Curriculum for Dual Degree

B.Tech in Electronics and Communication Engineering and M.Tech in Microelectronics and VLSI Systems

From The Academic Year 2025

(Approved in Senate 61)

Indian Institute of Information Technology Design and Manufacturing, Kancheepuram

Chennai-600 127

Semester 1					
Category	**Course Name**	**L**	**T**	**P**	**C**
BSC	Calculus	3	1	0	4
BSC	Physics for Engineers	3	0	2	4
BEC	Basic Electrical Engineering	3	1	0	4
ITC	Problem Solving and Programming	3	0	2	4
DSC	Concepts in Engineering Design	2	0	2	3
BEC	Engineering Skills Lab	0	0	2	1
HMC	Effective Language and Communication Skills	1	0	2	2
HMC	NSO/NCC/SSG/NSS/YOGA	0	0	2	P/F
					22.0
Semester 2					
Category	**Course Name**	**L**	**T**	**P**	**C**
BSC	Differential Equations	3	1	0	4
SEC	Dept. Specific Science Elective I	3	0	0	3
BEC	Engineering Graphics and Modeling	1	1	2	3
ITC	Data Structures and Algorithms	3	0	2	4
DSC	Design Realization	2	0	2	3
PCC	Network Analysis and Synthesis	3	1	0	4
HMC	Earth, Environment and Design	1	0	0	P/F
					21.0
Semester 3					
Category	**Course Name**	**L**	**T**	**P**	**C**
SEC	Dept. Specific Science Elective II (Linear Algebra)	3	0	0	3
ITC	Introduction to AI with Python	2	0	2	3
PCC	Electronic Devices and Circuits	3	1	0	4
PDC	Digital Circuit Design	3	1	0	4
PCC	Signals and Systems	3	1	0	4
PDC	Digital Circuit Design Lab	0	1	2	2
PCC	Electronic Devices and Circuits Lab	0	1	2	2
HMC	Indian Constitution and Essence of Indian Traditional Knowledge	1	0	0	P/F
					22.0
Semester 4					
Category	**Course Name**	**L**	**T**	**P**	**C**
SEC	Dept. Specific Science Elective III (Probability and Statistics)	3	0	0	3
ITC	Data Science for Electronics Engineers	2	0	2	3
PCC	Digital Signal Processing	3	1	0	4
PDC	Analog Circuit Design	3	1	0	4
PCC	Engineering Electromagnetics	3	1	0	4
PDC	Microprocessors and Embedded System Design	2	1	2	4
PDC	Analog Circuit Design Practice	0	1	2	2
HMC	Human Values and Stress Management	1	0	0	P / F
					24.0

Semester 5					
Category	**Course Name**	**L**	**T**	**P**	**C**
HMC	Entrepreneurship and Management Functions	1	0	2	2
PCC	Control Systems	3	1	0	4
PCC	Communication Systems	3	1	0	4
PDC	Antenna Theory and Design	3	0	2	4
PCC	Digital Signal Processing Lab	0	1	2	2
PEC	Program Elective 1	3	1	0	3
HMC	Professional Ethics and Organizational Behaviour	1	0	0	P/F
					19.0
Semester 6					
Category	**Course Name**	**L**	**T**	**P**	**C**
PCD	Product Design and Prototyping	0	0	2	1
PCC	Digital Communication	3	1	0	4
PCC	RF and Microwave Engineering	3	0	2	4
PDC	VLSI Design	3	0	2	4
PCC	Communication Systems Lab	0	1	2	2
PEC	Program Elective 2	3	1	0	3
ELC	Open Elective 1	3	0	0	3
HMC	Professional Communication	1	0	2	2
HMC	Intellectual Property Rights	1	0	0	P/F
					23.0
	Summer				
PCD	**Summer Internship MID MAY to MID JULY**				**P/F**
Semester 7					
Category	**Course Name**	**L**	**T**	**P**	**C**
PCC	MOS Modeling for VLSI Circuits	3	1	0	4
PCC	VLSI System Design	3	1	0	4
PCC	VLSI Testing and Testable Design	2	0	4	4
PCC	Device Modeling and Simulation Lab	0	1	2	2
PEC	Programme Elective Course 1	3	1	0	4
PEC	Programme Elective Course 2	3	1	0	4
					22
Semester 8					
Category	Course Name	L	T	P	C
PCC	CMOS Analog VLSI Design	3	1	0	4
PCC	High Level Verification with UVM	2	0	4	4
PCC	IC Fabrication	2	0	4	4
PCC	CMOS VLSI Design Lab	0	0	4	2
PEC	Programme Elective Course 3	3	1	0	4
PEC	Programme Elective Course 4	3	1	0	4
					22
	Summer				
PCD	M Tech Dissertation (MTD) Phase I	0	0	8	4
					4
	Semester 9				
Category	Course Name	L	T	P	C

