Year 2022-23 onward

B. Tech. Programme Structure

Electronics and Communication Engineering [ECE]

NIST Institute of Science and Technology (Autonomous)
Institute Park, Pallur Hills, Berhampur, Odisha, INDIA. Pin: 761008.
Web: www.nist.edu

Fourth Semester					
Theory					
Sl. No.	**Category**	**Subject Code**	**Subject Name**	**L-T-P**	**Credit**
1	HSMC	22CM4HS01T	**Humanities-I** Organizational Behavior/	3-0-0	3
		22CM4HS02T	**Management-I** Engineering Economics and Costing		
2	ESC	22EC4ES01T	Digital Electronic Circuits	3-0-0	3
3	PCC	22EC4PC01T	**PCC-3:**Analog Communication Techniques	3-0-0	3
4	PCC	22EC4PC02T	**PCC-4:** Electromagnetic Theory	3-0-0	3
5	PCC	22EC4PC03T	**PCC-5:** Control System Engineering	3-0-0	3
6	PEC	**Professional Elective-1:**		3-0-0	3
		22EC4PE01T	Sensor and Transducer		
		22EC4PE02T	Semiconductor Devices		
		22EC4PE03T	Introduction to Python Programming		
7	**HSMC**	**22CM4HS03T**	**Universal Human Values-II/***	**3-0-0**	**3**
Total Credit (Theory)					**21**
Practical					
1	ESC	22EC4ES01L	Digital Electronic Circuits Laboratory	0-0-2	1
2	PCC	22EC4PC01L	**PCC Lab-3:** Analog Communication Techniques Laboratory	0-0-2	1
3	PCC	22EC4PC02L	**PCC Lab-4:** Control System Engineering Laboratory	0-0-2	1
4	PCC	22EC4PC03L	Product Development Laboratory	0-0-2	1
Total Credit (Practical)					**4**
Total Semester Credit					**25**

*** For CSE/IT: theory credits are 22 and practical credits are 3: Total 25 [Due to inclusion of Discrete structure subject]. This structure can be followed by other departments based on the BoS decision.

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4th	
Subject Name	Organizational Behavior	
Course Type	Theory	
Course Code	22CM4HS01T	
Category	HSMC (Humanities, Social Science and Management Courses)	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge		
Subject Description		
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. Developing an understanding of the behaviour of individuals and groups inside organizations by enhancing the skills in appreciating individual, interpersonal, and group processes for increase. 2. Developing effectiveness both within and outside of organizations is the goal of any organization.	

<table>
<tr><td></td><td colspan="2">3. Through this course students will develop theoretical and practical insights.
4. The students will develop problem-solving capabilities for effectively managing the organizational processes.</td></tr>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Students will understand the essential of maintaining the inter-personal relationships in organisations.
2. Personality factors will be effectively used to understand the communication among groups.
3. The reasons for conflict will be known and prescriptive methods can be devised to enhance higher productivity in organisations.
4. Being an employee in an organisation the importance of organisational change and culture can be known to all.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">Organizational Behaviour, Robbins, Judge, Sanghi, Pearson.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">1. Understanding Organizational Behaviour, Parek, Oxford
2. Organizational Behaviour, Hitt, Miller, Colella, Wiley
3. Organizational Behaviour, K. Awathappa, HPH.
4. Organizational Behaviour, VSP Rao, Excel
5. Understanding Organizational Behaviour, Parek, Oxford</td></tr>
</table>

Digital Learning Resources	

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1		
CO2		
CO3		
CO4		

DETAILED SYLLABUS:

Module No. 1	Fundamentals of OB	06 Hours
Introduction: Definition, nature and scope of OB (environmental and organizational context), Relationship between OB and the individual, Impact of IT, globalization and diversity on OB.		

Module No. 2	Foundations of Individual Behaviour	10 Hours
Personality: Meaning and definition, Determinants of personality, Personality traits, Personality and OB. Perception: Meaning and definition, Perceptual process, Importance of perception in OB. Motivation: Nature and importance, Herzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory. Attitude: Definition, nature and dimensions, Attitude and OB.Learning: Nature, learning and OB.		

Module No. 3	Group Dynamics of OB-I	08 Hours

Communication: Types, interactive communication in organizations, barriers to communication, strategies to improve the follow of communication. Stress and Conflict: Meaning and types of stress, Meaning and types of conflict, Effect of stress on individuals, strategies to cope with stress and conflict.

Module No. 4	**Group Dynamics of OB-II**	**06 Hours**
Power and Politics: Meaning and types of power empowerment. Groups Vs. Teams- Nature of groups, dynamics of informal groups, dysfunctions of groups and teams, teams in modern work place.		

Module No. 5	**Foundations of Organizational Behaviour**	**06 Hours**
Organizational Culture: Culture and organizational effectiveness. Organizational Change: Types of change, reasons to change, resistance to change. Organisational Structure and Development: Concepts and process.		

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4th	
Subject Name	Engineering Economics and Costing	
Course Type	Theory	
Course Code	22CM4HS02T	
Category	HSMC (Humanities, Social Science and Management Courses)	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge		
Subject Description		
Objectives and Outcomes	**Objectives:** The course should enable the students to: 1. To prepare engineering students to understand the basic concepts of Engineering economics and their application. 2. To carry out numerically the effects of changes in demand and supply on price determinations of products and services. 3. To justify or reject alternative projects in the light of changing domestic and global scenario on the eve of technological innovations. 4. To analyse the macroeconomic environment and financial system of	

	the country and its impact on business society and enterprise.	
	Outcomes: Upon completion of this course, the student will be able to: 1. Students will understand how to solve economic problems and the art of taking the right decision on scarce resources. 2. This will help to solve different microeconomic problems related to production, cost, and revenue maximization. 3. Students will be understood different market structures and levels of competition and determine the price. 4. This will help engineering students while evaluating and determining the cost of a project. This is also helpful in determining the value of money for future courses of action. 5. This will help to understand basic microeconomic concepts like inflation, national income, and money market.	
Assessment/ Evaluation	Mid-Term Examination	30 %
	Quiz Test-1	2.5 %
	Quiz-Test-2	2.5 %
	Surprise Test	5 %
	Assignment-1	2.5 %
	Assignment-2	2.5 %
	Attendance	5 %
	End-Term Examination	50 %
Prescribed Text Book(s)	Principles of Economics: Deviga Vengedasalam& Karun agaran Madhavan-Oxford Publication	
Reference Book(s)	1.Engineering Economics and Costing: D.M.Methani& Suresh Chandra Das-Himalaya Publishing House 2.Engineering Economics and Costing: Sasmita Mishra-PH Learning Private Limited 3.R.Panneerselvam, 'Engineering Economics', PHI 4.Riggs,Bedworth and Randhwa, 'Engineering Economics', McGrow Hill Education India 5. Engineering Economics and Costing: Mahendra P. Agasty, Scitech	

	Publications (INDIA) Pvt.Ltd.
Digital Learning Resources	

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1		
CO2		
CO3		
CO4		

DETAILED SYLLABUS:

Module No. 1		**10 Hours**
Engineering Economics: Nature and Scope, Basic Problems of an Economy, Micro and Macro Economics; Demand: Meaning of demand, Determinants of demand, Demand function, Law of demand and its exceptions, Elasticity of demand and its measurement, (Simple numerical problems to be solved). Supply: Meaning of Supply, Determinants of Supply, Supply function, Law of Supply and its exception, Elasticity of Supply.		

