses:

- Computer Networks.

Course Objectives:

- To familiarize students with Web Programming basic concepts.
- To learn and understand Web scripting languages.
- To introduce students to responsive web design frameworks and modern UI components.
- To provide knowledge of web page styling and layout design for effective user interfaces.
- To familiarize students with website development using no-code platforms.

Course Outcomes:

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

CO1: Understand a basic of web application.

CO2: Develop structured web pages using HTML.

CO3: Apply styling and layout design principles to create visually appealing web interfaces.

CO4: Develop responsive and user-friendly web pages using modern design frameworks and layout approaches.

CO5: Create and publish functional websites using modern website development tools.

Course Contents:

Unit-I: Introduction to Web Applications 08 Hours

Internet, Basic internet protocols, World Wide Web, HTTP Request message, HTTP response message, Client–Server Architecture, Frontend vs Backend, World Wide Web, Role of browsers and web servers, Introduction to W3C and web standards.

Unit-II: Web Essentials and Mark-up Language- HTML 08 Hours

HTML: Introduction, history and versions. Tags, elements, and attributes, HTML elements: headings, paragraphs, line break, links, frames, lists, tables, images and forms, Input elements and basic validation, difference between HTML and HTML5.

Unit-III: CSS Styling and Layout Design **08 Hours**

CSS: Introduction to Style Sheet, CSS features, Types of CSS, CSS core: Properties, Classes, Child-Class (Nested CSS), Colors, Text, Background, Border, Margin, Padding, Positioning (flex, grid, inline, block), Animation, Transition.

Unit-IV: Bootstrap for Responsive Web **08 Hours**

Bootstrap vs plain CSS, Installing and using Bootstrap, Bootstrap grid system, Responsive design using Bootstrap, **Common Bootstrap Classes:** Buttons, Tables, Forms, Cards, Navigation bar, Alerts and Models.

Unit-V: Website Design Using No-Code Platforms **08 Hours**

Introduction to no-code and low-code web development and Advantages, Website design using **Wix Studio:** Page structure and layout, Responsive design tools, Customization of UI components, **Website design using WordPress:** Themes and templates, Page builders, Content management basics, Publishing and maintaining websites.

Learning Resources:

Text Books:

1. Jeffrey C. Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035.
2. Robert W. Sebesta, “Programming the World Wide Web”, 4th Edition, Pearson Education.
3. Jon Duckett, HTML and CSS: Design and Build Websites, Wiley Publications.

Reference Books:

1. Marty Hall, Larry Brown, "Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
2. HTML5 & CSS3 Complete Reference”, McGraw-Hill.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed79

List of Practicals:

1. Create a simple HTML webpage that displays basic information about yourself including name, photo, educational details, hobbies, and contact information using headings, paragraphs, images, and hyperlinks, ordered and unordered list.
2. Develop a webpage that displays a student marksheet using HTML tables including subjects, marks, and total percentage.

3. Create an HTML form for student registration including fields such as name, email, gender, date of birth, course selection, and submit/reset buttons. Apply basic input validation.
4. Design a webpage using external CSS to demonstrate styling of text, background colors, borders, and fonts also make use CSS Flexbox to arrange elements such as header, navigation bar, content section, and footer.
5. Design a webpage demonstrating CSS animation and transition effects on buttons, images, or text elements.
6. Create a responsive webpage using Bootstrap that includes navigation bar, image banner, cards, alerts, buttons, and tables and content sections.
7. Design a responsive webpage using Bootstrap Grid System that adjusts layout for mobile, tablet, and desktop screens.
8. Develop and publish a basic website using a No-Code platform such as WordPress or Wix Studio that includes at least three pages (Home, About, Contact).
9. Mini Project: Design and develop a complete responsive website for a small business, institute, or portfolio using HTML, CSS, and Bootstrap or a No-Code platform. The website should include navigation, forms, images and a responsive layout.

Course Code: 170505G	Course Name: Applied Data Science	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks**

Expected Prerequisite Courses:

- Programming and Problem Solving.

Course Objectives:

- To introduce the fundamentals of Data Science.
- To apply Data Science in different domain.
- To do exploratory analysis on a given data.
- To understand the concept of regression models.
- To facilitate learning of data pre-processing using R Programming.

Course Outcomes:

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

CO1: Apply statistics and probability methods to solve real-life problems.

CO2: Demonstrate the Data Science Process and how its components interact.

CO3: Apply basic tools (plots, graphs, summary statistics) to carry out EDA.

CO4: Solve real life problems using regression techniques.

CO5: Apply machine learning algorithms for real world applications.

Course Contents:

Unit-I: Probability and Statistics 08 Hours

Basics: sample space, outcomes, probability. Events: mutually exclusive, Conditional probability, Bayes' rule. Describing a Single Set of Data, Correlation and Causation Probability: Dependence and Independence, Conditional Probability, Random Variables, Continuous Distributions, The Normal Distribution. **Case Study:** Probability Analysis of Credit Card Fraud Detection.

Unit-II: Introduction to Data Science and Data Preprocessing 08 Hours

Defining data science and big data, Recognizing the different types of data, Machine Learning Definition and relation with Data Science, Data Science Process: Data collection; Data preparation; Training a model on the data, evaluation of the model performance, Data visualization techniques and inferences. **Case Study:** Data Preprocessing for Online Shopping

Recommendation System.

Unit-III: Exploratory Data Analysis (EDA) 08 Hours

Statistical measures, Basic tools (plots, graphs and summary statistics) of EDA, Data Analytics Lifecycle, Discovery Developing Initial Hypotheses, Identifying Potential Data Sources, EDA case study, testing hypotheses on means, proportions and variances. **Case Study:** Analysis of Food Delivery Trends.

Unit-IV: Regression models 08 Hours

Simple linear regression, least-squares principle, MLR, logistic regression, Multiple correlation, Partial correlation, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression. **Case Study:** House Price Prediction Using Real Estate Data.

Unit-V: Introduction to Machine Learning & R Programming 08 Hours

Supervised learning, Unsupervised learning, Association Rule mining, Naive Bayes Classifier, k-means clustering, Introduction to R, R packages, Tidy data, Tabular data and data import, Strings and regular expressions. **Case Study:** Customer Segmentation in Retail Business.

Learning Resources:

Text Books:

1. Data Science from Scratch: Joel Grus, O'Reilly Media Inc. 2015, ISBN: 9781491901427.
2. R for data science: import, tidy, transform, visualize, and model data", Wickham, Hadley, and Garrett Grolemund. O'Reilly Media, Inc.", 2016.
3. Cathy O'Neil and Rachel Schutt, "Doing Data Science", O'Reilly, 2015, ISBN: 9781449358655.

Reference Books:

1. Introduction to Probability and Statistics for and Engineers and Scientists, S. Ross, 3rd Edition, Elsevier, 2004.
2. Software for Data Analysis: Programming with R (Statistics and Computing), John M. Chambers, Springer.
3. Hadley Wickham,Garrett Grolemund, " R for Data Science" , O'Reilly Media, 12 December 2016, ISBN:9781491910344, 1491910348.

Web link for MOOC / NPTEL Links:

1. Python for Data Science
   https://onlinecourses.nptel.ac.in/noc20_cs36/preview

List of Practicals:

1. Download any standard dataset from Kaggle. Using a programming language such as Python /R, perform statistical analysis to understand the structure, distribution, and relationships within the data.
2. Write python code that loads any standard dataset downloaded from Kaggle and plot the graph.
3. Perform some basic data cleaning operations on standard dataset using Python / R (Dataset should contain minimum 1000 records)
4. Perform data preprocessing, exploratory analysis on any standard dataset (dataset should contain minimum 1000 records) Using Python /R.
5. Perform correlation and regression analysis for any standard dataset downloaded from Kaggle, Government databases etc using Python / R.
6. Perform Simple Linear regression on for any standard data set downloaded from Kaggle, UCI, Government databases Using Python / R
7. Perform data analysis using Python / R / Weka for readily available data set using any one machine learning algorithm.

Course Code: 170505H	Course Name: Electrical Machines	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 25 Marks

Expected Prerequisite Courses:

- Basic Electrical Engineering.

Course Objectives:

- To understand selection of machines for specific applications.
- To understand the construction, principle of operation of various motors.
- To test & analyze the performance of single phase and three phase motors.

Course Outcomes:

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

CO1: Understand the principles of electromechanical energy conversion, torque equation, and constructional features of electric motors.

CO2: Apply characteristics and speed control methods of DC motors to select suitable drives for applications.

CO3: Examine performance characteristics of three-phase induction motors for selection and control in mechanical loads.

CO4: Compare single-phase motors to select appropriate types for domestic and light-industrial use.

CO5: Apply operating principles and control methods of synchronous, BLDC, stepper, and servo motors in engineering applications.

Course Contents:

Unit-I: Fundamentals of Electric Motors **08 Hours**

Basic concepts of electromechanical energy conversion, Fleming's rules, torque and EMF equations. Constructional features: Stator, rotor, windings, bearings, cooling systems, Comparison of AC vs DC motors and their industrial relevance, Safety considerations & motor nameplate data interpretation.

Unit-II: DC Motors **08 Hours**

Construction: Lap and wave windings, commutator, field excitation, Working principle and back EMF, Types: shunt, series, compound motors, Torque-speed characteristics and performance curves, Speed control techniques (armature and field control), Applications in traction, lifts, rolling mills, robotics. Brushless DC motors: construction, electronic commutation, uses in EV and drones.

Unit-III: Three-Phase Induction Motors **08 Hours**

Construction and working: squirrel cage vs slip-ring, Rotating magnetic field concept, slip, torque production, Torque-speed characteristics: starting torque, breakdown torque, Starting methods: DOL, star-delta, auto-transformer, Speed control: V/f control, rotor resistance, slip power recovery, Selection criteria for mechanical drives (load type, duty cycle), Use in pumps, compressors, crushers, conveyors, HVAC systems.

Unit-IV: Single-Phase Induction Motors & Auxiliary Motors **08 Hours**

Limitations of single-phase supply, double-revolving field theory, Types: split-phase, capacitor-start, capacitor-run, shaded pole, Universal motor: working and uses, Applications in domestic & light-industrial mechanical equipment (fans, washing machines, small tools).

Unit-V: Synchronous & Special Motors **08 Hours**

Synchronous Motors: excitation, torque-angle characteristics, Starting methods, V-curves, power factor improvement. **PMSM:** Construction, electronic controller, uses in EV. **Stepper Motors:** Variable reluctance & PM types, step angle, control, Servo motors for automatic control systems & CNC automation, Application focus in robotics, precision positioning and aerospace actuators.

Learning Resources:

Text Books:

1. Edward Hughes “Electrical Technology”, ELBS, Pearson Education.
2. Ashfaq Husain, “Electrical Machines”, Dhanpat Rai & Sons.
3. S. K. Bhattacharya, “Electrical Machine”, Tata McGraw Hill publishing Co. Ltd, 2nd Edition.
4. Nagrath & Kothari, “Electrical Machines”, Tata McGraw Hill.
5. Bhag S Guru, Husein R. Hiziroglu, “Electrical Machines”, Oxford University Press.
6. K Krishna Reddy, “Electrical Machines- I and II”, SCITECH Publications (India) Pvt. Ltd. Chennai.

Reference Books:

1. I. J. Nagrath and D. P. Kothari, Electric Machines, Tata McGraw Hill, New Delhi, 2005.
2. M. G. Say, The performance and design of alternating current machines, CBS Publishers and distributors, Delhi, 1983.
3. Fitzgerald, Kingsley and Umans, Electric Machinery, Tata McGraw Hill, New Delhi, 2003
4. S. K. Sen, Electrical Machinery, Khanna Pub., Delhi, 2012.
5. Mukherjee and Chakravorty, Electrical Machines, Dhanpat Rai Pub., New Delhi, 2005.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc19_ee69/preview
2. https://archive.nptel.ac.in/courses/108/102/108102146/

List of Practicals (Any 8):

1. Load test on DC shunt motor to obtain torque-speed, efficiency and performance characteristics.
2. Speed control of DC motor using armature voltage and field control methods.
3. No-load and blocked-rotor tests on 3-phase induction motor to determine equivalent circuit parameters.
4. Load test on 3-phase induction motor to obtain performance characteristics.
5. Study and comparison of DOL, star-delta & auto-transformer starters for induction motor.
6. V/f (open-loop) speed control of induction motor using inverter (simulation or hardware).
7. Load test on synchronous motor to plot V-curves and study power-factor control.
8. Performance characterization of BLDC motor (simulation or hardware kit).
9. Stepper motor stepping and micro-stepping experiment to determine step angle and positioning accuracy.
10. Servo motor position control using PID controller and performance analysis.
11. Thermal/run-down and insulation resistance test (theoretical analysis for motor selection).
12. Motor selection and design mini-project based on given mechanical load (simulation/theoretical).