PCD	Comprehensive Exam				P/F
PCD	M Tech Dissertation (MTD) Phase II	0	0	24	12
					12
	Semester 10				
Category	Course Name	L	T	P	**C**
PCD	M Tech Dissertation (MTD) Phase III	0	0	28	14
					14
	TOTAL CREDITS				**205**

Semester wise Credit Distribution	Credits												
Category	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**Summer**	**S9**	**S10**	**Total**	**%**
Basic Science Course (BSC)	8	4	0	0	0	0	0	0	0	0	0	12	5.9
Science Elective Course (SEC)	0	3	3	3	0	0	0	0	0	0	0	9	4.4
Basic Engineering Course (BEC)	5	3	0	0	0	0	0	0	0	0	0	8	3.9
Design Course (DSC)	3	3	0	0	0	0	0	0	0	0	0	6	2.9
IT Skill Course (ITC)	4	4	3	3	0	0	0	0	0	0	0	14	6.8
Program Core Course (PCC)	0	4	10	8	10	8	14	14	0	0	0	68	33.2
Program Design Course(PDC)	0	0	6	10	4	4	0	0	0	0	0	24	11.7
Program Elective Course (PEC)	0	0	0	0	0	0	8	8	0	0	0	16	7.8
Open Elective Course (ELC)	0	0	0	0	3	6	0	0	0	0	0	9	4.4
Humanities and Management Course (HMC)	2	0	0	0	2	2	0	0	0	0	0	6	2.9
Professional Career Development (PCD)	0	0	0	0	0	1	0	0	4	12	14	31	15.1
Total	**22**	**21**	**22**	**24**	**19**	**23**	**22**	**22**	**4**	**12**	**14**	**205**	**100.0**
	22	**43**	**65**	**89**	**108**	**131**	**153**	**175**	**179**	**191**	**205**	**205**	

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COURSE FORMAT

Course Code		Course Name	Calculus			
Offered by the Department	SH-Mathematics	Structure (LTPC)	3	1	0	4
To be offered for	B Tech	Course type	Core			
Pre-requisite	NIL	Approved In	Senate 61			
Learning Objectives	The course will introduce the students to basic concepts in Calculus, such as convergence, differentiation & integration, and their applications.					
Contents of the Course	➢ Limit and Continuity of functions defined on intervals, Intermediate Value Theorem, Differentiability, Rolle's Theorem, Mean Value Theorem, and Taylor's Formula (5L+2P) ➢ Sequences and series (7L+2P) ➢ Definite integral as the limit of sum, Mean value theorem, Fundamental theorem of integral calculus, and its applications (9L+3P) ➢ Functions of several variables, Limit and Continuity, Geometric representation of partial and total derivatives, Derivatives of composite functions (8L+3P) ➢ Directional derivatives, Gradient, Lagrange multipliers, Optimization problems (7L+2P) ➢ Multiple integrals: Evaluation of line and surface integrals (6L+2P)					
Essential Reading	1. Thomas G B. and Finney R. L., Calculus, Pearson Education, 2007					
Supplementary Reading	1. Piskunov N., Differential and Integral Calculus, Vol. I & II, Mir Publishers, 1981 2. Kreyszig E., Advanced Engineering Mathematics, Wiley Eastern, 2007. 3. Hass J., Weir M. D., Giordano F. R., Thomas Calculus, 11th Edition, Pearson.					