Module No. 2		**07 Hours**
Production: Factors of Production, Production Function; Laws of Returns: Law of Variable Proportions, Law of Returns to Scale, Cost and Revenue Concepts: Short Run Total Costs, Long Run Average Cost Curves, Total Revenue, Average Revenue and Marginal Revenue.		

Module No. 3		**06 Hours**
Market Structures: Basic understanding of different Market Structures; Determination of Equilibrium Price under Perfect Market Competition and Monopoly. Margin of safety and Break Even Analysis: Linear Approach (Simple numerical problems to be solved).		

Module No. 4		**10 Hours**
Time Value of Money: Interest- Simple and Compound, Nominal and Effective Rate of Interest, Cash flow diagrams, Principles of Economic Equivalence, Evaluation of Engineering Projects: Present, Future and Annual worth Method, Rate of Return Analysis; Cost-Benefit Analysis		

Module No. 5		**07 Hours**
Inflation: Meaning of Inflation, Types, Causes and Measures to Control Inflation. National Income: Definition, Concepts of National Income and its measurement, Banking: Commercial Bank, Functions of Commercial Bank, Central Bank, Functions of Central Bank.		

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4th	
Subject Name	Digital Electronic Circuits	
Course Type	Theory	
Course Code	22EC4ES01T	
Category	ESC (Engineering Science Courses)	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Basics of Digital Electronics	
Subject Description	The digital revolution marked the beginning of the Information Age. Adoption of digital computers and digital data storage devices followed by development of semiconductors leverage the digital technology to touch all the needs of society. In this course, the basic building blocks like gates and their uses to design logic function is discussed followed by function simplification using Boolean algebra and Mapping method. The course postulates the fundamental blocks like combinational and sequential logic circuits to design complex digital systems. The application of CMOS logic family is revealed to design the basic and universal logic gates. The inherited knowledge cited here enables the students for understanding digital VLSI technology.	
	Objectives:	

<table>
<tr><td>Objectives

and

Outcomes</td><td colspan="2">The course should enable the students to:

1. Comprehend insight about the requirement of designing low cost and high speed Digital systems.
2. Gain inclusive knowledge about combinational and sequential logic blocks.
3. Learn memory and application of CMOS to design basic logic gates that help to design digital integrated circuits.
4. Demonstrate the idea of designing complex digital circuits.</td></tr>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Acquire the fundamental knowledge about digital electronics.
2. Understand the behavior of combinational arithmetic and logic circuits for development of complex digital systems.
3. Employ the functionality of basic memory elements for designing synchronous and asynchronous sequential circuits.
4. Apply the knowledge of CMOS logic family to design complex Integrated circuits.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
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<tr><td>Assignment-1</td><td>2.5 %</td></tr>
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<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">M. Morris Mano, Michael D Ciletti, Digital Design, 5th Edition, Pearson Publication, 2016, New Delhi.</td></tr>
</table>

<table>
<tr><td>Reference Book(s)</td><td>1. Charles H. Roth and Larry L. Kinney, Fundamentals of Logic Design, 7th Edition, Cengage Learning, 2013.
2. Donald P Leach, Albert Paul Malvino, GoutamSaha, Digital Principles and Applications, 8th Edition, Tata McGraw Hill Education, 2015, New Delhi.
3. A. Anand Kumar, Fundamentals of digital circuits, 4th edition, PHI, 2016, New Delhi.
4. T.L. Floyd and R.P. Jain, Digital Fundamentals, 7th Edition, Pearson Education, 2005, Bangalore
5. Norman Balabanian & Bradley Carlson, Digital Logic Design Principles, 2nd edition, John Wiley & Sons, 2004, New York.</td></tr>
<tr><td>Digital Learning Resources</td><td>
<table>
<tr><td>Course Name</td><td>Digital Circuits and Systems</td></tr>
<tr><td>Course Link</td><td>https://nptel.ac.in/courses/117106086/</td></tr>
<tr><td>Course Instructor</td><td>Prof. S. Srinivasan, IIT Madras</td></tr>
</table>
<table>
<tr><td>Course Name</td><td>Digital Circuits</td></tr>
<tr><td>Course Link</td><td>https://nptel.ac.in/courses/117103064/</td></tr>
<tr><td>Course Instructor</td><td>Prof. Anil Mahanta, Prof. Roy Paily Palanthinkal, IIT Guwahati</td></tr>
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CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Acquire the fundamental knowledge about digital electronics.	PO1, PO2, PO3, PO4
CO2	Understand the behavior of combinational arithmetic and logic circuits for development of complex digital systems.	PO1, PO2, PO3, PO4,PO5, PO6,PO7
CO3	Employ the functionality of basic memory elements for designing synchronous and asynchronous sequential circuits.	PO1, PO2, PO3, PO4,PO5, PO6,PO7
CO4	Apply the knowledge of CMOS logic family to design complex Integrated circuits.	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS:

Module No. 1	**Digital Fundamentals and Binary Codes**	**8 Hours**
Signed Binary representation, Arithmetic Operation using 1's and 2`s Complements, Binary codes(BCD and 8421), Canonical Logic Forms, Extracting Canonical Forms, K-Maps: Two, Three and Four variable K-maps.		

Module No. 2	**Combinational Logic Design**	**14 Hours**
Function Implementations: Specifying the Problem, NAND, NOR, AND-OR, OR-AND, NAND-NAND, NOR-NOR, AOI, OAI. Arithmetic Circuits: Half Adder, Full Adder, Half Subtractor, Full Subtractor, Binary Parallel Adder, Multiplier, Magnitude Comparator Logic Circuits: Gray to Binary and Binary to Gray Code Converters, Multiplexer, De-Multiplexer, Decoder, Encoder, Priority encoder		

Module No. 3	**Fundamentals of Sequential Circuits**	**6 Hours**
Storage elements, Latches(SR and D), Analysis of Flip-Flops(SR, D, JK, T): Functional Table, Characteristic Table, Characteristic Equation, State Diagram, Excitation Table, Timing Diagram, Positive-Edge-Triggered D Flip-Flop, Master-Slave JK-FF, Flip-Flop conversions.		

Module No. 4	**Design of Synchronous and Asynchronous Sequential logic Circuits**	**10 Hours**
Sequential Circuits Design: Design Procedure, Counter: Asynchronous and Synchronous Counter, Analysis and Synthesis of Clocked Sequential Circuits, FSM Fundamentals: Melay and Moore Machines. Shift Registers: Shifting of Binary Bits, SISO, SIPO, PISO, PIPO, Ring Counter, Johnson		

Counter.

Module No. 5	**Fundamentals of Memory and CMOS logic family**	**06 Hours**
Fundamentals of Memory: Types of memory, RAM and ROM, Memory decoding, 1-bit SRAM and DRAM cell. CMOS logic family: Characteristics, Fan out, Fan in, Power dissipation, Average Power, Propagation delay, Noise margin, Application of CMOS to design basic logic gates.		