Course Code: 104506	Course Name: Electronics Skill Development	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Practical : 4 Hours/Week	**2**	**TW : 50 Marks**

Expected Prerequisite Courses:

- Fundamentals of Electronics, Electronics Devices and circuits, Digital Electronics.

Course Objectives:

- To provide industry-oriented technical skills relevant to modern Electronics and Telecommunication industries.
- To enhance practical knowledge in embedded systems, IoT, PCB design, industrial automation, FPGA/VLSI and communication systems.
- To develop vocational and employability skills through hands-on training.
- To improve problem-solving, teamwork, communication skills.
- To bridge the gap between academic learning and industrial requirements.

Course Outcomes:

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

CO1: Identify and select an appropriate problem statement for Electronic Skill Development considering industrial requirements and practical applications.

CO2: Design, simulate and implement embedded and IoT-based applications.

CO3: Develop PCB layouts and troubleshoot electronic systems.

CO4: Analyze and test the developed electronic system rigorously.

CO5: Demonstrate vocational, teamwork, presentation, and entrepreneurship skills through projects.

Guidelines for Conduction:

A. Execution:

- Project group shall consist of not more than 3 students per group.
- Project Work should be carried out in the Design / Projects Laboratory. Following standard laboratory safety procedures.
- Project designs ideas can be necessarily adapted from recent issues of electronic design magazines.
- Use of Hardware devices/components is mandatory.
- PCB design shall include single-layer and double-layer PCB layout design, component

placement, routing, copper pours, and design rule verification.

- Schematic-to-layout validation shall be carried out.
- PCB Bare board validation 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.
- IoT.
- Embedded Systems.
- Power Electronics.
- Mechatronics Systems.
- Microcontroller based projects, should use ATmega controller/MCS 51 Family.
- Biomedical Electronics.
- FPGA/VLSI.

C. Monitoring: (for students and teachers both):

Suggested Plan for various activities to be monitored by the teacher.

Week 1 and 2:

- Formation of groups.
- Problem identification.
- Finalization and distribution of work.

Week 3 and 4:

- PCB schematic design, footprint assignment, and single-layer/double-layer PCB artwork development using appropriate EDA tools.
- PCB layer stack-up planning, routing, and DRC verification.
- Circuit simulation and validation.

Week 5 to 8:

- PCB manufacturing through at lab.
- Hardware assembly.
- Programming (if required).
- Testing, enclosure design, fabrication etc.

Week 9 and 10:

- Final testing and performance evaluation of the product.
- Preparation of draft report.
- Checking, verifying, and correcting the draft report.

Week 11 and 12:

- Demonstration and Group presentations.
- A logbook 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 page
- Acknowledgement
- Abstract
- Table of Content
- Introduction
- Problem Statement Objective
- Literature survey
- Methodology with block diagrams & Design calculation circuitdiagram , Product
- Enclosure Development
- Implementation of project
- Result & discussion, Future Scope
- Conclusion, References
- Bill of Material (BOM) with cost
- Schematic Diagram, PCB Layout
- Test Results with Conclusions.

Learning Resources:

Text Books:

1. Mahumad Ali Mazadi, Janice Gillispie Mazadi,Rolin D Mckinlay, The 8051 Microcontroller & embedded Systems, (using Assembly and C), PHI, 2nd Edition
2. Ramakant Gaikwad, Op-Amps & linear Integrated Circuits, Pearson Education
3. Milan Milenkovic, Internet of Things: Concepts and system Design, Springer,2020.

Reference Books:

1. Embedded Systems- SoC, IoT, AI and Real-Time Systems-Raj Kamal, McGraw-Hill Education India , 4th Edition,2020.
2. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards-Simon Monk, McGraw-Hill Education TAB, 1st Edition,2024
3. Industrial Electronics and Control- S. K. Bhattacharya & S. Chatterjee, McGraw –Hill Education, 1st Edition 2019
4. Embedded Real-time Systems Programming-Iyer & Gupta, McGraw-Hill Education India,1st Edition,2003.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses-archive.nptel.ac.in/noc18_cs05/preview
2. https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee168
3. https://onlinecourses-archive.nptel.ac.in/noc18_cs05/preview
4. https://onlinecourses.swayam2.ac.in/e-learning/preview/aic20_sp04
5. https://swayam.gov.in/explorer?category=Engineering_and_Technology

Semester - VI

Course Code: 104601		Course Name: Power Electronics
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Electronics Engineering, Basics of Electrical Engineering, Electronic Devices and Circuits, Integrated Circuits.

Course Objectives:

- To explore different power devices with construction, characteristics and typical triggering/driver circuits.
- To design a wide variety of power-controlled rectifiers
- To develop the ability to design power-controlled inverters
- To understand working and performance analysis and applications of various power-controlled inverters
- To analyze and inculcate the SMPS and MPPT.

Course Outcomes:

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

CO1: Identify suitability of the power device for certain applications.

CO2: Design triggering and driver circuits.

CO3: Evaluate and analyze various performance parameters of the different controlled rectifiers and its topologies.

CO4: Analysis and Design of different controlled inverters and its topologies.

CO5: Analyze performance parameters of the different choppers & SMPS.

Course Contents:

Unit-I: Power Devices **08 Hours**

Construction, working & V-I characteristics of - SCR, DIAC, TRIAC, Power MOSFET, IGBT & GTO. Turn ON & Turn OFF switching characteristics of SCR, importance of series and parallel operations of various power devices, performance overview of Silicon, Silicon Carbide & GaN based MOSFET and IGBT.

Numerical based on series and parallel operations of various power devices.

Unit-II: Firing & Commutation for Thyristors **08 Hours**

Concept of commutation for thyristors, Commutation methods, Construction, working & V-I characteristics of UJT, design of triggering / driver circuits for SCR, TRIAC, Power MOSFET, IGBT & GTO. Numerical based on the design of triggering circuits.

Unit-III: Controlled Rectifiers **08 Hours**

Controlled & uncontrolled rectifiers, Significance of power factor and its improvement techniques, Single phase Full controlled rectifiers using SCR, IGBT & Power MOSFET, Single Phase PWM Rectifier using IGBT, Three phase Full controlled rectifier using SCR.

Numerical based on single & three phase controlled rectifiers.

Unit-IV: Controlled Inverters **08 Hours**

Single phase half and full bridge square wave inverter, its performance analysis and numerical, need of voltage control and strategies in inverters, classifications of voltage control techniques, control of voltage using various PWM techniques and their advantages, Three Phase voltage source inverter for balanced star R load, modular multilevel inverter.

Numerical: Single phase half and full bridge inverter, three phase voltage source inverter.

Unit-V: Choppers **08 Hours**

Classification of choppers, Step down chopper and its performance analysis, Step up chopper, various control strategies for choppers, type A, B, C, D & E choppers, overview of buck & boost converters, type switch mode power supply, concept & types of maximum power point tracking techniques. Numerical: Step down chopper, SMPS.

Learning Resources:

Text Books:

1. M. D. Singh and K. B. Khanchandani, Power Electronics, TMH, 2nd Edition 2006.

Reference Books:

1. M. H. Rashid, “Power Electronics Circuits, Devices and Applications”, PHI,4th Edition, 2017, New Delhi.
2. Ned Mohan, T. Undeland & W. Robbins, “Power Electronics Converters Applications and Design, John Wiley & Sons, Singapore, 2nd Edition, Oxford University Press, New Delhi, 2005.

Web link for MOOC / NPTEL Links:

1. Power Electronics.
   https://nptel.ac.in/courses/108/105/108105066/
   https://nptel.ac.in/courses/108/102/108102145/

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

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

List of Practicals:

Group – A [(Any Three) (Any One by using Open-Source Simulation Software)]

1. V-I Characteristics of SCR i) Plot output V-I characteristics to measure IH, IL and voltage before and after breakdown , ii) Observe the effect of gate current on forward break down
2. V-I Characteristics of DIAC i) Plot output V-I characteristics and breakdown voltage in forward and reverse conditions ii) Observe the effect of gate current on forward & reverse breakdown
3. V-I Characteristics of TRIAC i) Plot output V-I characteristics and breakdown voltage in forward and reverse conditions ii) Observe the effect of gate current on forward & reverse breakdown
4. V-I Characteristics of Power MOSFET i) Plot output characteristics and calculate output resistance ii) Plot transfer characteristics and measure threshold voltage
5. V-I Characteristics of IGBT i) Plot output characteristics and calculate output resistance ii) Plot transfer characteristics and measure threshold voltage

Group – B [(Any Two) (Any One by using Open-Source Simulation Software)]

6. Single phase Full Converter with R & R-L load i) Observe load voltage waveform, ii) Measurement of average o/p voltage across loads, iii) Verification of theoretical values with practically measured values.
7. Single-Phase PWM based bridge inverter for R load i) Observe output voltage waveforms and measure set of rms output voltage for varying pulse width and variable input dc voltage, ii) compare measured output voltages with the theoretical findings
8. Step down / Step up chopper i) Measure duty cycle and observer effect on average load voltage for DC chopper

Group – C [(All Compulsory) (Any One by using Open- Source Simulation Software)]

9. SMPS Performance Evaluation for % load & line regulation
10. Single phase AC voltage controller for R load i) Observe output rms voltage waveforms, ii) Measurement output voltage across load, iii) Verification of theoretical values with practically measured values.
11. To study speed control of DC motor

Course Code: 104602		Course Name: Fundamentals of VLSI
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Digital Electronics, Electronic Devices & Circuits.

Course Objectives:

- To understand the fundamentals of VLSI design methodologies.
- To describe the fundamental principles underlying digital design using CMOS logic and analyze the performance characteristics of these digital circuits.
- To implement combinational and sequential circuits using Verilog HDL.
- To understand the architecture and design flow of FPGA.
- To evaluate digital design reliability issues and testability techniques.

Course Outcomes:

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

CO1: Apply fundamentals of VLSI design methodologies in integrated circuit design.

CO2: Design CMOS circuits for specified applications using CMOS Technology.

CO3: Develop effective HDL coding for digital circuit design.

CO4: Analyze the architecture and design flow of FPGA for implementing digital systems.

CO5: Apply knowledge of chip level issues, faults and testability in design.

Course Contents:

Unit-I: VLSI Design Overview **08 Hours**

Overview of VLSI Design: Historical perspective, overview of VLSI design methodologies, VLSI design flow, design hierarchy, concepts of regularity, modularity, and locality, VLSI design styles, design quality, packaging technology, CAD technology. MOSFET : Device Structure, Electrical behavior of MOS transistors, Capacitance- Voltage Characteristics and Non-ideal Effects; Effects of scaling on MOSFETs and Interconnects.

Unit-II: CMOS Logic Design **08 Hours**

CMOS basics, CMOS Inverter: DC Transfer Characteristics, Static and Dynamic Behavior, CMOS Basic Gates, Compound Gates, CMOS Sequential Logic Design – Latches and Flip Flops, Multiplexer, Combinational circuit and Sequential circuit design using CMOS,

Transmission gates, example of TG for combinational circuit, Lambda rules, Design Rule Check for CMOS circuits.

Unit-III: Verilog HDL **08 Hours**

Overview of Digital Design with Verilog HDL, Hierarchical Modelling Concepts, Basic Concepts, Modules and ports, Initial and always block, Design Elements in Verilog, Modelling Style, Dataflow Modelling, Behavioral Modelling, Switch level Modelling. Tasks and functions, Verilog Test bench, Combinational, Sequential circuits and FSM.

Unit-IV: Xilinx FPGA **08 Hours**

Introduction of FPGA, Logic Block Architecture, Routing Architecture, Programmable Interconnections, Design Flow, Xilinx Artix 7 (Architecture), Altera Stratix, Actel 54SX Architecture, Boundary Scan, Programming FPGA's.