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Physics for Engineers</td></tr>
<tr><td>Dept./ Specialization</td><td>SH -Physics</td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td>To be offered for</td><td>B. Tech. and DD</td><td>Status</td><td colspan="2">Core ☑</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Faculty Proposing the course</td><td>SH - Physics</td><td>Type</td><td colspan="2">New ☑</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>None</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate-61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">To learn about
• Transformation of three dimensional coordinate systems for scalar and vector fields
• Concepts of gradient, divergence and curl in the context of scalar and vector fields.
• Theories of electrostatics, magnetostatics, magnetism with hands on experience experiments.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the student should be able to
• Visualize the three dimensional coordinates transformation of vectors and curved surfaces
• Describe physical meaning of gradient, divergence and curl for practical purposes
• Explain knowledge of electrostatics, magnetostatics and magnetism</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">• Vectors-an introduction; Unit vectors in Cartesian, spherical, and cylindrical polar co-ordinates; Transformation of coordinate systems, line, surface, and volume integrals, Concept of scalar and vector fields; Gradient of a scalar field; Directional derivative, Equipotential surfaces, Conservative vector fields and their potential functions-gravitational and electrostatic examples. (9L)
• Flux, divergence of a vector, Gauss's theorem, Continuity equation; Curl– rotational and irrational vector fields, Stoke's theorem. Conservation principles for matter, energy, and electrical charge, physical applications in gravitation and electrostatics. Irrotational versus rotational vector fields. (8L)
• Electrostatics: Electrostatic potential and field due to discrete and continuous charge distributions, boundary condition, Energy for a charge distribution, Conductors and capacitors, Laplace's equation Image problem, Dielectric polarization, Electric displacement vector, Dielectric susceptibility, Energy in dielectric systems. (12L)
• Magneto statics: Lorentz force law, Bio-Savart's law and Ampere's law in magneto statics, Divergence and curl of B, Magnetic induction due to configurations of current-carrying conductors, Magnetization and bound currents, Energy density in a magnetic field, Magnetic permeability and susceptibility, Boundary conditions. (13 L)
Practice components will cover the experiments on electrostatics and magneto statics viz. Electrostatic field, dielectric polarization, Electric Permittivity, capacitance, electric conductivity, Biot Savart law, Magnetic field, Magnetic permeability, Helmholtz Coil, Magnetization, Hysteresis, Faraday's law etc. (28 P)</td></tr>
<tr><td>Text Book</td><td colspan="6">1. David J. Griffiths, Introduction to Electrodynamics, 4th Edition, Pearson, 2015, ISBN – 13: 978-9332550445
2. Bhag Singh Guru, Huseyin R. Hiziroglu, Electromagnetic field Theory, 2nd Edition, Cambridge University Press, 2009; ISBN-13 : 978-0521116022</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. W. H. Hayt, J. A. Buck and M. Jaleel Akhtar, Engineering Electromagnetics, McGraw Hill (India) Education Pvt. Ltd, Special Indian Edition 2020.
2. G. B. Arfken, H. J. Weber and F. E. Harris, Mathematical Methods for Physicists, Academic Press, 7th Edition, 2013, ISBN-13: 978-9381269558</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Basic Electrical Engineering</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="3">To be offered for</td><td rowspan="3">B.Tech & DD (All Branches)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">● To impart foundational knowledge on the construction, operation, and analysis of basic electrical and electronic circuits.
● To develop the ability to systematically analyze DC and AC circuits for practical engineering applications.
● To introduce students to fundamental electrical machines and their relevance in industrial and consumer contexts.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to
• Represent and interpret basic electrical systems using standard technical conventions.
• Analyze and solve linear electric circuits (both DC and AC) with single or multiple power sources in the time domain.
• Understand the fundamentals of electronic components and circuits.
• Understand the construction, operation, and applications of electrical machines commonly used in industry.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Basics of Electricity: Systems of units - charge and current, voltage, power and energy, electricity tariff, circuit elements - sources and passive elements (R,L,C), Overview of power system (4L+1T)

DC Circuits: Basic laws and circuit analysis - Ohm's law, Kirchhoff's laws, voltage and current division, Wye-Delta transformations, Nodal and Mesh analysis with independent sources (6L+3T).

Circuit theorems (with independent sources) - Linearity property, Superposition, source transformation, Thevenin's theorem, Norton's theorem, maximum power transfer theorem (5L+3T)

AC Circuits: Sinusoids and phasors – phasor relationships, Impedance and Admittance; sinusoidal steady-state analysis – Nodal and mess analysis, theorems; AC power analysis- Instantaneous and average power, RMS, apparent and PF, complex power (10L+4T)

Electrical Machines: Transformers – principle of operation, types, EMF equation, equivalent circuit, Losses and efficiency calculation, Dot convention (4L+1T)

DC Machines - principle of operation, emf and torque equation, types, characteristics and speed control of DC motors (4L+1T).