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4^{th}	
Subject Name	Analog Communication Technique	
Course Type	Theory	
Course Code	22EC4PC01T	
Category	PCC	
Credit Point	3	
Time Commitment	Lecture	38 Hours
	Tutorial	06 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Signals and Systems	
Subject Description	Modulation is one of the important component of any communication network. Modulation is a technique which is used to convert the low frequency real time signals to high frequency signal component so that they can be transmitted over large distances. This subjectintroduces the students the concept of representing signals in both time domain and frequency domain. The concepts on random processes, noise analysis, modulation theory, system design for analogue modulators and demodulators are integral part of this subject.	
Objectives	**Objectives:**	

<table>
<tr><td>and

Outcomes</td><td colspan="2">The course should enable the students to:

1. Comprehend the concept of time and frequency domain analysis of signals used in communication systems.
2. Understand various analog modulation techniques and their applications in real world scenario.
3. Demonstrate the Sampling theorem in analog-to-digital conversion and understand thepractical limits of sampling techniques.
4. Describe the performance of various modulation techniques in noisy environment</td></tr>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

5. Analyze frequency response of signals and illustrate the concepts of random variables used in communication systems.
6. Evaluate various continuous wave modulation techniques and evaluate in terms of power, bandwidth, etc.
7. Apply the concept of analog to digital conversion and various pulse modulation techniques in signal transmission.
8. Explain and analyze the time and frequency-domain representation of noise and its effect on communication systems.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
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<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. H. Taub, D. L Schilling, G. Saha, Principles of Communication System, 4th Edition, McGraw Hill, 2013, India.
2. B. P. Lathi, Zhi Ding, Modern Digital and Analog Communication Systems, 4th Edition,Oxford University Press, 2017, India.</td></tr>
</table>

Reference Book(s)	6. MasoudSalehi, John G. Proakis, Communication System Engineering, 2nd Edition, Pearson Education, 2015, India. 7. P Ramakrishna Rao. Analog Communication, 1st Edition, Tata McGraw-Hill, 2013, New Delhi, India
Digital Learning Resources	

Course Name	Analog Communication
Course Link	https://nptel.ac.in/courses/117105143
Course Instructor	Prof. Goutam Das, Department of ECE, IIT Kharagpur

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Analyze frequency response of signals and illustrate the concepts of random variables used in communication systems.	PO1, PO2, PO3, PO4, PO5, PO12
CO2	Evaluate various continuous wave modulation techniques and evaluate in terms of power, bandwidth, etc.	PO1, PO2, PO3, PO4, PO5
CO3	Apply the concept of analog to digital conversion and various pulse modulation techniques in signal transmission.	PO1, PO2, PO3, PO4, PO5
CO4	Explain and analyze the time and frequency-domain representation of noise and its effect on communication systems.	PO1, PO2, PO3, PO4, PO5

DETAILED SYLLABUS:

Module No. 1	**Signals and Spectra:**	**6 Hours**
Signals and Spectra: Introduction to Communication Systems, Elements of communication System, Power SpectralDensity using Fourier series **Random Variables and Processes:** Probability, Random variables: mean and variance, CDF,PDF, joint probability and distribution function, Useful Probability Density functions,		

Random Process: Autocorrelation and Power Spectral Density

Module No. 2	**Amplitude Modulation Systems:**	**10 Hours**
Need of modulation, linear and nonlinear type of modulation, Frequency translation, Amplitude Modulation: Time and frequency analysis of DSB-C, DSB-SC, SSB and VSB Modulation. Modulators and demodulators: Square law modulator, switching modulator, square law detection and envelope detection, Concept of Frequency Division Multiplexing.		

Module No. 3	**Angle Modulation**	**8 Hours**
Types of angle modulation (FM and PM), Comparison: modulation index, sidebands, power and phasor diagram, Tone Modulated FM Signal, Arbitrary Modulated FM signal, Concept of narrowband and wideband FM(PM), FM Modulators: Direct & Indirect methods, Demodulators: limiter and discriminator. **Radio Transmitter and Receiver:** FM and AM Superheterodyne receiver, image frequency and its rejection, FM stereo broadcasting		

Module No. 4	**Digital Transmission of Analog Signal:**	**8 Hours**
Concept of sampling, types of sampling, Time and frequency analysis of Sampling Theorem Pulse Modulation: Pulse Amplitude Modulation: bandwidth, generation and recovery, Time division multiplexing of PAM signals, Pulse Width Modulation and Pulse Position Modulation. **Digital Representation of Analog Signal:** PCM, Quantization noise, Companding		

Module No. 5	**Noise Analysis**	**06 Hours**

Mathematical Representation of Noise: Some Sources of Noise, Frequency-domain Representation of Noise, Superposition of Noises, Linear Filtering of Noise.

Noise in Amplitude Modulation System: Calculation of SNR for SSB-SC, DSB-SC, DSB-C under synchronous detection, Comparison of AM system in terms of SNR and Figure of Merit. Noise in Frequency Modulation System: An FM Receiving System, Calculation of Signal to Noise Ratio, Comparison of FM and AM, Pre-emphasis and De-emphasis for SNR Improvement.

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4^{th}	
Subject Name	Electromagnetic Theory	
Course Type	Theory	
Course Code	19EC4PC02T	
Category	PCC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Basic knowledge of vector calculus Electric and Magnetic fields and its laws	
Subject Description	Electromagnetic theory is of paramount importance for B.Tech students as it forms the foundation for understanding and designing electrical and electronic systems, including communication devices, power systems, and various modern technologies. This course covers Electrostatics and Magnetostatics, Maxwell's equations, Electromagnetic Wave Propagation, Reflection and Transmission of EM wave, and Transmission Line Analysis. It provides students with a solid understanding of electromagnetic principles essential for modern engineering applications and offering practical knowledge for designing and optimizing transmission systems.	

<table>
<tr><td rowspan="2">Objectives

and

Outcomes</td><td colspan="2">Objectives:

The course should enable the students to:

1. Understand the basic concepts of electric and magnetic fields.
2. Understand the concepts related to Faraday‘s law, induced emf and Maxwell‘s equations.
3. Comprehend wave propagation in various material media.
4. Understand the basics of Transmission line.</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Apply electrostatic and magneto static principles to solve problems related to fields, potential, boundary conditions, and energy density.
2. Realize the diaspora of Maxwell’s equations in both static and time varying field.
3. Apply Maxwell‘s equations to solutions of problems relating to plane wave propagation in different media.
4. Design and modeling of high frequency transmission lines considering different parameters.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
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<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Matthew. N.O. Sadiku&Kulkarani, Principles of Electromagnetics, 6th Edition, Oxford University Press, First Indian Edition 2015, New Delhi.

2. Bhag Singh Guru and Huseyin R. Hiziroglu, Electromagnetic Field Theory Fundamentals, 4th Revised Edition, Cambridge University Press 2014, UK.</td></tr>
</table>

Reference Book(s)	3. D. M. Pozar, Microwave Engineering, 4th Edition, John Wiley & Sons, Inc. 2012, USA 4. William H. Hayt Jr. and John A Buck, Engineering Electromagnetics, 8th Edition, Tata McGraw Hill, 2012, New Delhi. 5. L. D. Landau, E. M. Lifshitz, Lev, The Classical Theory of Fields, 4th Edition, Butterworth-Heinemann, 2003, London. 6. Allen Taflove, Susan C. Hagness, Computational Electrodynamics: The Finite-Difference Time-Domain Method, 3rd Edition, Artech House, 2005, London.
Digital Learning Resources	

Course Name	Online/MOOC courses: Electromagnetic Theory
Course Link	https://onlinecourses.nptel.ac.in/noc21_ee83/preview
Course Instructor	Prof. Pradeep Kumar, IIT Kanpur

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Apply electrostatic and magnetostatic principles to solve problems related to fields, potential, boundary conditions, and energy density.	PO1, PO2, PO3, PO6, PO7
CO2	Realize the diaspora of Maxwell's equations in both static and time varying field.	PO2, PO6, PO7, PO12
CO3	Apply Maxwell's equations to solutions of problems relating to plane wave propagation in different media.	PO1, PO2, PO5, PO7, PO8
CO4	Design and modeling of high frequency transmission lines considering different parameters.	PO3, PO4, PO5, PO7, PO11

DETAILED SYLLABUS:

Module No. 1	Electrostatic and Magnetostatic:	12 Hours
Orthogonal Co-ordinate systems, Coulomb's and Gauss'slaws, boundary conditions for electrostatic fields, electrostatic energy density, Poisson's and Laplace's equations, Ampere's circuital law, Lorentz's force equation, vector magnetic potential, Biot-Savart law andapplications, Boundary conditions for magentostatic fields.		