Unit-V: Digital Design Issues and Testability **08 Hours**

Metastability and solutions, Timing considerations and Skew, Clock distribution and jitter, Supply and ground bounce, Power distribution techniques and optimization, Need of Design for Testability (DFT), DFT Guideline, Testability, Types of fault and fault models, Hazards, Test pattern generation, Sequential circuit test, Built-in Self-Test.

Learning Resources:

Text Books:

1. Neil H. Weste, Harris, A. Banerjee, CMOS VLSI Design, A Circuit and System Perspective, 2015, 4th Edition, Pearson Education, Noida, India.
2. Charles H. Roth, Digital systems design using VHDL, PWS.
3. Wyane Wolf, Modern VLSI Design (IP-Based Design), 4E, Prentice Hall.
4. Steve Kilts, Advanced FPGA Design Architecture, Implementation and Optimization, Wiley.

Reference Books:

1. Jan M. Rabaey, Anantha Chadrakasan, Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective Paperback, 2016, 3rd Edition, Pearson Education, India.
2. Sung-Mo Kang, Yusuf Liblebici, Chulwoo Kim, CMOS Digital Integrated Circuits: Analysis and Design, 2019, Revised 4th Edition, Tata Mc Graw Hill, New Delhi, India.
3. Cem Unsalan, Bora Tar, Digital System Design with FPGA: Implementation Using Verilog and VHDL, McGraw-Hill.
4. John F. Wakerly, Digital Design Principles and Practices, 3E, Prentice Hall.

Web link for MOOC / NPTEL Links:

1. VLSI Technology by Dr. Nandita Dasgupta, IIT Madras.
   https://nptel.ac.in/courses/117106093
2. VLSI Circuits by Prof. S. Srinivasan, IIT Madras.

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

https://nptel.ac.in/courses/117106086

List of Practicals:

Group – A (Any Four)

1. Simulate and verify the truth tables of basic and universal gates.
2. Implementation of Full Adder using all modeling styles
3. Design and implement a 4-bit ALU
4. Implement a 4-bit up counter using any modeling style.
5. Designandimplement4bituniversalshiftregister.
6. Design and implement FIFO memory.

Group – B (Any Four)

7. Design and implement an Inverter, NAND, and NOR gate using CMOS logic with & without a capacitive load.
8. Design, prepare, and simulate the CMOS Layout of Half adder and Full adder with & without capacitive load.
9. Design& Implement a D flip-flop using CMOS transistors.
10. Design and implement a 2:1 Mux using logic gates & transmission gates.
11. Design& Implement a D flip-flop using CMOS transistors.

Group – C (Any One Case Study)

12. Design a lift controller for a 4-floor building. Assume suitable data. Also, write a test bench for it.
13. Design a washing machine controller. Assume suitable data. Also, write a test bench for it.
14. Design a Traffic Light Controller, assuming suitable data. Also, write a test bench for it.
15. Design and implement Static Random Access Memory (SRAM) -6T SRAM Cell Layout & Read/Write Simulation.
16. Implement a 2-to-4 decoder using CMOS logic.
17. Implement a 5-stage ring oscillator and measure oscillation frequency.
18. Implement the given 4-variable function using CMOS logic.

Course Code: 104603A	Course Name: Industrial Drives and Automation	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Control Systems and Power Electronics.

Course Objectives:

- To understand the fundamentals of industrial drives.
- To study the operating principles and speed control methods of DC drives used in industries.
- To learn AC drive control techniques, VFD operation, and energy-efficient motor control methods.
- To develop PLC programming skills for industrial process monitoring and control applications.
- To enable selection, integration, and troubleshooting of industrial drives and automation systems.

Course Outcomes:

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

CO1: Apply the concepts of industrial drives to classify drive systems, identify major components, and interpret torque–speed characteristics for industrial loads.

CO2: Analyze the operation and speed control methods of DC drives for industrial applications.

CO3: Apply AC drive control techniques and VFDs for industrial motor control and energy-saving operations.

CO4: Develop PLC programs using logic functions, timers, and counters for industrial control applications.

CO5: Implement PLC-based integration with industrial drives for automation, monitoring, troubleshooting, and maintenance applications.

Course Contents:

Unit-I: Introduction to Industrial Drives **08 Hours**

Importance of drives in industries, classification of drives – AC, DC, servo, stepper, basic drive

system components, types of loads & torque–speed characteristics, Four-quadrant operation, Selection of drive for industrial application.

Unit-II: DC Drives **08 Hours**

DC motor construction & characteristics, armature voltage and field control, single-phase & three-phase converter-fed DC drives, closed-loop control of DC drives, advantages, limitations & industrial applications-rolling mills, paper mills, elevators.

Unit-III: AC Drives & VFDs **08 Hours**

Need for AC motor speed control, scalar control (v/f control), vector control (Field-Oriented Control – FOC), power converters for AC drives, components of a VFD (rectifier, dc link, inverter), drive selection & rating, energy saving using VFD, industrial applications: pumps, fans, HVAC, conveyors, mixers.

Unit-IV: Sensors &Automation **08 Hours**

Industrial automation pyramid, open-loop vs closed-loop automation, control panels, MCC, PCC, sensors & transducers, proximity, pressure, temperature, flow, level, actuators, relays, solenoids, contactors, motor starters, control wiring basics.

Unit-V: Programmable Logic Controller (PLC) **08 Hours**

PLC architecture & operation, types of inputs & outputs, addressing modes, PLC programming: ladder logic, function block diagram, structured text (optional), timers, counters, internal bits, analog input/output processing, integration with drives, start/stop, speed reference, fault confirmation, PLC troubleshooting & maintenance.

Learning Resources:

Text Books:

1. Electrical Drives: Concepts and Applications" – G.K. Dubey, New Age International.
2. Power Electronics: Circuits, Devices and Applications" – Muhammad H. Rashid, Pearson Education
3. Programmable Logic Controllers" – Frank D. Petruzella, McGraw-Hill
4. Sensors and Transducers, Patranabis D., Prentice Hall of India Pvt. Ltd.

Reference Books:

1. Programmable Logic Controllers: Principles and Applications, John W. Webb, Ronald A. Reis, Prentice Hall.
2. Industrial Motor Control, Stephen L. Herman, Delmar Cengage Learning.
3. Modern Power Electronics and AC Drives, Bimal K. Bose, Pearson.

Web link for MOOC / NPTEL Links:

1. Fundamentals of Electric Drives, Prof.S.P.Das, IIT, Kanpur.
   https://nptel.ac.in/courses/108104140

2. Industrial Automation and Control, Prof. S. Mikhopadhay and Prof. S. Sen, IIT, Kharagpur.
   https://nptel.ac.in/courses/108105063

List of Practicals: (Any 10)

1. Study of industrial drives components & specifications.
2. No-load & load characteristics of DC motor.
3. Speed control of DC drive using a chopper.
4. Speed control of an induction motor using a VFD.
5. V/f control characteristics of an AC motor.
6. Energy saving analysis using VFD.
7. Introduction to PLC wiring and addressing.
8. Ladder logic programming, timers/counters.
9. PLC-based control of induction motor through VFD.
10. Interfacing sensors with PLC (level/temperature/proximity).
11. HMI development for motor start/stop & monitoring.
12. Monitoring drive parameters using Modbus/RS-485.

Course Code: 104603B		Course Name: Speech and Language Processing
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Signals and Systems, Python Programming, Digital Signal Processing.

Course Objectives:

- To be able to understand the fundamental concepts of Natural Language Processing, morphology, parsing, and semantic interpretation techniques.
- To be able to build knowledge of corpora, word embeddings, and data-driven approaches used in NLP model development.
- To be able to understand the sentiment analysis, statistical methods, and neural approaches used in intelligent NLP systems.
- To be able to develop the analytical understanding of phonetic and acoustic models used in speech-processing systems.
- To be able to understand the advanced speech features and their role in high-performing speech systems.

Course Outcomes:

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

CO1: Apply morphology, parsing, and semantic interpretation techniques in Natural Language Processing systems.

CO2: Analyze corpora, word embeddings, and data-driven techniques used in NLP models.

CO3: Apply sentiment analysis, statistical approaches, and neural approaches in intelligent NLP systems.

CO4: Analyze speech-processing systems using phonetic and acoustic models.

CO5: Evaluate advanced speech features used in high-performing speech systems..

Course Contents:

Unit-I: Introduction to Natural Language Processing 08 Hours

Overview of NLP, Levels of NLP, Morphology-Deviational and inflectional, POS tagging, Parsing: Shallow and dependency parsing, Semantics: word-level semantics and thematic roles.

Unit-II: Text Pre-processing and Feature Representation 08 Hours

Introduction to corpora, Sentence Segmentation, Stemming: Porter stemmer, Bag of words (BOW) and vector space model, Topic modeling, N-gram Language models, Smoothing techniques (Laplace/Add-1, Good-Turing, Kneser-Ney), Word Embeddings: Word2vec, Glove, fast text.

Unit-III: Applications of NLP 08 Hours

Sentiment Classification, Named Entity Recognition (NER): CRF and LSTMs, Text Summarization, Statistical and deep learning NLP models, Machine translation: Encoder and Decoder model, Attention models, Question answering: knowledge-based and deep learning Q & A models.

Unit-IV: Introduction to Speech Processing 08 Hours

Fundamentals of speech processing, perception of sound, vocal tract model, phonetics, short-time analysis of the signals, energy, zero crossing, autocorrelation, Short Time Fourier Analysis (STFT).

Unit-V: Speech Feature Representation 08 Hours

Mel Frequency Cepstral Coefficients (MFCC), Perceptual Linear Prediction (PLP), Linear Prediction Coefficients (LPC), Cepstral Coefficients, Gammatone frequency cepstral coefficients (GFCC) and I vector representation.

Learning Resources:

Text Books:

1. Dan Jurafsky &James H. Martin, Speech and Language Processing, 3rd Edition, Prentice Hall, 2022.
2. Jacob Benesty, M. M. Sondhi, Yiteng Huang, Springer Handbook of Speech Processing, Springer, 2008.
3. L. R. Rabinder and S. W. Schafer, Digital Processing of Speech Signals, Pearson Education
4. James Allen, Natural Language Understanding, Pearson Education, 2002.

Reference Books:

1. Uday Kamath, John Liu, James Whitaker, Deep Learning for NLP and Speech Recognition, Springer, 2019.
2. Steven Bird, Ewan Klein, Edward Loper, Natural Language Processing with Python, O'Reilly Media, 2009.
3. Ben Gold, Nelson Morgan, Dan Ellis, Speech and Audio Signal Processing: Processing and Perception of Speech and Music, John Wiley & Sons, 2011.

Web link for MOOC / NPTEL Links:

1. Natural Language Processing by Prof. Pawan Goyal, IIT Kharagpur.

https://nptel.ac.in/courses/106105158

https://nptel.ac.in/courses/117105145

List of Practicals:

1. Implementation of morphological analysis and POS tagging using NLP libraries
2. Development of shallow and dependency parsing pipelines
3. Construction of Bag-of-Words and TF–IDF vector-space models using custom corpora
4. Implementation of stemming and lemmatization (including Porter Stemmer)
5. Building N-gram language models with smoothing (Add-1, Good-Turing, Kneser-Ney)
6. Training word-embedding models (Word2Vec, GloVe, FastText)
7. Sentiment classification using classical ML and deep learning methods
8. Machine translation using Encoder–Decoder (Seq2Seq) with Attention
9. Extraction of speech features: energy, ZCR, auto-correlation, STFT
10. Comparison of speech feature extraction methods (MFCC, PLP, LPCC, GFCC, i-Vector)
11. Development of a simple speech-recognition system for voice commands
12. Development of a continuous speech-recognition system.

Course Code: 104603C	Course Name: Antenna and Wave Theory	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Electromagnetics.

Course Objectives:

- To understand wave propagation mechanisms and signal behavior in a wireless communication system.
- To analyze the antenna performance by using appropriate parameters.
- To analyze the array theory for predicting and optimizing antenna radiation characteristics.
- To analyze different types of antennas used in communication systems.
- To evaluate antennas used in modern communication applications.