AC Induction Machines- operating principles, equivalent circuits, torque-speed characteristics, speed control, efficiency (4L+1T)

Electronic Circuits: Operational Amplifiers - Ideal op-amp, inverting and noninverting amplifier, Applications of Op-Amp (2L+1T)</td></tr>
</table>

	Diodes - V-I characteristics and their applications (2L)
Text Books	1. Alexander C. and Sadiku M. N. O., Fundamentals of Electric Circuits, 7th Edition, Tata McGraw-Hill, New Delhi, ISBN: 9781260226409, 2013. 2. A.E. Fitzgerald and Charles Kingsley, 'Electric Machinery', Tata McGraw-Hill Education Publications, 6th Edition, 2002.
Reference Books	1. Hughes, 'Electrical and Electronic Technology', Pearson Education India, 10th Edition, 2010. 2. W. H. Hayt and T. E. Kimmerley, Engineering Circuit Analysis, 9th Edition, TMH, ISBN: 9780073545516, 2019. 3. Joseph. A. Edminister, 'Electric Circuits - Schaum's Outline Series', McGraw-Hill Publications, 6th Edition, 2003.

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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Problem Solving and Programming</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">CSE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech, DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td>--</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The course focuses on problem solving skills / techniques. Students shall be exposed to data representations, base conversions, arithmetic in fixed and floating point representations. Sequence, selection, iterative statements and various other programming constructs in C,Python shall be discussed with case studies. The practice component of this course shall equip the students to test drive the theory concepts using appropriate case studies.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• The teaching and assessment shall ensure that given a computational problem, students can use computers as a tool to solve the problem.
• Developing pseudo codes and programs using various programming constructs are expected out of the students.
• Students will be able to develop simple applications using the various programming constructs.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Evolution of Computing Machines - Number Representation - Fixed & Floating Point - Base Conversions: Binary, Decimal, Octal, Hexa-decimal number systems and conversions. Introduction to algorithms and flow chart, Data types in C – Input and output statements – Formatted input/output – Phases of program development –Applications involving sequence statements (8L)
Operators - Arithmetic, logical, relational, shift, unary operators – Precedence and Associativity - Selection Statements: IF-ELSE, SWITCH-CASE - Programs involving sequence & selection - GOTO statements - break statement - Nested IF (6 L)
Repetition Statements - FOR, WHILE, DO WHILE - Programs involving sequence, selection & repetition - continue statement - Nested loops - Introduction to Arrays and Strings - Array manipulation - string manipulation -string operations - multi-dimensional arrays (10 L)
Functions in C – Function declaration, definition – scope -storage class-Built-in and user defined functions –Recursive functions (5 L)
Introduction to Pointers, Pointer Arithmetic, Dynamic Memory Allocation – Basic data structures using pointers, Structures and File processing, Command Line Arguments (6 L)
Introduction to Python programming: basic programming constructs, selection (IF), Looping Statements, Functions and Recursion - Examples. (7 L)
Practice Component: Introduction to text editors - basic text processing - case studies involving office software - doc and ppt creation, Introduction to Linux commands - file/directory creation - copy, move, pdf creation, zip commands -Applications using sequence statements - input/output statements - arithmetic with precedence and associativity. Case studies involving selection and repetition statements – arrays, functions, strings, recursion. Case studies involving pointers, dynamic memory allocation, structures, file processing (28P)
Note: 30% of the practice component to be done using Python</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Deitel P J and Deitel H M, C How to Program, Prentice Hall, 9th Edition, 2022, 978-0137398355.
2. Deitel P J and Deitel H M, Python for Programmers, Pearson Education, 2019, 978-0135224335.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Kernighan, Ritchie D, The C Programming Language, Prentice Hall, 2nd Edition, 2015, 978-9332549449
2. Byron S. Gottfried, Programming with C, TMH Publishers, 4th Edition, 2018, 978-9353160272
3. Donald E. Knuth, The Art of Computer Programming, 3rd Edition,2022, 978-0137935109.
4. Yashavant Kanetkar, Understanding Pointers in C& C++, BPB Publications, 5th Edition, 2019, 978-9388176378.</td></tr>
</table>