Module No. 2	Maxwell's equations for static and time varying field	07 Hours
Maxwell's equations for static field in differential and integral form, Faraday's Law, Transformer and Motional EMFs, Properties of dielectrics, Displacement Current, Maxwell's Equations for time varying field, Time-Varying Potentials, Time-Harmonic Fields		

Module No. 3	Electromagnetic Wave Propagation	07 Hours
General wave equation, Plane Waves in Lossless Dielectrics, Wave Propagation in Lossy Dielectrics, Plane Waves in Free Space, Plane Waves in Good Conductors, Power flow and the Poynting Vector		

Module No. 4	Incidence of uniform plane waves	07 Hours
Polarization of Electromagnetic waves (Linear, Elliptical and Circular), Reflection and transmission of a plane wave at Normal incidence and Oblique incidence in conductor and dielectric interfaces, Brewster's Angle.		

Module No. 5	Transmission line & Analysis	07 Hours
The lumped-element circuit model for transmission line, Telegraph equation, Lossless transmission line, Characteristic impedance and propagation constant, Reflection and transmission coefficients		

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4th	
Subject Name	Control System Engineering	
Course Type	Theory	
Course Code	22EC4PC03T	
Category	ESC (Engineering Science Courses)	
Credit Point	3	
Time Commitment	Lecture	42 Hours
	Tutorial	Nil
	Practice	Nil
	Total	42 Hours
Recommended Background Knowledge	Basics of Engineering Mathematics	
Subject Description	Control system engineering is a discipline of engineering that uses control theory ideas to create a system that produces the desired behavior in a controlled way. As a result, control system engineering is concerned with a wide spectrum of dynamic systems, including human and technological interaction. Extensive variety of systems can be covered in control systems. Control Systems can be studied as a bachelor's degree, a certificate, a certification, or a postgraduate degree, depending on your preferences and qualifying requirements.	
	Objectives:	

<table>
<tr><td rowspan="2">Objectives

and

Outcomes</td><td colspan="2">Upon completion of this course, the student will be able to:

1. Understand the concept of feedback systems and analysis of physical systems.
2. Analyze the transfer function, characteristic equations, poles zeros in Laplace plane.
3. Study the systems performances in time-domain and frequency domain.
4. Analyze the system stability and relative stability deploying different approaches and understand the concepts of state variable analysis and state transition matrix.</td></tr>
<tr><td colspan="2">Outcomes:

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

1. Formulate mathematical model of systems and solve using reduction techniques.
2. Use the control system in time-domain and frequency domain.
3. Deploy the stability analysis techniques to design real-time control systems
4. Implement the state space approach for the analysis of control systems.</td></tr>
<tr><td rowspan="8">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Benjamin C. Kuo, Automatic Control Systems, 7th Edition, Prentice-Hall India, 1995
2. I. J. Nagrath and M. Gopal, Control Systems Engg., 6th Edition, New Age International Publishers 2017</td></tr>
</table>

Reference Book(s)	1. U. A. Bakshi and V. U. Bakshi, *Control Systems*, 4th Edition, Technical Publications, 2019. 2. Raymond T. Stefani, Bahram Shahian, Late Clement J. Savant & Late Gene H. Hostetter, *Design of Feedback control systems,* 4th Edition, Oxford publications, 2006. 3. Katsuhiko Ogata, *Modern Control Engineering*, 5th Edition, Pearson publications, 2009.
Digital Learning Resources	

Course Name	Control Engineering
Course Link	https://nptel.ac.in/courses/108/102/108102043/
Course Instructor	Prof. Madan Gopal, Department of Electrical Engineering, IIT Delhi

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Formulate mathematical model of systems and solve using reduction techniques.	PO1,PO2,PO3,PO4,PO7 PO11,PO12
CO2	Use the control system in time-domain and frequency domain.	PO1,PO2,PO3,PO4,PO5, PO6,PO7,PO9,PO10, PO11,PO12
CO3	Deploy the stability analysis techniques to design real-time control systems	PO1,PO2,PO3,PO4,PO6, PO7,PO9,PO10
CO4	Implement the state space approach for the analysis of control systems.	PO1,PO2,PO3,PO4,PO5, PO9,PO10,PO11,PO12

DETAILED SYLLABUS:

Module No. 1	Introduction:	8 Hours

Basic Concepts of Control Systems, Open loop and closed loop systems. Feedback Characteristics of Control Systems: Feedback and Non-feedback System, effect of Feedback on Overall gain, stability, sensitivity, and external disturbance or noise. Types of feedback control systems, Linearizing effect of feedback, regenerative feedback. Mathematical Modeling: Electrical and Mechanical system (Translation and Rotational systems), analogy between Mechanical and Electrical quantities

Module No. 2	**Transfer Function Representation and Time Response Analysis:**	**14 Hours**
Transfer function representation: Impulse response and transfer functions of linear systems. Determination of Transfer functions by block diagram algebra, and Signal Flow Graphs. Time response Analysis: Typical test Signals for Time response of control systems Steady State Errors by Static Error Constants and Generalized error constant method. Unit step response of second order system and time domain specifications, Transient response of a prototype second order systems.		

Module No. 3	**Stability of Linear Control Systems:**	**6 Hours**
Concept of stability, BIBO stability, Rout- Hurwitz Criterion, Relative Stability. Root locus Technique: Basic properties of the root loci, properties and construction of Root Loci-effect of adding poles and zeros to the transfer functions.		

Module No. 4	**Frequency Response Analysis and Stability in Frequency Domain:**	**10 Hours**
Frequency Response Analysis: Frequency response of closed – Loop systems, frequency domain specifications. Correlation between time response and frequency Response of control system. **Stability in Frequency Domain:** Mathematical Preliminaries, , Stability analysis with the Bode		

plot, polar plot, Nyquist Stability Criterion, Assessment of Relative stability using Nyquist Criterion. **Closed loop frequency response:** Constant – M Loci in the G (jω) -plane, Constant – Phase Loci in the G (jω) – plane.

Module No. 5	**Design of Control Systems:**	**08 Hours**
Design of control systems with PD, PI, PID, Phase – Lead, Phase – Lag, and Lead- Lag Controllers. State Space Analysis of Continuous Systems: Concepts of State, State Variables, State transition Matrix, and State Model from Block Diagram and Signal flow graph, Diagonalization – solving the time invariant state equations- state transition matrix and its properties.		

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4th	
Subject Name	Sensor and Transducers	
Course Type	Theory	
Course Code	22EC4PE01T	
Category	PEC (Professional Elective Courses)	
Credit Point	3	
Time Commitment	Lecture	34 Hours
	Tutorial	06 Hours
	Practice	Nil
	Total	40 Hours
Recommended Background Knowledge	Basics of Electronics and Electrical Engineering	
Subject Description	Sensors and transducers are the key component in any automation system. Along with sensors, conditioning circuits are also important to process the signal and convert it into a form suitable for the controllers. This course will equip the students with fundamental knowledge and skills on sensors and transducers and its applications.	
Objectives and Outcomes	**Objectives:** The course should enable the students to: **1.** Learn the first and second order instruments and understand the static and dynamic characteristics of the instruments. **2.** Explain the working principle and characteristics of major industrial sensors like Strain Gauge, Thermocouple, RTD and Thermistor, etc.	