Course Outcomes:

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

CO1: Apply wave propagation mechanisms for signal behavior in wireless communication.

CO2: Analyze antenna performance by the appropriate parameter.

CO3: Analyze array antenna by radiation characteristics.

CO4: Analyze different types of antennas for effective communication.

CO5: Evaluate antennas for modern communication system.

Course Contents:

Unit-I: Wave Propagation **08 Hours**

Propagation Model- Path Loss, Free space loss, Plane earth Loss. Modes of propagation - Ground wave Propagation, Space wave propagation. Troposphere Propagation-Sky wave Propagation- Ionospheric Propagation - Structure of ionosphere, Skip distance, wave bending mechanism, Virtual height, Critical frequency, MUF.

Unit-II: Radiation and Antenna Parameters **08 Hours**

Antenna Radiation mechanism, Radiation pattern, beam width, field region, radiation power density, directivity, gain, bandwidth, polarization, efficiency, antenna effective length and area, Friss Transmission formula.

Unit-III: Arrays **08 Hours**

Linear array. Two-element array, N-element linear array- broadside array, end-fire array- directivity, radiation pattern, pattern multiplication. Non-uniform excitation- Binomial, Chebyshev distribution. Planar array, Phase array, Beamforming and Beam Steering.

Unit-IV: HF and Microwave Antennas **08 Hours**

Wire Antennas- loop antenna-helical antenna, Yagi-Uda Antenna. Frequency independent antennas - spiral and log periodic antenna- Aperture antennas – Hornantenna, Parabolic reflector antenna- Microstrip antenna.

Unit-V: Antennas for Modern Communication **08 Hours**

Antennas for Terrestrial mobile communication. Antennas for Satellite Communication, Ultra-wideband antenna, Wearable antenna, MEMS antenna, MIMO antenna.

Learning Resources:

Text Books:

1. A. Balanis, Antenna Theory - Analysis and Design, 2016, 3rd edition, Wiley & Sons, New York, USA.
2. Electromagnetic Waves and Radiating Systems, E.C. Jordan and K.G. Balmain, 2000.

Reference Books:

1. Warren L. Stutzman and Gary A. Thiele, Antenna Theory and Design, 2013, 3rd edition, Wiley & Sons, New York, USA.
2. J. D. Krauss, R. J. Marhefka and A. S. Khan, Antenna and Wave Propagation, 2012, 4th edition, Tata McGraw-Hill.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/108101092 2. https://nptel.ac.in/courses/117107035

List of Practicals:

1. To study the variation of radiated field with distance from transmitting antenna.
2. To demonstrate the reciprocity theorem for transmitting and receiving antenna.
3. To study and plot the radiation pattern of the dipole/folded antenna.
4. To study and plot the radiation pattern of the log periodic antenna.
5. To study and plot the radiation pattern of the microstrip antenna.
6. Calculate the input impedance of a Horn antenna.
7. Design and simulate the broadside array antenna.
8. Design and simulate the Enfire array antenna.
9. Design and simulate the Yagi-uda antenna.
10. Design and simulate the microstrip antenna.
11. Design and simulate the helical antenna.

Course Code: 104603D	Course Name: Operating System	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Data structures and Algorithms.

Course Objectives:

- To understand operating system objectives, design, and architectures with Linux shell scripting.
- To learn process and thread management, scheduling, and thread programming.
- To explore synchronization, deadlock handling, and concurrency solutions.
- To study memory management techniques like paging and virtual memory.
- To understand I/O management, disk scheduling, and file systems.

Course Outcomes:

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

CO1: Analyze the role and functions of an Operating System in resource management.

CO2: Apply process/thread scheduling algorithms in operating systems.

CO3: Implement process synchronization techniques.

CO4: Evaluate memory management techniques for optimization.

CO5: Compare I/O management, disk scheduling, and file system techniques.

Course Contents:

Unit I: Foundations of Operating Systems **08 Hours**

Operating System Objectives, the evolution of Operating System (OS), OS Design Considerations for Multiprocessor and Multi-core OS, Architectures of Operating System: Monolithic, Microkernel,

Linux OS: Basic Shell Commands, Shell Scripting using BASH, Introduction to embedded Linux.

Unit-II: Process and Thread Management **08 Hours**

Process: Process Concept, Process States, Process Control Block, Process Description

Threads: Process and Threads, Basic types of threads, Multithreading,

Process Scheduling: Types of Scheduling, Scheduling Criteria, Scheduling Algorithms: First Come First- Served, Shortest-Job-First, Priority, Round Robin.

Unit-III: Synchronization and Deadlock Management 08 Hours

Concurrency and Synchronization: Critical - Section Problem, Mutual Exclusion: Requirements, Operating System support - Semaphore and Mutex, Interrupt synchronization..

Classical Synchronization Problems: Dining philosopher problem, Reader-Writer Problem, Producer – Consumer Problem, Real Life Problems.

Inter-Process Communication: Pipes and Shared Memory.

Deadlock: Principles of Deadlock, Deadlock Characterization: Necessary Conditions, Methods for Handling Deadlock: Deadlock Prevention, Deadlock Avoidance, Deadlock Detection and Recovery.

Unit-IV: Memory Management 08 Hours

Memory Management Fundamentals: Goals, Requirements, and Challenges.

Memory Partitioning: Fixed Partitioning, Dynamic Partitioning, Paging, Segmentation.

Virtual Memory: DMA overview, Demand Paging, Page Replacement, Thrashing.

Unit-V: Input / Output and File Management 08 Hours

I/O Management: I/O Devices, Organization of the I/O Function, I/O Buffering, Secondary **Storage Management:** Disk Structure. Disk Scheduling

File Management: Overview-Files and File Systems, File Structure. File Organization and Access, File Directories, File Sharing, Case Study: Linux File System, Android File System.

Learning Resources:

Text Books:

1. Tanenbaum, A. S., & Bos, H. (2014). Modern operating systems (4th ed.). Pearson.
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons,Inc., 9th Edition,2012, ISBN 978-1-118-06333-03.
3. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition, 2014, ISBN-10: 0133805913.

Reference Books:

1. Tom Adelstein and Bill Lubanovic, Linux System Administration, O'Reilly Media, ISBN-10: 0596009526, ISBN-13: 978-0596009526.
2. Harvey M. Deitel, Operating Systems, Prentice Hall, ISBN-10: 0131828274, ISBN-13: 978- 0131828278.
3. Thomas W. Doeppner, Operating System in depth: Design and Programming, WILEY, ISBN: 978- 0-471-68723-8.

Web link for MOOC / NPTEL Links:

1. Introduction to Operating System.
   https://onlinecourses.nptel.ac.in/e-learning/ preview/ noc25_cs94
2. Operating System Fundamentals.
   https://onlinecourses.nptel.ac.in/e-learning/preview/ noc24_cs108

List of Practicals:

1. Study basic Linux commands such as echo, ls, read, cat, touch, tac, test, diff, grep, sed, and find; and explore loops, conditional statements, and arithmetic operations
2. Write a program demonstrating process creation using the fork() system call, where the parent and child processes independently sort a list of integers using different sorting algorithms. Use the wait() system call for synchronization and demonstrate zombie and orphan process states during execution.
3. Write a program to simulate at least one CPU scheduling algorithm: FCFS, SJF, Priority Scheduling, and Round Robin.
4. Write a program to solve the Producer–Consumer problem using counting semaphores along with mutex/binary semaphores for process synchronization.
5. Write a program to solve the Reader–Writer problem with reader-priority synchronization.
6. Write a program to implement a Deadlock Avoidance algorithm (e.g., Banker's Algorithm).
7. Write a program to simulate Page Replacement algorithms such as FIFO, LRU, and Optimal Page Replacement.

Note: Write a program for full-duplex communication between two independent processes using pipes. The first process accepts sentences from the user and sends them through one pipe to the second process. The second process counts the number of characters, words, and lines in the received input, writes the results to a text file, and sends the file contents back through another pipe to the first process for display on the standard output.

Course Code: 104604A	Course Name: Electronics Circuit Design	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Electronics Engineering, Basics of Electrical Engineering, Electronic Devices and Circuits, Integrated Circuits, Microcontroller.

Course Objectives:

- To design a wide variety of diode-based circuits
- To develop the ability to design BJT-based circuits
- To develop the ability to design MOSFET-based circuits
- To analyze and implement a wide variety of OPAMP-based circuits
- To develop the ability to design an automated microcontroller-based electronic system.

Course Outcomes:

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

CO1: Design an unregulated and regulated power supply.

CO2: Design a BJT amplifier and switch.

CO3: Design MOSFET amplifier and switch.

CO4: Design a variety of OPAMP-based circuits.

CO5: Design an automated microcontroller-based electronic system.

Course Contents:

Unit I: Diode Applications **08 Hours**

Full wave rectifier with & without filter - selection criterion of source, diodes & filter. Voltage clippers & clampers using diode - selection criterion of sources, diodes & capacitors. Voltage multipliers using diode - selection criterion of sources, diodes & capacitors. Voltage regulator using a zener diode – selection criterion of sources, resistors, and zener diode.

Unit-II: BJT Applications **08 Hours**

Small signal BJT voltage amplifier & current amplifier - selection criterion of sources, transistors, resistors, capacitors. BJT-based multistage voltage amplifier- selection criterion of sources, transistors, resistors, and capacitors. BJT-based audio amplifier - selection criterion of sources, transistors, resistors, and capacitors. BJT as a switch to drive – LED, electromagnetic

relay, 7-segment common anode & common cathode LCD display - selection criterion of sources, transistor, resistors.

Unit-III: MOSFET Applications **08 Hours**

Small signal MOSFET voltage amplifier - selection criterion of sources, transistor, resistors, capacitors, MOSFET-based audio amplifier - selection criterion of sources, transistor, resistors, and capacitors, MOSFET as a switch to drive – LED, electromagnetic relay, 7-segment common anode & common cathode LCD display - selection criterion of sources, transistor, resistors.

Unit-IV: OPAMP Applications **08 Hours**

Instrumentation Amplifier - selection criterion of sources, OPAMP, resistors,Sample & Hold Circuit - selection criterion of sources, OPAMP, transistor, capacitor,Precision Full Wave Rectifier - selection criterion of source, OPAMP, resistors,Audio Equalizers - selection criterion of source, OPAMP, resistors, capacitors,ADC & DAC - selection criterion of sources, OPAMP, transistor, capacitor, resistors.

Unit-V: Data Acquisition System **08 Hours**

Auto water level monitoring system - selection criterion of level sensor, flow sensor, temperature sensor, current sensor, microcontroller, LCD display, signal conditioning circuits using OPAMP, ADC using OPAMP, relay driver circuit using MOSFET.

Learning Resources:

Text Books:

1. Donald Neaman, Electronic Circuit Analysis and Design,3rd Edition, Tata McGraw-Hill.
2. Millman, Halkias, Integrated Electronics- Analog and Digital Circuits and Systems, 2nd TMH.
3. Ramakant Gaikwad, Op Amps & Linear Integrated Circuits, Pearson Ed.

Reference Books:

1. Op Amps and Linear Integrated Circuits, Concepts and Applications, James M. Fiore CENGAGE Learning.
2. D. Roy Choudhury and Shail B. Jain, Linear Integrated Circuits, New Age International Publishers.

Web link for MOOC / NPTEL Links:

1. Chemical Process Safety.
   https://onlinecourses.nptel.ac.in/noc20_ch38/preview

List of Practicals:

Group – A [(Any Two) (Any one by using Open-Source Simulation Software)]

1. Design, implement & test dual linear regulated power supply using 78xx & 79xx regulators.
2. Design, implement & test positive variable linear regulated power supply using LM317 regulator.
3. Design, implement & test negative variable linear regulated power supply using LM337 regulator.
4. Design, implement & test voltage clipper using switching diode.
5. Design, implement & test voltage clampers using switching diode.
6. Design, implement & test voltage doubler, trippler & quadraplur circuits using rectifier diodes.
7. Design, implement & test regulated power supply using zener diode.

Group – B [(Any Two) (Any one by using Open-Source Simulation Software)]

8. Design, implement & test BJT CE amplifier.
9. Design, implement & test BJT CC amplifier.
10. Design, implement & test BJT CB amplifier.
11. Design, implement & test BJT based multistage amplifier.
12. Design, implement & test BJT based audio amplifier.
13. Design, implement & test BJT as a switch to drive LED.
14. Design, implement & test BJT as a switch to drive Electromagnetic Relay.
15. Design, implement & test BJT as a switch to drive Common Anode 7 Segment LCD display.
16. Design, implement & test BJT as a switch to drive Common Cathode 7 Segment LCD display.

Group – C [(Any Two) (Any one by using Open-Source Simulation Software)]

17. Design, implement & test CS MOSFET amplifier.
18. Design, implement & test MOSFET based audio amplifier.
19. Design, implement & test MOSFET as a switch to drive LED.
20. Design, implement & test MOSFET as a switch to drive Electromagnetic Relay.
21. Design, implement & test MOSFET as a switch to drive Common Anode 7 Segment LCD display.

Group – D [(Any Two) (Any one by using Open-Source Simulation Software)]

22. Design, implement & test OPAMP based Instrumentation Amplifier.

23. Design, implement & test OPAMP based Sample & Hold Circuit.
24. Design, implement & test OPAMP based Precision Full Wave Rectifier.
25. Design, implement & test OPAMP based Audio Equalizer Circuit.
26. Design, implement & test OPAMP based ADC.
27. Design, implement & test OPAMP based DAC.

Group – E [Any One by using Open-Source Simulation Software]

28. Design, implement & test OPAMP based signal conditioning circuits to sense the AC voltage & current.
29. Design, implement & interface MOSFET based electromagnetic relay driver circuit with microcontroller.
30. Design, implement & interface BJT based LED driver circuit with microcontroller.

Course Code: 104604B	Course Name: Digital Image Processing	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Signals and Systems, Digital signal processing.

Course Objectives:

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

Course Outcomes:

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

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

CO2: Implement spatial domain image operations.

CO3: Design and realize various algorithms for image segmentation.

CO4: Design and realize various algorithms for image Compression.

CO5: Apply restoration to remove noise in the image.

Course Contents:

Unit-I: DIP Fundamentals 08 Hours

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

Unit-II: Image Enhancement in Spatial Domain 08 Hours

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

Unit-III: Image Segmentation and Analysis **08 Hours**

Point, line, and edge detection, Thresholding, Region-Based segmentation, Edge linking and boundary detection, Hough transform, Morphological Image Processing: Dilation, Erosion, Opening, Closing on Binary Images.

Unit-IV: Image Compression **08 Hours**

Fundamentals of redundancies, Basic Compression Methods: Huffman coding, Concept of Discrete Cosine Transform, Joint Picture Expert Group(JPEG) Compression standard, Y CB CR transformation, Introduction to Motion Picture Expert Group(MPEG) standard, Motion estimation, compensation, Introduction to video compression.

Unit-V: Image Restoration **08 Hours**

A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the Fourier transform and the frequency domain, estimating the degradation function.

Learning Resources:

Text Books:

1. Gonzalez & Woods, “Digital Image Processing”, Pearson Education, 3rd Edition,2008
2. S Sridhar, “Digital Image Processing”, Oxford University Press, 2nd Edition.

Reference Books:

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

Web link for MOOC / NPTEL Links:

1. NPTEL Course “Digital Image Processing.”

   https://nptel.ac.in/courses/117105135
2. NPTEL Course “Digital Image Processing.”

   https://nptel.ac.in/courses/117104069
3. Virtual Laboratory

   https://cse19-iiith.vlabs.ac.in/

List of Practicals:

Group A (All Compulsory)

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

Group B (Any Two)

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

Group C (Any One)

11. Implement the inverse filter and wiener filter over the image and comment on them.
12. Implement the Huffman coding algorithm for image compression.
13. Implement wiener filter over image and comment on it.

Course Code: 104604C	Course Name: Cellular Networks	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Analog Communication, Digital Communication.

Course Objectives:

- Wireless channel models, diversity techniques for system performance and enhancing signal reliability.
- Cellular system structure, frequency reuse, cell planning techniques, mobility management through handoff and roaming mechanisms.
- 5G vision, goals, and key performance indicators, next-generation mobile communication.
- Multiplexing techniques and their role in enabling efficient and reliable multi-user wireless communication.
- Wireless communication system performance parameters, link-budget calculations, and tele-traffic models for effective network planning.

Course Outcomes:

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

CO1: Apply the channel models for performance assessment.

CO2: Analyze handoff and roaming processes for efficient mobile communication.

CO3: Analyze real-world applications of 5G use cases.

CO4: Analyze multiplexing schemes for efficient communication.

CO5: Evaluate wireless system performance using performance metrics.

Course Contents:

Unit I: Wireless Channels **08 Hours**

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

Unit-II: Cellular Network Fundamentals **08 Hours**

Cell Geometry, Overview of Cellular mobile and Network architecture, Cellular radio system

design-- Frequency assignments, frequency reuse channels, Concept of cell splitting and Cell sectoring. Significance of Handover in cellular systems with Handoff algorithms and roaming.

Unit-III: 5G Network Infrastructure **08 Hours**

Introduction to Cellular Service Progression. LTE- advanced, 5G – Architecture. 5G vision, goals, and key performance indicators (KPIs), 5G use cases, 5G deployment models: NSA vs SA.

Unit-IV: Multiplexing Techniques **08 Hours**

Need for multiplexing, (Orthogonal Frequency Division Multiple Access (OFDMA). Multiple-Input Multiple-Output Wireless Communications, MIMO System Model and MIMO-OFDM. Introduction to SDMA, Space Division Multiple Access using MIMO.

Unit-V: Performance Parameter and Planning **08 Hours**

Performance metrics: Signal-Related, Data Performance, Mobility Performance, Quality of Service, Link-Budget Analysis, Tele-traffic Theory, Tele-traffic System Model and Steady State Analysis.

Learning Resources:

Text Books:

1. Rappaport, T. S., "Wireless Communications--Principles and Practice", Pearson, 2nd Edition.
2. Jagannatham, A. K., "Principles of Modern Wireless Communication Systems", McGraw-Hill Education.

Reference Books:

1. Cristopher Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications", Wiley, 2nd Edition.
2. E. Dahlman, J. Skold, and S. Parkvall, "4G, LTE-Advanced Pro and The Road to 5G", Academic Press, 3rd Edition.
3. Obaidat, P. Nicopolitids, "Modeling and simulation of computer networks and systems: Methodologies and applications", Elsevier, 1st Edition.

Web link for MOOC / NPTEL Links:

1. Introduction to Wireless & Cellular Communications. https://nptel.ac.in/courses/106/106/106106167/
2. Advanced 3G and 4G Wireless Mobile Communications. https://nptel.ac.in/courses/117/104/117104099/
3. Virtual Lab: Fading Channels: http://www.vlab.co.in/
4. Virtual Lab: Mobile Communications: http://fcmcvlab.iitkgp.ac.in

List of Practicals:

1. Compute and compare the median loss by employing Hata model for various distance and carrier frequencies
2. Simulate BER performance over a Rayleigh fading wireless channel with BPSK transmission for SNR 0 to 50 dB.
3. Simulate BER performance of multi-antenna Rayleigh channel for variation in SNR
4. Simulate and Compute minimum spacing required between the antennas for independent fading channels against operating carrier frequency bands.
5. Compute the RMS delay spread for a given Power profile and plot the graph of Power vs Delay.
6. Perform a Link-Budget analysis for a wireless communication system.
7. Estimate channel coefficient vector Multi-Antenna Systems.
8. Program to implement OFDM and evaluate frame error rate against SNR
9. Simulate received signal variation with distance using the two-ray model.
10. Simulate received signal variation with antenna height using the two-ray model.
11. Simulate Rayleigh fading and observe impact on SNR, SINR, and BER.
12. Calculate blocking probability, call congestion, and required channels for a cellular system.

Course Code: 104604D	Course Name: Web Technology	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Database Management Systems, Basic Programming in C/Java/Python, Basic OOP concepts.

Course Objectives:

- To develop structured and styled web pages using HTML, CSS, Bootstrap and core web technologies.
- To implement interactive client-side applications using JavaScript, DOM manipulation, and ES6 features.
- To develop basic backend applications using Node.js and MongoDB for handling server-side operations and database management.
- To design and develop interactive web applications using React and modern frontend development concepts.
- To provide knowledge of modern web development tools and technologies for designing and deploying responsive websites.

Course Outcomes:

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

CO1: Apply HTML, CSS, and web fundamentals to create structured and responsive web pages.

CO2: Develop dynamic client-side applications using JavaScript, DOM manipulation, event handling, and ES6 features.

CO3: To design and develop backend web applications using Node.js and MongoDB for server-side processing and database management.

CO4: Develop basic web applications using React concepts for interactive and server-side programming.

CO5: Develop and deploy responsive websites using modern web development tools and technologies.

Course Contents:

Unit I: Web Essentials, Mark-up language- HTML, and Bootstrap 08 Hours

Request message, HTTP response message, web clients, web servers.

HTML: Structure of HTML Document, HTML Tags and Elements, Text Formatting, Lists, Links, Images, Tables, Forms and Input Controls

CSS: Introduction to CSS, CSS Syntax and Selectors, Styling Text, Colors, Backgrounds, Margins, Padding, Inline, Internal and External CSS, Basic Webpage Layout using CSS.

Bootstrap: Introduction to Bootstrap Framework, Bootstrap Grid System, Bootstrap Containers and Responsive Design, Bootstrap Components: Buttons, Cards, Navbar, Forms, Alerts, Creating Responsive Webpages using Bootstrap.

Unit-II: Client side Technology 08 Hours

Introduction to JavaScript: Features and importance of JavaScript, Client-side vs Server-side scripting, JavaScript syntax and structure, Embedding JavaScript in HTML. Variables, Data Types and Operators, Control Statements and Functions, Arrays and Strings.

DOM: Manipulation and Event Handling: Accessing HTML elements, Event handling basics (onclick, onchange, onmouseover), Basic Form Validation. Introduction to ES6 Features.

Unit-III: Backend Technology 08 Hours

Node.js: Introduction to Backend Development, Introduction to Node.js, Features and Architecture of Node.js, Installing and Setting up Node.js, Node.js Modules and npm, Creating Simple Web Server using Node.js, File System Module and Event Handling

MongoDB: Introduction to NoSQL Databases, Features of MongoDB, Installing and Configuring MongoDB, Database, Collection and Document, CRUD Operations in MongoDB, Connecting MongoDB with Node.js, Building Simple Backend Applications using Node.js and MongoDB.

Unit-IV: Introduction to React.js 08 Hours

Introduction to React.js: Features and Advantages, Installation and Environment Setup using Node.js and npm.

React.js Basics: JSX Syntax, Components, Props and State, Event Handling, React Hooks (useState), React Router Basics and Styling in React.

Unit-V: Website Design Using No-Code Platforms 08 Hours

Introduction to no-code and low-code web development & Advantages, Website design using

Wix Studio: Page structure and layout, Responsive design tools, Customization of UI

components, Website design using WordPress: Themes and templates, Page builders, Content management basics, Publishing and maintaining websites.

Learning Resources:

Text Books:

1. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035.
2. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, “Internet & World Wide Web How to Program”, Fifth Edition, Deitel Series, 2012.
3. Robert W. Sebesta, “Programming the World Wide Web”, 4th Edition, Pearson education, 2008.

Reference Books:

1. Marty Hall, Larry Brown,"Core Web Programming", Second Edition, Pearson Education, 2001, ISBN 978-0130897930.
2. Giulio Zambon, Michael Sekler, “Beginning JSP , JSF and Tomcat Web Development: From Novice to Professional”, Apress Publication, 2007.
3. Chris Bates, “Web Programming Building Internet Applications”, 3rd Edition, Wiley India, 2006.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/e-learning/preview/aic22_ge30
2. https://www.youtube.com/@GoogleSearchCentral
3. https://www.youtube.com/@Codevolution
4. https://www.coursera.org/specializations/web-design

List of Practicals: (Any 8 + Mini Project)

1. Design an E&TC department webpage using HTML and CSS that includes text formatting, hyperlinks, images, tables, and basic webpage layout.
2. Develop an online laboratory registration form for students using HTML form controls and CSS styling with proper webpage structure and layout.
3. Design a responsive student profile webpage using Bootstrap typography, images, colors, spacing utilities, and grid system.
4. Develop a webpage using JavaScript DOM manipulation to dynamically add and delete items from a student list.
5. Create an interactive online feedback form using DOM event handling and basic form validation in JavaScript.
6. Create a simple web server using Node.js to display a welcome message and handle basic routing.