<table>
<tr><td></td><td colspan="2">3. Describe suitable signal conditioning circuits of various sensors.
4. Understand the smart sensors and how it could be used as a transmitter.</td></tr>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Apply transient analysis to understand the response of first order and second order instruments.
2. Explain the calibration and static & dynamic characteristics of the instruments.
3. Analyze the instrumentation amplifier, design and select suitable resistive and reactive bridges and understand the idea of an AC carrier system.
4. Apply the knowledge of different sensors in designing various automation systems.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">7. J P Bentley, Principles of Measurement Systems, Third Edition, Pearson Education, 2007, New Delhi.
8. E.O. Doeblin, Measurement Systems Application and Design, Fourth Edition, McGraw-Hill, 1990, New York.</td></tr>
<tr><td>Reference Book(s)</td><td colspan="2">9. A. K. Ghosh, Introduction to Measurements and Instrumentation, Fourth Edition, PHI, 2012, New Delhi.
10. J. W. Dally, W. F. Riley and K. G. Mc Connel, Instrumentation for Engineering Measurements, Second Edition, John Wiley, 2003, New York.
11. T. R. Padmanabhan, Industrial Instrumentation Principles and Design, First Edition, Springer, 2000, London.</td></tr>
</table>

Digital Learning Resources	

Course Name	Sensor and Transducers/Industrial Instrumentation
Course Link	https://nptel.ac.in/courses/108/105/108105064/#
Course Instructor	Prof. Alok Barua, Department of Electrical Engineering, IIT Kharagpur

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Apply transient analysis to understand the response of first order and second order instruments.	PO1, PO2, PO3, PO4, PO5
CO2	Explain the calibration and static & dynamic characteristics of the instruments.	PO1, PO2, PO3, PO5
CO3	Analyze the instrumentation amplifier, design and select suitable resistive and reactive bridges and understand the idea of an AC carrier system.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Apply the knowledge of different sensors in designing various automation systems.	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS:

Module No. 1	**Elements of a General Measurement System**	**10 Hours**
Measurement system, Static Characteristics: systematic characteristics, statistical characteristics, calibration; Dynamic characteristics of measurement systems: transfer functions of typical sensing elements, step and frequency response of first and second order elements, and dynamic error in measurement systems.		

Module No. 2	**Sensing Elements**	**10 Hours**
Resistive sensing elements: potentiometers, Resistance Temperature Detector (RTD), thermistors, strain gauges. Capacitive sensing elements: variable separation, area and dielectric; Inductive sensing elements: variable reluctance and LVDT displacement sensors.		

Module No. 3	**Signal Conditioning Elements**	**10 Hours**
Deflection bridges: design of resistive and reactive bridges, push-pull configuration for improvement of linearity and sensitivity Amplifiers: Operational amplifiers-ideal and non-ideal performances, inverting, non-inverting and differential amplifiers, instrumentation amplifier and filters.		

Module No. 4	**Thermoelectric and Elastic Sensing Elements**	**06 Hours**
Thermoelectric sensing elements, laws, thermocouple characteristics, installation problems, cold junction compensation. Elastic sensing elements, Bourdon tube, bellows, and diaphragms for pressure sensing, force and torque measurement.		

Module No. 5	**Electromagnetic Sensing Elements**	**04 Hours**
Velocity sensors, A.C. carrier systems, phase sensitive demodulators and its applications in instrumentation and IC temperature sensor.		

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4^{th}	
Subject Name	Semiconductor Devices	
Course Type	Theory	
Course Code	22EC4PE02T	
Category	PEC	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	08 Hours
	Practice	Nil
	Total	44 Hours
Recommended Background Knowledge	Basic Electronics, Analog Electronics	
Subject Description	The Semiconductor Devices course provides a comprehensive overview of semiconductor physics and device applications. Beginning with semiconductor basics and energy bands, students explore the intricacies of carrier transport in semiconductors. The course delves into the crucial P-N junction, examining its behavior and applications. It then progresses to the study of Bipolar Junction Transistors (BJTs) and Metal-Oxide-Semiconductor Field-Effect Transistors (MOSFETs), essential components in electronic circuits. Through theoretical principles and practical applications, students gain insights into the design, analysis, and optimization of semiconductor devices, preparing them for roles in the forefront of technology and innovation in the semiconductor industry.	
	Objectives:	

<table>
<tr><td>Objectives
and
Outcomes</td><td colspan="2">The course should enable the students to:
1. Understand the formation of energy band diagram and physics of semiconductors.
2. Comprehend the carrier transport mechanism in semiconductors.
1. Familiarization ofpn-junction under different biasing conditions.
2. Get the knowledge of basic fabrication process and the operation and performance of semiconductor devices such as BJTs & MOSFETs.</td></tr>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:
1. Impart knowledge in physical properties of semiconducting materials affecting the operation of semiconductor devices.
2. Apply the operating principle of conventional semiconductor devices to understand the advanced devices.
3. Solve practical problems by applying he knowledge of physics of semiconductor devices.
4. Acquire fundamental knowledge about semiconductor device design and fabrication technology.</td></tr>
<tr><td rowspan="9">Assessment/
Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. Semiconductor Physics and Devices-Donald A. Neamen, Tata McGraw Hill Publishing Company Limited, New Delhi, 3rd Edition
2. Solid State Electronics Devices-Ben. G. Streetman and Sanjay Banarjee, Pearson Education, New Delhi, 6th Edition</td></tr>
</table>

<table>
<tr><td>Reference Book(s)</td><td>3. Modern Semiconductor Devices for Integrated Circuits-Chenming Calvin Hu, Pearson Education/Prentice Hall, 2009
4. Physics of Semiconductor Devices-S.M. Sze and Kwok K. Ng, Wiley India Pvt. Limited, New Delhi, 3rd Edition
5. Physics of Semiconductor Devices-Dillip K. Roy, University Press (India) Pvt. Ltd., Hyderabad, 2nd Edition.</td></tr>
<tr><td>Digital Learning Resources</td><td><table><tr><td>Course Name</td><td>Online/MOOC courses: NPTEL Lecture on Solid State Devices</td></tr><tr><td>Course Link</td><td>https://nptel.ac.in/courses/106/102/106102064/</td></tr><tr><td>Course Instructor</td><td>Dr. S. Karmalkar, Department of Electrical Engineering, IIT Madras</td></tr></table></td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Impart knowledge in physical properties of semiconducting materials affecting the operation of semiconductor devices.	PO1, PO4, PO6, PO8, PO11
CO2	Applying the operating principle of conventional semiconductor devices to understand the advanced devices.	PO1, PO2, PO5, PO6
CO3	To solve practical problems by applying he knowledge of physics of semiconductor devices.	PO1, PO3, PO4, PO6
CO4	Acquire fundamental knowledge about semiconductor device design and fabrication technology.	PO2, PO3, PO4, PO6, PO11, PO12

DETAILED SYLLABUS:

Module No. 1	**Basics of Semiconductor and Energy bands**	**08 Hours**
Formation of energy bands, Metals, Semiconductors, & Insulators, k-space, Density of State, Fermi-Dirac distribution, Fermi Energy level, Electron and hole concentration of Intrinsic and Extrinsic Semiconductors, Variation of Fermi level with doping concentration and temperature, Compensated semiconductor.		