7. Perform CRUD operations in MongoDB and connect MongoDB with Node.js to store and retrieve student data.
8. Create a simple React.js application to display “Hello World” using JSX and components.
9. Develop a React.js application to display student information using functional components and props.
10. Create a simple student registration React.js form application with state handling and event management.
11. Write a Node.js program to display system information using built-in modules.
12. Write a Node.js program to create, read, and write data into a text file.
13. Design a simple responsive website homepage using Wix Studio with text, images, and basic UI customization.
14. Create and publish a basic blog or portfolio website using WordPress themes and page builder tools.
15. One mini project is compulsory.

Course Code: 170605A	Course Name: Automotive Technology	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Engineering Physics, Engineering Mechanics.

Course Objectives:

- To provide fundamental understanding of construction and working of automobile subsystems.
- To equip students with tools and methods to measure and analyze performance of automobiles.
- To acquaint students with contemporary automotive technologies.

Course Outcomes:

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

CO1: Compare the various chassis and drive-trains of an automobile.

CO2: Analyze axles, wheels, tyres and the steering system of an automobile.

CO3: Select suspension and braking systems of an automobile.

CO4: Measure and analyze the performance of an automobile and describe the safety aspects.

CO5: Discuss electrical systems and assess modern propulsion technologies of an automobile.

Course Contents:

Unit-I: Introduction to Chassis and Drive Train 08 Hours

Introduction: Current scenario in Indian auto/ancillary industries, vehicle specifications and classification.

Chassis and Frames: Types of chassis layout with reference to power plant locations and drive, various types of frames and constructional details.

Drive Trains: Necessity and selection of clutch, necessity of gearbox and different types, overdrive, torque convertor, continuous variable transmission, dual clutch transmission, automated manual transmission, propeller shaft, final drive, and differential.

Unit-II: Axles, Wheels, Tyres and Steering System 08 Hours

Axles: Purpose, requirement and types of front and rear axle, loads acting on rear axles.

Wheels and Tyres: Wheel construction, alloy wheel, wheel balancing and rotation, type of

tyres, tyre construction, tyre materials, factors affecting tyre life.

Steering System: Steering mechanism, steering geometry, cornering force, slip angle, scrub radius, steering characteristics, steering linkages and gearbox, power steering, collapsible steering, reversibility of steering, four-wheel steering, wheel alignment.

Unit-III: Suspension and Brake Systems 08 Hours

Suspension: Types of suspension linkages, types of suspension springs- leaf, coil, air springs, hydrogas, interconnected suspension, self-leveling suspension (active suspension), shock absorbers (hydraulic and air). **Brake Systems:** Drum, disc, mechanical, hydraulic, air brakes, power-assisted brakes, hand brake, ABS, EBD, BA.

Unit-IV: Vehicle Performance and Safety 08 Hours

Vehicle performance: parameters; vehicle resistances; traction and tractive effort; power requirements for propulsion; road performance curves (numerical examples); vehicle stability; vehicle testing on a chassis dynamometer; NVH in automobiles. **Vehicle safety:** Types of active and passive safety, vehicle interior and ergonomics.

Unit-V: Electrical Systems and Modern Propulsion Technologies 08 Hours

Batteries: Principles and construction of lead-acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on battery condition, charging methods, introduction to lithium batteries.

Electrical System and Accessories: Basic electric layout of the vehicle, automotive sensors and actuators, electronic control unit/module.

Modern Propulsion Technologies: Concept and environmental importance of EVs and HEVs, Layout, construction and working, Challenges and future scope of EVs and HEV.

Learning Resources:

Text Books:

1. William H. Crouse., “Automotive Mechanics”, Tata McGraw Hill Publishing House.
2. Narang G. B. S, “Automobile Engineering”, S. Chand and Company Ltd.

Reference Books:

1. Kirpal Singh, “Automobile Engineering”, Volume 1, Standard Publishers distributors.
2. R. K. Rajput, “Automobile Engineering”, Laxmi Publications.

Web link for MOOC / NPTEL Links:

1. Fundamentals of Automotive Systems: https://onlinecourses.nptel.ac.in/noc20_de06/preview
2. Autotronics: https://onlinecourses.nptel.ac.in/noc26_me101/preview

3. Vocational: Automotive Services Technician (Four-Wheeler): https://onlinecourses.swayam2.ac.in/nos24_ge28/preview
4. Automotive Industrial Engineering: https://www.coursera.org/learn/automotive-industrial-engineering
5. Automotive Engineering: Automobile Fundamentals: https://www.udemy.com/course/automotive-engineering-automobile-fundamentals-and-advanced/

List of Practicals: (Any 6)

1. Identify four vehicles having different chassis layout and compare their performance.
2. Identify four vehicles equipped with different types of automatic transmission and compare their performance.
3. Visit an automobile service centre for demonstration of wheel alignment and write a detailed report on axle, wheels, tyres and wheel alignment of one car.
4. Experimental study of shock absorber.
5. Measurement of noise and vibration in an automobile.
6. Study of requirements of BNCAP test.
7. Demonstration on basic maintenance and checks of an automobile such as doors etting, consumable checking and replacing, brake pad checking &replacing, checking tyre wear etc.

Course Code: 170605B	Course Name: Database Systems	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Fundamentals of Programming.

Course Objectives:

- To understand the fundamental concepts of database management.
- To identify and classify entities, attributes, and relationships in real-world problem domains.
- To understand the principles and structure of the relational data model.
- To demonstrate the use of SQL for secure and efficient database querying and management.
- To understand the basic concepts of transaction processing and concurrency control.

Course Outcomes:

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

CO1: Explain the basic concepts, architecture, and components of database systems.

CO2: Convert ER diagrams into equivalent relational database schemas.

CO3: Normalize relational schemas using functional dependencies.

CO4: Explain the purpose and components of SQL in relational database systems.

CO5: Identify various transaction states and common transaction operations.

Course Contents:

Unit-I: Introduction to Database Systems **08 Hours**

Need of database system, Types of Data, Database System Applications, Database System VS File System, View of Data, Data Abstraction, data independence, Data Models, Structure of Database Management Systems. **Case Study:** Study of Architecture of any Database Management System (DBMS) like Oracle or MySQL.

Unit-II: Entity Relationship Modeling **08 Hours**

Conceptual data modeling: entities, entity types, attributes and its types, relationships, cardinalities on relationship, Entity Relationship diagram extended Features: Specialisation and Generalization on the ER Model. **Case Study:** ER Diagram conversion into Tables for

College Management Systems.

Unit-III: Relational Data Model **08 Hours**

Concept of relations, schema-instance distinction, keys and their types, Codd's Rules, Concept of Anomalies, Normalization, functional dependencies and Normal forms, 1NF, 2NF, 3NF and BCNF decompositions and desirable properties of them. **Case Study:** Library management system to identify different types of keys.

Unit-IV: Structured Query Language (SQL) **08 Hours**

Querying in SQL, DDL to create database and tables, table constraints, update database-update behaviors, DML, aggregation functions group by and having clauses, retrieve data from the database, generate and query views. Different types of Joins. **Case Study:** Design and implementation of Student Course Management System using SQL for effective management of students, courses, and faculty members.

Unit-V: Overview of Transaction Management **08 Hours**

The ACID Properties, Transactions and Schedules, Concurrency Control–The Need for Concurrency Control, Serializability, Locking Methods, Deadlock, Time Stamping Methods, Concurrency Control Protocols. Database Recovery: Need for Recovery, Recovery Techniques. **Case Study:** Design Online Shopping Cart Transaction Management In an e-commerce platform, multiple users simultaneously add, update, and purchase products.

Learning Resources:

Text Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, ISBN 0-07-120413-X, 6th edition
2. S.K.Singh, "Database Systems: Concepts, Design and Application", Pearson Education, ISBN 978-81-317-6092-5
3. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition, ISBN-13: 978-0-136-08620-8.

Reference Books:

1. Shio Kumar Singh, Database Systems Concepts Design and Applications, Pearson
2. Mario Piattini, Oscar Diaz - Advanced Database Technology and Design- online book.

Web link for MOOC / NPTEL Links:

1. Introduction to Database Systems By Prof. Sreenivasa Kumar, IIT Madras. https://onlinecourses.nptel.ac.in/noc20_cs03/preview

List of Practicals:

1. Study of installation of various database software like MySQL, MariaDB & Oracle, etc.
2. Draw an ER diagram for any database system with various entities and their attributes on ERWin/ERDPLUS Software.
3. Implement SQL queries to provide students with hands-on experience for studying various commands of DDL.
4. Implement SQL queries to provide students with hands-on experience for studying various commands of DML.
5. Implement SQL queries to provide students with hands-on experience for studying various Logical Operators of SQL.
6. Implement SQL queries to provide students with hands-on experience in implementing various data constraints using SQL commands in MySQL/MariaDB.
7. Write at least 10 SQL queries for suitable database applications using SQL DML statements by implementing all types of joins.
8. Write at least 10 SQL queries for suitable database applications using SQL DML statements by implementing sub-queries and views.
9. Write at least 10 SQL queries for suitable database applications using SQL DML statements for studying various aggregation functions.
10. ER Modeling and Normalization: a. Consider case studies and formulate.
    a. Problem statement for any application to be developed.
    b. Propose a conceptual design using ER.
    c. Convert ER diagram into relational tables and normalize relational data model.
11. Mini- Project.

Course Code: 170605C	Course Name: Industrial Control Components	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Fundamentals Electronics Engineering.

Course Objectives:

- To understand the basics of process control, including variables, system types, and real-world applications of control loops.
- to learn about transmitters, signal standardization, communication protocols, and converters used for accurate measurement in process control.
- To explore control actions and tuning methods to optimize controller performance and prevent issues like reset windup.
- To understand control valve design, terminology, types, and sizing using Cv calculations in line with industry standards.
- To learn about valve accessories and actuators, focusing on their design and function for optimal control system performance.

Course Outcomes:

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

CO1: Analyze process variables, control system types, and process characteristics, and evaluate examples of process control loops in industry.

CO2: Apply knowledge of transmitters, signal standards, protocols, and converters to evaluate their role in process control systems.

CO3: Design and apply control actions and tuning methods to optimize controller performance and system stability.

CO4: Evaluate control valve selection, sizing, and design based on key characteristics and industry standards.

CO5: Analyze and evaluate valve accessories and actuators for optimal performance in process control systems.

Course Contents:

Unit-I: Introduction to Process Control 08 Hours

Key Concepts in Process Control: Process Variables: Definition and differentiation of manipulated, disturbance, and output variables.

Control System Types: Understanding Open-Loop vs. Closed-Loop systems.

Block Diagram Representation: Structure and components of control loops. Examples of Process Control Loops: Application examples of control loops in industries—temperature, flow, level, and pressure.

Unit-II: Transmitters and Converters 08 Hours

Transmitters and Signal Standardization: Importance of transmitters in process control systems. Standardization of signals: current (4-20 mA), voltage (0-10 V), and pressure signal standards. **Types of Transmitters:** Live zero vs. dead zero, and concept of two-wire. SMART Transmitters. **Differential Pressure Transmitters (DPT):** Types, installation, and calibration of DPTs. Application in level and flow measurement. Zero elevation, suppression.

Converters: Understanding the difference between converters and transmitters. Types: Current-to-pressure and pressure-to-current converters.

Unit-III: Control Actions and Tuning Techniques 08 Hours

Discontinuous Control: On-Off, multi-position, floating control modes. **Continuous Control:** Proportional (P), Integral (I), Derivative (D), PI, PD, and PID control modes.

Reset Windup: Techniques to prevent reset windup, rate before reset, and bumpless transfer.

Controller Tuning Methods: Introduction to process reaction curve. Tuning techniques: Ziegler-Nichols.

Unit-IV: Control Valve: Design, Sizing, and Selection 08 Hours

Control Valve Fundamentals: Key terminology: Rangeability, turndown ratio, cavitation, flashing, noise, viscosity index, valve capacity, AO, AC, and fail-safe actions. **Valve Characteristics:** Linear, equal percentage, and quick-opening characteristics.

Valve Types and Applications: Overview of different valve types: Globe, Ball, Butterfly, Diaphragm, and specialty valves for high-temperature and high-pressure applications.

Valve Sizing and Selection: Cv Calculation.

Unit-V: Control Valve Accessories and Actuator Design 08 Hours

Valve Accessories: Detailed discussion on accessories such as positioners (pneumatic, electro-pneumatic, and digital), I/P converters, volume boosters, air lock, limit switches, solenoid valves, and hand wheels.

Actuator Types and Design: Understanding different actuator types: Spring and diaphragm, piston cylinder, and smart actuator.

Learning Resources:

Text Books:

1. C. D. Johnson, Process Control and Instrument Technology, Tata McGraw Hill, Publications, 8th Edition.
2. N. A. Anderson, Instrumentation for Process Measurement and Control, CRC Press.

Reference Books:

1. G. Liptak, "Process Control", Instrument Engineering Handbook CRC Press,

Web link for MOOC / NPTEL Links:

1. Industrial Automation and Control, By Prof. Siddhartha Mukhopadhyay, IIT Kharagpur.
   https://nptel.ac.in/courses/108105062
2. Process Control and Instrumentation, by Dr. P.K. Saha, IIT Guwahati.
   https://nptel.ac.in/courses/103103037

List of Practicals: (Any 8)

1. Identification of industrial control components.
2. Block diagram of an industrial automation system.
3. Comparison of open-loop and closed-loop systems.
4. Direction control valve applications.
5. Control valve sizing basics.
6. Actuator selection.
7. Valve characteristic comparison.
8. PID control exercises.
9. Tuning of PID controller for level/flow control loop.
10. Controller tuning problems.
11. Process reaction curve analysis.
12. Study of the control valve & plot the installed characteristics of the control valve.

Course Code: 170605D	Course Name: Embedded System in IoT	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Basic Electronics Fundamentals, Sensors and Actuators, Basic C Programming.

Course Objectives:

- To understand the fundamentals of embedded systems, IoT architecture, and the role of hardware–software co-design in connected devices.
- To develop the ability to interface sensors, actuators, and communication modules with microcontrollers for IoT applications.
- To analyze and implement embedded programming concepts using platforms such as Arduino, Raspberry Pi, or ARM-based controllers.
- To design and develop IoT-based systems using networking protocols (e.g., MQTT, HTTP) and cloud integration techniques.
- To evaluate security, power management, and real-time constraints in embedded IoT systems for efficient and reliable performance.

Course Outcomes:

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

CO1: Explain fundamentals of embedded systems, including components, classifications, design metrics, and the role of microcontrollers.

CO2: Apply IoT hardware design concepts using microcontroller platforms, interfaces, and communication modules with effective power management.

CO3: Apply IoT communication models, protocols, data transmission, and basic cloud integration concepts.

CO4: Analyze Embedded C programming, real-time processing, RTOS concepts, and low-power design techniques in IoT-based embedded systems.

CO5: Evaluate end-to-end IoT system design, security mechanisms, and real-world IoT applications across domains.

Course Contents:

Unit-I: Introduction to Embedded Systems 08 Hours

Definition, characteristics, and requirements of embedded systems, Embedded system components: hardware, software, processors, peripherals, Classification of embedded systems, Embedded system design metrics: cost, power, performance, memory, reliability, Applications of embedded systems in various domains, Overview of microprocessors vs microcontrollers, Role of 8-bit microcontrollers in embedded development.

Unit-II: IoT Hardware Platforms and Interfacing 08 Hours

Design Considerations for IoT Hardware, Microcontroller Platforms: Arduino, ESP32, NodeMCU, Nucleo (STM32 Overview), ADC, DAC, GPIO Programming, Communication Interfaces: UART, SPI, I2C, Wireless Communication Modules (Wi-Fi, BLE, GSM, LoRa – Basics), Power Management in IoT Devices.

Unit-III: IoT Communication Protocols and Networking 08 Hours

IoT Communication Models, IP Addressing Basics, Application Layer Protocols: MQTT, HTTP, CoAP (Overview), Client-Server vs Publish-Subscribe Model, Data Acquisition and Transmission, Introduction to Cloud Platforms (ThingsBoard / AWS IoT – Conceptual), REST API Basics.

Unit-IV: Embedded Software and Real-Time Concepts for IoT 08 Hours

Embedded C for IoT Applications, Interrupt Handling and Timer-Based Programming, Real-Time Data Monitoring, Introduction to RTOS for IoT Devices, Task Scheduling Basics, Data Logging and Local Storage, Edge Computing Concept, Low Power IoT Design Techniques.

Unit-V: IoT System Design, Security and Applications 08 Hours

End-to-End IoT System Design Methodology, IoT Security: Authentication, Encryption Basics, Secure Communication (TLS Concept), Data Analytics Basics for IoT, Industrial IoT (IIoT) Overview, Smart City Applications, Smart Energy Monitoring System, IoT-Based Environmental Monitoring, Smart Irrigation System, Remote Health Monitoring System.

Learning Resources:

Text Books:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi & Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Pearson Education.
2. Zdravko Karakehayov, “Embedded Systems Design with 8051 Microcontrollers: Hardware and Software”, CRC Press / Taylor & Francis.
3. Raj Kamal, “Embedded Systems: Architecture, Programming & Design”, Tata McGraw-Hill.

4. David E. Simon, “An Embedded Software Primer”, Pearson Education.

Reference Books:

1. Daniel D. Gajski, Samar Abdi, “Embedded System Design: Modeling, Synthesis and Verification”, Springer, 2021.
2. Peter Marwedel, “Embedded System Design: Foundations of Cyber-Physical Systems and the Internet of Things”, Springer
3. Qing Li & Caroline Yao, “Real-Time Concepts for Embedded Systems”, CRC Press (Taylor & Francis)
4. Marilyn Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Elsevier
5. Catherine H. Gebotys, “Security in Embedded Devices”, Springer.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.nptel.ac.in/noc24_ee68/preview
2. https://onlinecourses-archive.nptel.ac.in/noc19_cs32/course
3. https://www.coursera.org/learn/iot

List of Practicals: (Any 8)

1. Draw and explain 3-layer and 5-layer IoT architecture. Map real-world application to architecture layers.
2. Comparison of IoT Development Boards. Compare Arduino, ESP32, Raspberry Pi based on: Processing speed, Memory, Connectivity, Power consumption, Application suitability.
3. Sensor & Actuator Selection. Select appropriate sensors for:
    a. Smart irrigation system
    b. Health monitoring system
    c. Smart energy meter

    Justify selection with technical reasoning.
4. Protocol Comparison. Compare MQTT, HTTP, CoAP. Identify best protocol for given IoT scenario.
5. IoT Communication Model Analysis. Device-to-Device. Device-to-Cloud. Device-to-Gateway. Draw block diagrams and explain.
6. Embedded C Programming Problems. Write logic for:
    a. Sensor threshold detection
    b. PWM-based motor control
    c. Interrupt-based event detection.
7. IoT Security Case Study. Identify security threats in smart home system. Suggest countermeasures.

8. Design complete IoT solution for Smart parking.
9. Design complete IoT solution for Weather monitoring.
10. Industrial IIoT Monitoring Plan. Design a predictive maintenance node with: Vibration analysis, Data transmission, Dashboard planning.
11. Smart Campus IoT Design. Complete architecture including: Sensors, Networking, Cloud, Security, Cost estimation.
12. Sensor Signal Conditioning Design. Design amplifier gain for low-voltage sensor. Select filter type for noise removal.

Course Code: 170605E	Course Name: Governing Policies	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Business Economics.

Course Objectives:

- To explain the principles of infrastructure systems, governance frameworks, and policy implementation in urban and rural contexts.
- To examine economic evaluation tools, including demand forecasting, cost–benefit analysis, financing options, and PPP models.
- To interpret national infrastructure programs, policies, and regulations for effective development planning.
- To apply sustainable, inclusive, and technology-driven approaches to plan and manage urban and rural infrastructure.

Course Outcomes:

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

CO1: Understand infrastructure, governance, and policy implementation in urban and rural development.

CO2: Analyze economic aspects of infrastructure, apply demand forecasting, cost–benefit analysis, financing mechanisms, and PPP models.

CO3: Apply national infrastructure programs, policies, and regulations to plan and assess urban and rural development projects.

CO4: Implement planning and management tools for urban and rural infrastructure projects.

CO5: Apply concepts of sustainable and inclusive infrastructure by integrating climate resilience, risk reduction, resource efficiency, digital governance, and global case insights.

Course Contents:

Unit-I: Infrastructure Governance **08 Hours**

Concept, scope, and components of urban & rural infrastructure, Infrastructure lifecycle and asset management, Principles of good governance, Role of central, state, and local governments, Urban Local Bodies (ULBs), Panchayati Raj Institutions (PRIs), National

policies on housing, transport, water, sanitation, energy, rural development, Policy formulation, implementation, monitoring.

Unit-II: Economics of Urban and Rural Infrastructure 08 Hours

Economic characteristics of infrastructure (public goods, externalities, natural monopoly), Demand forecasting & cost–benefit analysis (CBA), Budgetary allocations, grants, and intergovernmental transfers, Municipal finance and rural development financing, PPP models, Case studies, Life-cycle costing, Economic impact assessment, social cost–benefit analysis.

Unit-III: Policies, Acts and Regulatory Frameworks 08 Hours

AMRUT, Smart Cities Mission, Swachh Bharat Mission, National Urban Housing Policy, PMAY, National Transport Policies, PMGSY, NRLM, MGNREGA, Rural drinking water, sanitation, electrification programs, Environmental regulations (EIA, Water/Air Acts, Waste Management Rules), Land acquisition and R&R policies, Infrastructure concession frameworks.

Unit-IV: Planning, Implementation and Monitoring of Infra. Projects 08 Hours

Master planning, regional planning, Integrated urban/rural planning approaches, GIS-based infrastructure planning, DPR preparation, feasibility studies, Procurement methods, contract management, Risk management, KPIs for urban and rural services, Service level benchmarks (SLBs), Digital governance & monitoring systems.

Unit-V: Sustainable, Inclusive and Resilient Infrastructure Governance 08 Hours

Green and climate-resilient infrastructure, Disaster risk reduction, Energy efficiency, circular economy, Infrastructure for marginalized groups, Rural–urban linkages for balanced development, E-governance tools IoT, AI, and data analytics, UN SDGs and infrastructure governance, international case studies.

Learning Resources:

Text Books:

1. Town Planning, G. K. Hiraskar, Dhanpat Rai Publications
2. Town Planning, S. C. Rangwala, Charotar Publishing House Pvt. Ltd.
3. Rural Development: Planning Strategy & Policy Imperatives — Vivek Saurath & Manoj Agarwal.

Reference Books:

1. Urban Planning by Chris Couch.
2. Urban Infrastructure and Governance by G. Ramesh, Vishnu Prasad Nagadevara, Gopal Naik, Anil Suraj.

3. Urban and Regional Planning Education: Learning for India (edited by Ashok Kumar, Diwakar S. Meshram, Krishne Gowda.
4. Swachh Bharat Mission Guidelines.
5. MRTP Act 1966: The director, government printing, stationary and publications, Maharashtra state, Mumbai
6. URDPFI & AMRUT Guidelines: Ministry of housing and urban affairs, Government of India.
7. Natural Infrastructure and Resilient Cities: Role of Green Infrastructure in Urban Planning for Adaptation to Climate Change in India (2025, by National Institute of Disaster Management, Delhi).
8. Role of Edge Analytics on Sustainable Smart City Development: Challenges and Solutions by G. R. Kanagachidambaresan.
9. Sustainable Smart Cities in India: Challenges and Future Perspectives (The Urban Book Series) by Poonam Sharma and Swati Rajput.
10. Rural Development: Principles, Policies and Development by Katar Singh and Anil Shishodia. Atlantic Publications.