Module No. 2	**Carrier Transport in Semiconductors**	**08 Hours**
Carrier Concentration and Mobility, diffusion and drift of carriers, mechanism of carrier scattering, Einstein relation, continuity equation, Injected minority charge carrier, Recombination and generation of charge carriers		

Module No. 3	**P- N Junction**	**10 Hours**
Basic fabrication technology, Energy band diagram, Built-in potential, Depletion layer model: charge, field and potential profiles in p-n junctions, diode equation and diode characteristics, Junction Breakdown, Metal–Semiconductor junction (Schottky and Ohmic contact).		

Module No. 4	**Bipolar Junction Transistor**	**08 Hours**
Basic fabrication technology of a BJT, Modes of operation; Minority Carrier distribution, current gain factors, Base width Modulation, Breakdown mechanism.		

Module No. 5	**MOSFET**	**06 Hours**
Basic fabrication technology, MOS capacitor operation with band diagram, Flatband and threshold voltage, Frequency effect, Basic operation of Enhancement & Depletion mode MOSFET.		

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4^{th}	
Subject Name	Introduction to Python Programming	
Course Type	Theory	
Course Code	22EC4PE03T	
Category	PEC (Professional Elective Courses)	
Credit Point	3	
Time Commitment	Lecture	36 Hours
	Tutorial	10 Hours
	Practice	Nil
	Total	46 Hours
Recommended Background Knowledge	Basics programming languages	
Subject Description	Python is a high-level general purpose programming language where code is easy to understand with simple syntax, making it accessible to beginners and experienced developers alike. Python's simplicity enables faster development, easier maintenance, and collaboration among team members. Python has been used to great effect in web development, enterprise applications, software development, task automation, data analytics, machine learning, data science, data engineering, IOT and even machine learning and artificial intelligence. Many top businesses and software companies depend on Python including Facebook, Google, Netflix, Instagram, and others. Python is relatively easy to learn, so it has been adopted by many non-programmers, such as accountants and scientists, for a variety of everyday tasks, like organizing finances. It is considered one of the hottest skills and the most popular programming language in the world. Python Developers are in great demand because of their diverse skill set. This course introduces the students with the Python environment and basic features of Python. The students will be able to write basic programs using the data structures such as string, tuples, list, set and	

<table>
<tr><td></td><td colspan="2">dictionary and conditional and looping constructs. Also, this course will enable the students to familiarize with the object oriented concepts in Python and create executable codes.</td></tr>
<tr><td rowspan="2">Objectives

and

Outcomes</td><td colspan="2">Objectives:

The course should enable the students to:

1. Understand the features, application areas and scope of Python programming Language.
2. Learn the syntax and semantics, data structures and operators in Python.
3. Comprehend the Python strings manipulation and learn the use of flow control in Python program.
4. Use Python functions to solve problems and use OOPs feature in writing Python programs.</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Learn and utilize various data types and operators in Python.
2. Evaluate the complex data using Python lists, tuples, sets and dictionaries and use the flow control mechanism for solving problems.
3. Manipulate the Python strings and search for pattern using regular expressions.
4. Develop and execute simple Python programs using procedural oriented and OOPs feature of Python.</td></tr>
<tr><td rowspan="9">Assessment/ Evaluation</td><td>Mid-Term Examination</td><td>30 %</td></tr>
<tr><td>Quiz Test-1</td><td>2.5 %</td></tr>
<tr><td>Quiz-Test-2</td><td>2.5 %</td></tr>
<tr><td>Surprise Test</td><td>5 %</td></tr>
<tr><td>Assignment-1</td><td>2.5 %</td></tr>
<tr><td>Assignment-2</td><td>2.5 %</td></tr>
<tr><td>Attendance</td><td>5 %</td></tr>
<tr><td>End-Term Examination</td><td>50 %</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">Python programming, Reema Thareja, Oxford publications.</td></tr>
</table>

Reference Book(s)	1. Kenneth Lambert, "Fundamentals of Python: First Programs", Cengage Learning, 2019 2. Martin C Brown, "The Complete Reference with Python", McGrawHill, 2018. 3. John Zelle, Python Programming: An introduction to Computer Science, Franklin Associates, Third Edition, 2016. 4. Mark Lutz, "Learning Python", Fifth edition, O'Reilly, 2013. 5. R.G. Dromey, "How to Solve it by Computer", Pearson, 1982.
Digital Learning Resources	

Course Name	Programming Data Structures and Algorithm in Python
Course Link	https://nptel.ac.in/courses/106/106/106106145/
Course Instructor	Prof. Madhavan Mukund, Chennai Mathematical Institute

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Learn and utilize various data types and operators in Python.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO2	Evaluate the complex data using Python lists, tuples, sets and dictionaries and use the flow control mechanism for solving problems.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO3	Manipulate the Python strings and search for pattern using regular expressions.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.
CO4	Develop and execute simple Python programs using procedural oriented and OOPs feature of Python.	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10, PO11, PO12, PEO1, PEO2.

DETAILED SYLLABUS:

Module No. 1	Introduction and Basics of Python Programming	08 Hours
Introduction, Salient features of Python and its application Areas, Literal constants, Identifiers, Keywords (Reserve words), Comments, Indentation, Primitive data types – int, float, bool, complex, str, Type casting, Input operation (Real time / Run time input).		

Module No. 2	Python Data Structures and Operators	10 Hours
Data structures: Lists, Tuples, Sets and Dictionaries to represent complex data, Built-in functions and methods of data structures, List vs Tuple vs Set vs Dictionary. Operators: Arithmetic, Relational, Assignment, Bitwise, Shift, Logical, Membership, Identity; Operators precedence and associativity, Expressions.		

Module No. 3	Python Strings and Regular Expressions	10 Hours
Python strings: Concatenation, Appending and multiplying strings, Slice operation, String formatting operators, Built-in string methods and functions, ord() and chr() functions, in and not in operators, Comparing strings, String module, Regular expressions: match(), search(), sub(), findall(), finditer() functions, Application of regular expressions for pattern matching.		

Module No. 4	Decision Control Statements	08 Hours
Flow control: Conditional statements (if, if-else, if-elif-else, nested if statements); Iterative statements (for loop, while loop), Transfer statements (break, continue, pass statements). Functions: Function definition, Function call, Return statement, Variable scope and lifetime, User defined functions. Modules: import statement, dir() function.		

Module No. 5	OOPs using Python	10 Hours

Defining class, creating objects, self argument, _ _init_ _() method, class variable and object variable, _ _del_ _() method, class methods, static methods.

Accessing attributes, Buit-in functions to Get, Set and Delete class attributes.

Operator overloading, Implementing operator overloading, Implementing simple programs using scripting and OOPs feature in Python.

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4^{th}	
Subject Name	Digital Electronic Circuits Laboratory	
Course Type	Laboratory	
Course Code	22EC4ES01L	
Category	ESC (Engineering Science Courses)	
Credit Point	1	
Time Commitment	Lecture	05 Hours
	Tutorial	Nil
	Practice	20 Hours
	Total	25 Hours
Recommended Background Knowledge/Course Pre-requisites	Knowledge of basics of digital electronics and digital IC	
Subject Description	There is a notable increase in the use of the word 'digital' for products and services that are becoming part of our everyday life. Examples are digital camera, digital watch, digital weighing machine, digital signature, digital payment, digital art and so on. Digital Electronics Lab is helpful for the students to acquire the basic knowledge of digital logic gates and its application to design digital electronics circuits. This course will help students to perform the design, analysis and trouble shoot the various combinational and sequential circuits.	