Web link for MOOC / NPTEL Links:

1. https://onlinecourses.swayam2.ac.in/imb21_mg02/preview
2. https://onlinecourses.swayam2.ac.in/ugc23_ge04/preview
3. https://onl inecourses.nptel.ac.in/noc23_ce52/preview
4. https://onlinecourses.swayam2.ac.in/cec20_ar01/preview
5. https://www.coursera.org/learn/smart-cities
6. https://onlinecourses.nptel.ac.in/noc25_ar27/preview
7. https://onlinecourses.nptel.ac.in/noc26_ar08/preview
8. https://onlinecourses.nptel.ac.in/noc25_ar25/preview
9. https://onlinecourses.nptel.ac.in/noc26_ce48/preview

List of Practicals (Any 8):

1. Presentation on any national policy for housing and transport. (Group Activity)
2. Analyze the latest central/state government budget allocations for infrastructure sectors. (Individual Activity)
3. Comparison of Public-Private Partnership (PPP) models in infrastructure project (Individual Activity)
4. Conduct a sanitation or waste management study under Swachh Bharat guidelines with case study. (Individual Activity)
5. Prepare a compliance checklist for industries under Water Act, Air Act, and Waste Management Rules. (Group Activity)

6. Prepare a land use map and zoning proposal for a neighborhood. (Group work)
7. Conduct a basic energy audit of a building (college, hostel, home) and propose energy-saving measures. (Group Activity)
8. Suggest a small-scale circular economy project for rural or urban ward. (Group Activity)
9. Map how infrastructure projects (roads, water supply, housing, digital systems) contribute to SDGs 6, 7, 9, 11, and 13. (Individual Activity)
10. Identify and explain components of a tender document by referring to any online tender document related to infrastructure project.

Course Code: 170605F	Course Name: Application Development	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE** : 40 Marks **ESE** : 60 Marks **TW** : 50 Marks

Expected Prerequisite Courses:

- Web Development, Database Management Systems.

Course Objectives:

- To familiarize students with client-side scripting concepts.
- To provide knowledge of server-side development and backend processing in web applications.
- To enable students to understand basic database concepts.
- To understand and learn Web application deployment.

Course Outcomes:

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

CO1: Apply the client-side technologies for web development.

CO2: Develop user interfaces using component-based design approaches.

CO3: Apply the server-side technologies for web development.

CO4: Create effective web applications for business functionalities using the latest web development platforms.

CO5: Deploy web applications in collaborative environments.

Course Contents:

Unit-I: Basics of Web Application Interactivity 08 Hours

Introduction to JavaScript, JS Variables and Constants, JS Variable Scopes, JS Data Types, JS Functions, JS Array, JS Object, JS Events.

Unit-II: ReactJS 08 Hours

Introduction to ReactJS, ReactJS Components Styling, Routing, Redux- Architecture, Hooks-Basic hooks, useState() hook, useEffect() hook, useContext() hook.

Unit-III: Backend Development Using NodeJS 08 Hours

Role of backend in web applications, Introduction to NodeJS, Environment Setup, Node.JS Events, Node.JS Functions, Node.JS Built-in Modules, File System, Handling Data I/O in Node.JS, Create HTTP Server, Create Socket Server.

Unit-IV: Database Integration Using MongoDB 08 Hours

Introduction to databases, Need for databases in web applications, Types of databases: SQL vs NoSQL, MongoDB fundamentals, Data models and schemas, Basic CRUD operations.

Unit-V: Managing and Deploying Web Applications: GitHub 08 Hours

Deployment strategies, Overview of Git, Git Repositories: Public vs private repositories, Basic Git Workflow & commands, collaboration using GitHub.

Learning Resources:

Text Books:

1. Jeffrey C.Jackson, "Web Technologies: A Computer Science Perspective", Second Edition, Pearson Education, 2007, ISBN 978-0131856035.
2. Kogent Learning Solutions Inc, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, ISBN: 9788177228496.

Reference Books:

1. Shama Hoque, Full-Stack React Projects: Learn MERN Stack Development by Building Modern Web Apps, Packt Publishing.
2. Dr. Hiren Joshi, Web Technology and Application Development, DreamTech, 1st Ed.

Web link for MOOC / NPTEL Links:

1. https://www.coursera.org/learn/programming-with-javascript
2. https://www.coursera.org/specializations/build-dynamic-website

List of Practicals:

1. Design responsive user registration and login which will do the following actions: Register user, login user functionality.
2. Create a To-Do List application where users can add tasks, mark tasks as completed, and delete tasks.
3. Develop a frontend using React JS which includes forms and navigation.
4. Create a Node.JS Application which serves a static website.
5. Develop a Node.js application with MongoDB to perform CRUD Operations.
6. Create version control account on GitHub and implement basic git commands and repository handling.
7. Mini Project: Develop a web application using front end and backend technologies in any of the domains: Social Media, E-commerce, Finance, Education, Any other.

Course Code: 170605G	Course Name: Data Visualization	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Programming and Problem Solving.

Course Objectives:

- To introduce the fundamental concepts and importance of data visualization.
- To develop the ability to create basic graphical representations such as bar charts, line charts, etc.
- To enable students to explore and summarize datasets using filtering, aggregation, and basic statistical measures.
- To apply visualization techniques to analyze time-series and geospatial data commonly used in engineering applications.
- To develop skills for creating dashboards and communicating insights through visual storytelling and business analytics tools.

Course Outcomes:

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

CO1: Explain the importance, principles, and techniques of data visualization and perform basic data exploration using filtering and aggregation methods.

CO2: Apply appropriate visualization techniques to create basic and advanced charts.

CO3: Analyze time-series datasets to identify trends, seasonality, and noise using suitable visualization techniques.

CO4: Analyze geospatial data using mapping techniques to derive meaningful insights.

CO5: Develop interactive dashboards and visual reports using visualization tools to communicate data insights effectively.

Course Contents:

Unit-I: Overview of Data Visualization **08 Hours**

Importance and benefits of good data visualization– Design principles. Visualization ethics, misleading visualizations, accessibility considerations, and best practices for effective visual communication. Statistical Measures, Introduction to Python libraries for visualization,

Exploring Data – Reduce Items and Attributes: Filter and Aggregate.

Unit-II: Creation of Basic Visualization 08 Hours

Histogram, Bar (Vertical and Horizontal) and Line Chart, Box plot, Scatter plot (Examples and Exercises to be given for practice). Color palettes – Creation of 3D Charts. Creation of Advanced Visualization: Heat Map– Facet Grid – Interaction Techniques: Manipulate View – Creation of interactive Network topologies and Trees.

Unit-III: Visualization of Time Series Data 08 Hours

Summary statistics and plotting aggregated views - Visualization of seasonality, trends and noise– working with multiple time series data such as Power load variation, Machine temperature monitoring, Rainfall and water level data, Signal variation in electronics.

Unit-IV: Visualization of Geospatial Data 08 Hours

Spatial join - overlapping geospatial data to maps and adding special cues – Case Study-Visualization of multimodal data and analysis-case study sensor data and health care, genome and biomedical data.

Unit-V: Business Analytics and Visualization Tools 08 Hours

Creation of interactive dashboards, charts, and visual reports using data visualization tools, applying visualization principles and data storytelling techniques.

Learning Resources:

Text Books:

1. Python Data Visualization: An Easy Introduction to Data Visualization in Python, ISBN: 9780070087705, Tata McGraw-Hill Education, 2009.
2. Tamara Munzner, Visualization Analysis and Design, A K Peters Visualization Series, CRC Press, 2014.

Reference Books:

1. Hands-On Data Visualization: Interactive Storytelling from Spreadsheets to Code Jack Dougherty and Ilya Ilyankou 1st Edition, O'Reilly Media, 2021.
2. Alberto Cairo, The Functional Art: An Introduction to Information Graphics and Visualization, New Riders, 2012.

Web link for MOOC / NPTEL Links:

1. https://www.coursera.org/learn/advanced-data-visualization-with-tableau-public

List of Practicals:

1. Load a dataset and perform basic data exploration by identifying attributes, data types, and displaying summary statistics.
2. Using a dataset, compute statistical measures (mean, median, standard deviation) and perform filtering and aggregation
3. Create Histogram, Bar Chart (vertical and horizontal), and Line Chart using a suitable dataset.
4. Using a dataset, create Box Plot and Scatter Plot to analyze data distribution and relationships between variables.
5. Using a dataset, generate advanced visualizations such as Heat Map and Facet Grid with appropriate color palettes.
6. Using a time-series dataset, create visualizations to identify trends, seasonality, and patterns.
7. Using a geospatial dataset, plot location-based data on a map and analyze spatial distribution.
8. Create an interactive dashboard using data visualization tools and present insights using data storytelling.

Course Code: 170605H	Course Name: Drives and Controls	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Tutorial :** 1 Hour/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 50 Marks**

Expected Prerequisite Courses:

- Power Electronics, Electric Machines.

Course Objectives:

- To understand the fundamentals, components, and control principles of electric drive systems.
- To analyze thermal models and select appropriate motor power ratings for different duty cycles.
- To study performance, speed control, and braking methods of DC motor drives.
- To understand operation, control techniques, and speed control methods of induction motor drives
- To understand the types, operation, and control of synchronous and special motor drives for fixed and variable speed applications.

Course Outcomes:

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

CO1: Explain the fundamentals, components, selection criteria, and control techniques of electric drives, including closed-loop and PLL control.

CO2: Analyze the thermal characteristics of motors to determine suitable motor power ratings under different duty cycles and load conditions.

CO3: Analyze performance, speed control, multi-quadrant operation, and closed-loop control of DC motor drives.

CO4: Explain starting, speed control methods, slip power recovery techniques, and closed-loop control of induction motor drives.

CO5: Analyze the operation and control of synchronous, Permanent Magnet Synchronous Motor, BLDC, stepper, and switched reluctance motor drives.

Course Contents:

Unit-I: Basics of Electric Drives and Control **08 Hours**

Definition, Advantages of electrical drives, Components of Electric drive system, Selection Factors, status of Electrical Drives (DC & AC), speed control and drive classifications, close

loop control of drives, phase locked loop (PLL) control.

Unit-II: Selection of Motor Power Rating 08 Hours

Thermal model of motor for heating and cooling-Relationship between temperature rise and time, Heating time constant, Cooling time constant. classes of motor duty- continuous duty, short time duty, intermittent periodic duty, intermittent periodic duty with starting, intermittent periodic duty with starting & braking, continuous duty with intermittent periodic loading, continuous duty with starting & braking, Continuous duty with periodic speed changes. Determination of motor ratings, Selection of power ratings of motor -continuous duty and constant load, continuous duty and variable load, Short time rating of motor.

Unit-III: DC Motor Drives 08 Hours

DC motors and their performance starting, transient analysis, speed control, Controlled rectifier fed drives, full controlled 3 phase rectifier control of dc separately excited motor, Multi quadrant operation, Chopper controlled drives closed loop speed control of DC motor.

Unit-IV: Induction Motor Drives 08 Hours

Induction motor analysis, starting and speed control methods- voltage and frequency control, current control, closed loop control of induction motor drives, rotor resistance control, Slip power recovery: Static Kramer and Scherbius Drive, Single phase induction motor starting, braking and speed control.

Unit-V: Special Purpose Motor Drives 08 Hours

Synchronous motor types, operation with fixed frequency, variable speed drives, Permanent Magnet Synchronous Motor and BLDC motor drives, Stepper motor drives, switch reluctance motor drives.

Learning Resources:

Text Books:

1. G. K. Dubey, Fundamentals of Electrical Drives, 2nd Edition (sixth reprint), Narosa Publishing House, 2001.
2. M. L. Soni, P.V. Gupta, U. S. Bhatnagar, “A course in Electrical Power”, 1999, Dhanpat Rai & Sons.

Reference Books:

1. M. H. Rashid, Power Electronics -Circuits, devices and Applications, 3rd Edition, PHI Pub. 2004.
2. B. K. Bose, Modern Power Electronics and AC Drives, Pearson Education, Asia, 2003.

Web link for MOOC / NPTEL Links:

1. http://nptel.ac.in/courses/108104140

List of Practicals:

1. Based on basics of electric drives and control.
2. Based on the selection of motor power rating.
3. Based on DC motor drives.
4. Based on induction motor drives.
5. Based on special-purpose motor drives.
6. Mini project/case study on electrical drives.
7. Seminar on electrical drives.
8. Industrial visit to the electrical drive and control industry and prepare a report.

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