<table>
<tr><td rowspan="2">Objectives
and
Outcomes</td><td colspan="2">Objectives:
The course should enable the students to:
1. Understand the uses of basic digital ICs.
2. Comprehend the basic building blocks of combinational and sequential logic circuits.
3. Design and test various combinational circuits.
4. Implement and troubleshoot different sequential circuits.</td></tr>
<tr><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:
1. Apply the knowledge of various logic gate ICs in design of logic circuits.
2. Design and analyze various combinational circuits.
3. Implement and test different sequential circuits.
4. Understand the basic requirements for a system design and a cost-effective solution.</td></tr>
<tr><td rowspan="7">Assessment/
Evaluation</td><td>Lab Experiments</td><td>20%</td></tr>
<tr><td>Record Writing</td><td>10%</td></tr>
<tr><td>Behavior/ Attitude</td><td>05%</td></tr>
<tr><td>Quiz</td><td>10%</td></tr>
<tr><td>Attendance</td><td>05%</td></tr>
<tr><td>Final Lab Test</td><td>30%</td></tr>
<tr><td>Final Viva/ Final Lab Quiz Test</td><td>20%</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. M. Morris Mano, Michael D Ciletti, Digital Design, 5th Edition, Pearson Publication, 2016, New Delhi</td></tr>
</table>

Digital Learning Resources	<table><tr><td>Course Name</td><td>Digital Electronic Circuits Laboratory</td></tr><tr><td>Course Link</td><td>https://nptel.ac.in/courses/117106086/</td></tr><tr><td>Course Instructor</td><td>Prof. S. Srinivasan, Department of Electrical Engineering, IIT Madras.</td></tr></table> <table><tr><td>Course Name</td><td>Digital Electronic Circuits Laboratory</td></tr><tr><td>Course Link</td><td>https://nptel.ac.in/courses/117103064/</td></tr><tr><td>Course Instructor</td><td>Prof. Anil Mahanta, Prof. Roy Paily Palanthinkal, IIT Guwahati</td></tr></table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Apply the knowledge of various logic gate ICs in design of logic circuits.	PO1, PO2, PO3, PO4, PO5
CO2	Design and analyze various combinational circuits.	PO1, PO2, PO3, PO5
CO3	Implement and test different sequential circuits.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Understand the basic requirements for a system design and a cost- effective solution.	PO1, PO2, PO3, PO4, PO5, PO6

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Duration in Hrs
1	Digital Logic Gates: Investigate logic behavior of AND, OR, NAND, NOR, EX-OR, and Inverter gates.	2
2	Gate-level minimization: Two level and multi-level implementation of Boolean functions.	2
3	Design and Testing of combinational circuits: Half-Adder, Half-Subtraction, and Full Adder.	2
4	Design of binary to Gray, Gray to Binary Code Converter, and Seven Segment Display Decoder.	2
5	Design and implementation of 2-bit Binary Multiplier.	2
6	Testing of Multiplexer and function implementation using suitable Multiplexer.	2
7	Testing of Decoder and function implementation using suitable Decoder.	2
8	Testing of basic SR Latch and FFs: D-FF, JK-FF.	2
9	Design and Testing of SISO, SIPO Shift Registers.	2
10	Design and testing of 3-bit binary Asynchronous UP-Counter and Modulo-6 counter.	2

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4th	
Subject Name	Analog Communication Technique Lab	
Course Type	Laboratory	
Course Code	22EC4PC01L	
Category	PCC	
Credit Point	1	
Time Commitment	Lecture	10 Hours
	Tutorial	Nil
	Practice	20 Hours
	Total	30 Hours
Recommended Background Knowledge/Course Pre-requisites	Signal generation and measurements with function generator and CRO.. Basics of Matlab	
Subject Description	Modulation is a process in which a low-frequency continuous time signal is converted to a high frequency signal so that the signal can be transmitted over long distance. This lab demonstrates various modulation and demodulation techniques used for analog signals. Sampling technique is used to convert analog signal into digital form. Various pulse modulation techniques are also used for converting analog signals into pulse form.	
Objectives	**Objectives:**	

<table>
<tr><td>and

Outcomes</td><td colspan="2">The course should enable the students to:

1. Demonstrate the generation and reception of amplitude or angle modulated signals
2. Understand the use of sampling process in analog pulse modulation techniques
3. Learn the basic capabilities of MATLAB and Simulink for modeling and simulation of analog communication systems.
4. Demonstrate modulators and demodulators circuits for analog modulation techniques.</td></tr>
<tr><td></td><td colspan="2">Outcomes:
Upon completion of this course, the student will be able to:

1. Design and analyze modulator and demodulator circuits for different analog modulation techniques.
2. Demonstrate transmission of analog signals through pulse modulation techniques.
3. Apply sampling and multiplexing techniques on analog signal.
4. Design and analyze of various analog modulation techniques using computer simulations</td></tr>
<tr><td rowspan="7">Assessment/ Evaluation</td><td>Lab Experiments</td><td>20%</td></tr>
<tr><td>Record Writing</td><td>10%</td></tr>
<tr><td>Behavior/ Attitude</td><td>05%</td></tr>
<tr><td>Quiz</td><td>10%</td></tr>
<tr><td>Attendance</td><td>05%</td></tr>
<tr><td>Final Lab Test</td><td>30%</td></tr>
<tr><td>Final Viva/ Final Lab Quiz Test</td><td>20%</td></tr>
<tr><td>Prescribed Text Book(s)</td><td colspan="2">1. H. Taub, D. L Schilling, G. Saha, Principles of Communication System, 4th Edition, McGraw Hill, 2013, India.</td></tr>
</table>

Digital Learning Resources	Course Name	Analog Communication
	Course Link	https://nptel.ac.in/courses/117105143
	Course Instructor	Prof. Goutam Das, Department of ECE, IIT Kharagpur

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Design and analyze modulator and demodulator circuits for different analog modulation techniques.	PO1, PO2, PO3, PO4, PO5, PO12
CO2	Demonstrate transmission of analog signals through pulse modulation techniques.	PO1, PO2, PO3, PO4, PO5
CO3	Apply sampling and multiplexing techniques on analog signal.	PO1, PO2, PO3, PO4, PO5
CO4	Design and analyze of various analog modulation techniques using computer simulations	PO1, PO2, PO3, PO4, PO5

DETAILED SYLLABUS (EXPERIMENTS):

Minimum 10 Experiments to be performed from the list.

Sl. No.	Name of Experiments	Durations
1	Design and analysis of Amplitude modulation and demodulation technique.	
2	Generation and reception of DSB-SC signal and analyze its various parameters.	
3	Generation and reception of SSB AM signal and analyze its various parameters.	

4	Design, analysis and comparison of NBFM and WBFM.	
5	Spectrum analysis of various modulated signal with spectrum analyzer.	
6	Implement and analyze Frequency division multiplexing and de-multiplexing.	
7	Verify Sampling theorem by performing sampling and reconstruction of signals.	
8	Examine the process of pulse modulation in PAM, PPM and PWM signals.	
9	Analyze the process of quantization and encoding in PCM.	
10	Design and analysis of Pre-emphasis and De-emphasis circuits if FM system to increase SNR.	
11	Using MATLAB simulate modulation and demodulation techniques mentioned in Ex-1, Ex-2, Ex-3, Ex-4, Ex-8, and Ex-9. Verify the process of modulation and demodulation and analyze frequency spectrum of the signal after modulation and demodulation.	
12	Circuit design of (i) AM modulator(Transistor based Modulator and Bridge modulator for DSB-C and DSB-SC) (ii) FM receiver	

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4^{th}	
Subject Name	Control System Engineering Lab	
Course Type	Laboratory	
Course Code	22EC4PC02L	
Category	ESC (Engineering Science Courses)	
Credit Point	1	
Time Commitment	Lecture	05 Hours
	Tutorial	Nil
	Practice	20 Hours
	Total	25 Hours
Recommended Background Knowledge/Course Pre-requisites	Knowledge of basics of Control System Engineering	
Subject Description	The Control Engineering Laboratory aids undergraduate students in improving their comprehension of real-world system control processes. The B.Tech. (ECE/ELC) Program introduces the full laboratory course to teach students about creating mathematical models of physical systems, examining linear system behavior for stability, and further enabling them to comprehend fundamental control design techniques to meet desired performance requirements in industrial automation.	
Objectives	**Objectives:**	

and **Outcomes**	The course should enable the students to: 1. Learn time response analysis and determine the time domain specifications. 2. Realize the necessity of PID Controller in various control systems 3. Understand compensators and its effect on stability of the given system 4. Determine the time response and stability analysis with MATLAB	
	Outcomes: Upon completion of this course, the student will be able to: 1. Determine the time domain specifications of the given system 2. Understand the importance of PID technique for a control system. 3. Design the Lead, Lag compensator for the given system. 4. Design the time response and stability analysis using MATLAB.	
Assessment/ Evaluation	Lab Experiments	20%
	Record Writing	10%
	Behavior/ Attitude	05%
	Quiz	10%
	Attendance	05%
	Final Lab Test	30%
	Final Viva/ Final Lab Quiz Test	20%
Prescribed Text Book(s)	M. Morris Mano, Michael D Ciletti, *Digital Design*, 5th Edition, Pearson Publication, 2016, New Delhi	
Digital Learning Resources		

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Determine the time domain specifications of the given system	PO1,PO2,PO3,PO4,PO7
CO2	Understand the importance of PID technique for a control system.	PO1,PO2,PO3,PO4
CO3	Design the Lead, Lag compensator for the given system.	PO1,PO2,PO3,PO4,PO9,PO10
CO4	Design the time response and stability analysis using MATLAB.	PO1,PO2,PO3,PO4,PO5,PO9

DETAILED SYLLABUS (EXPERIMENTS):

Select any 6 experiments from Control, 2 experiments from instrumentation and 2 from MATLAB from the list of 12 experiments.

Sl. No.	Name of Experiments	Duration in Hrs
	CONTROL:	
1	Study of a dc motor driven position control system	2
2	Study of speed torque characteristics of two phase ac servomotor and determination of its transfer function	2
3	Obtain the frequency response of a lag and lead compensator	2
4	To observe the time response of a second order process with P, PI and PID control and apply PID control to servomotor	2
5	Testing of basic SR Latch and FFs: D-FF, JK-FF.	2

6	Design and Testing of SISO, SIPO Shift Registers.	2
7	Design and testing of 3-bit binary Asynchronous UP-Counter and Modulo-6 counter.	2
	INSTRUMENTATION:	
1	To plot the displacement-voltage characteristics of the given LVDT	2
2	Measurement of temperature-voltage characteristics of J-type thermocouple	
3	3. Use a strain gauge to plot the curve between strain applied to a beam and the outputvoltage	2
4	Study of resistance-voltage characteristics of Thermistors	2
	MATLAB	
1	Determine the time domain specifications of the given system	2
2	Understand the importance of PID technique for a control system.	2
3	Design the Lead, Lag compensator for the given system.	2
4	Design the time response and stability analysis using MATLAB.	2

COURSE DESCRIPTION:

Degree	B. Tech.	
Level	Undergraduate	
Branch	ECE (Electronics and Communication Engineering)	
Semester	4^{th}	
Subject Name	Product Development Laboratory	
Course Type	Laboratory	
Course Code	22EC4PC03L	
Category	ESC (Engineering Science Courses)	
Credit Point	1	
Time Commitment	Lecture	10 Hours
	Tutorial	Nil
	Practice	20 Hours
	Total	30 Hours
Recommended Background Knowledge/Course Pre-requisites	Digital electronics, Microprocessor/Microcontroller, and C-Programming.	
Subject Description	This subject aims at hardware design and simulation and testing of electronic circuits. Under this lab, student has to collect the information about different sensors and embedded boards available in the market and their specifications. Student will be able to collect data from remote location with the help of sensors using some communication protocols. In the process, student will get detailed knowledge on Arduino IDE software platform, Arduino UNO embedded board, and NodeMCU ESP32 IoT controller board with its application in real world. Through this subject student will get overall idea about different electronics components, sensors, embedded boards, data communication protocols, and their applications. Also, this course helps to develop an electronic hardware project to solve a real time issues.	
	Objectives:	

<table>
<tr><td>Objectives
and
Outcomes</td><td>The course should enable the students to:
1. Acquire knowledge on different sensors and embedded boards.
2. Realize the embedded C-programming application in project design.
3. Interpret and analyze collected data through sensors.
4. Explain the control of remote appliances.</td></tr>
<tr><td></td><td>Outcomes:
Upon completion of this course, the student will be able to:
1. Develop knowledge on sensor interfacing with processor.
2. Create the process of hardware-software co-simulation.
3. Analyze the different results generated through sensors.
4. Apply the subject knowledge to control appliances remotely.</td></tr>
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<tr><td>Final Viva/ Final Lab Quiz Test</td><td>20%</td></tr>
</table></td></tr>
<tr><td>Prescribed Text Book(s)</td><td>Ryan Turner,Arduino Programming, 1st Edition, Nelly B.L. International Consulting Ltd, 2019</td></tr>
<tr><td>Digital Learning Resources</td><td><table>
<tr><td>Course Name</td><td>Product Development Laboratory</td></tr>
<tr><td>Course Link</td><td>ESP32 Tutorials by ADEL KASSAH
https://www.youtube.com/watch?v=_0eHPrRC8oc&list=PLfPtpZzK2Z_QO8snrdnRTTNtQvLw35Zfc&index=1</td></tr>
<tr><td>Course Instructor</td><td>ADEL KASSAH, International Trainer, Tunisia</td></tr>
</table></td></tr>
</table>

CO's Mapping with PO's and PEO's

Course Outcomes	Course Outcome Statement	PO's / PEO's
CO1	Develop knowledge on sensor interfacing with processor.	PO2, PO3, PO4, PO5
CO2	Create the process of hardware-software co-simulation.	PO1, PO2, PO3, PO5, PO12
CO3	Analyze the different results generated through sensors.	PO5, PO6,PO8, PO12
CO4	Apply the subject knowledge to control appliances remotely.	PO7, PO9, PO10, PO11, PO12,

DETAILED SYLLABUS (EXPERIMENTS):

Sl. No.	Name of Experiments	Durations
1	Introduction to Arduino IDE Software.	2 Hours
2	Study on Hardware boards support by Arduino IDE.	2 Hours
3	Arduino UNO Hardware Board Specification and GPIO interfaces.	2 Hours
4	Write a program and implement on Arduino UNO to blink a LED.	2 Hours

5	Write a program and implement on Arduino UNO to control a LED using a push button switch.	2 Hours
6	Introduction to Node MCU ESP32 controller board.	2 Hours
7	Interface DHT11 sensor to measure temperature and humidity using Node MCU ESP32.	2 Hours
8	Interface ESP32 with Thing Speak cloud and send DHT11 sensor data to cloud.	2 Hours
9	Control a DC motor at node side after data analysis from the cloud data base using a gadget.	2 Hours
10	Develop an embedded C program to control two wheels of a robot using an embedded board.	2 Hours
11	Mini Project	10 Hours