Course Code		Course Title	Concepts in Engineering Design			
Dept./Faculty proposing the course	SIDI	Structure (LTPC)	L	T	P	C
			2	0	2	3
To be offered for	B Tech/DD	Type	Core ☑		Elective ☐	
		Status	New ☑		Modification ☐	
Pre-requisite	None	Submitted for approval			Senate 61	
Learning Objectives	• To understand the engineering design process, product development cycles, and market influences on design decisions. • To transform customer needs into technical specifications using QFD and competitive benchmarking. • To assess design alternatives using structured decision frameworks.					
Learning Outcomes	• Students will formulate engineering problems by translating customer requirements into technical specifications, generate and evaluate innovative design concepts using creative thinking methodologies.					
Contents of the course *(With approximate break-up of hours for L/T/P)*	• **Introduction** - Importance of engineering design- types of design- the design process- total life cycle- regulatory and social issues-product design- types of products- phases of product development process- product and process cycles-organization for product development-markets and marketing-technological innovation (5L+5P) • **Problem definition & need identification** - Identifying customer needs- gathering information- classifying customer requirements- establishing engineering characteristics- competitive benchmarking- quality function deployment- product design specification (6L+6P) • **Conceptual design** - Creativity in design- creativity and problem solving- creative thinking methods- conceptual decomposition- morphological methods-TRIZ (Theory of Inventive Problem Solving)- Decision making and concept selection-decision theories-concept screening and concept scoring (6L+6P) • **Embodiment design** - Product architecture- steps in developing product architecture-configuration design-industrial design- human factors design- prototyping and testing (6L+6P) • **Product Economics and related issues** - Risk, reliability and safety- failure mode & effects analysis- concept of total quality- robust design- economic decision making- time value of money-profitability of investment- cost estimation-design to cost (5L+5P)					
Text Books	1. George E.Dieter & Linda C.Schmidt, Engineering Design, McGraw-Hill International Edition 5, 2013, ISBN-10 : 9355322259, ISBN-13 : 978-9355322258 2. Anita Goyal, Karl T Ulrich, Steven D Eppinger, Product Design and Development , Tata McGraw-Hill Education, 4th Edition, 2009, ISBN-10: 0070146799, ISBN-13: 978-0070146792					
Reference Books	1. Kevin Otto, Kristin Wood, Product Design, Pearson Education, Indian Reprint, 2004, ISBN-10: 0130212717, ISBN-13: 978-0130212719 2. Yousef Haik, T.M.M. Shahin, Engineering Design Process, Cengage Learning, 2nd Edition Reprint, 2010, ISBN-10: 0495668141, ISBN-13: 978-0495668145 3. Clive L. Dym, Patrick Little, Engineering Design: A Project-based Introduction, John Wiley & Sons, 3rd Edition, 2009, ISBN-10: 0470225963, ISBN-13: 978-0470225967					

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Engineering Skill Practice</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">Mechanical Engineering</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">All UG & DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td>NIL</td><td colspan="2">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objective of this course is to give an exposure on the basic practices followed in the domain of mechanical, electrical, electronics and communication engineering. The exercises will train the students to acquire skills which are very essential for the engineers through hands-on sessions.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to choose suitable process/method among the mechanical, electrical, electronics, and communication engineering concepts that can full fill the functional outcomes of the parts/prototypes/products.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Experiments will be framed to train the students in following common engineering practices:

Basic manufacturing processes: Fitting, Drilling & tapping, Material joining processes, Carpentry, Sheet-metal work, Arc Welding, 3D Printing. (10P)

Familiarization of electronic components by Nomenclature, meters, power supplies, function generators and Oscilloscope – Bread board assembling of simple circuits: IR transmitter and receiver - LED emergency lamp – Communication study: amplitude modulation and demodulation. (6P)

Domestic wiring practice: Fluorescent lamp connection, Staircase wiring - Estimation and costing of domestic and industrial wiring - power consumption by Incandescent, CFL and LED lamps. (2P)

Dismantle and assembly of PC. Installing OS and disk management. (4P).</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Uppal S. L., “Electrical Wiring & Estimating”, 5Edn, Khanna Publishers, 2003.
2. Chapman. W. A. J., Workshop Technology, Part 1 & 2, Taylor & Francis.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Clyde F. Coombs, “Printed circuits hand book”, 6Edn, McGraw Hill, 2007
2. John H. Watt, Terrell Croft, “American Electricians' Handbook: A Reference Book for the Practical Electrical Man”, Tata McGraw Hill, 2002.</td></tr>
</table>

Course Code		Course Name	Effective Language & Communication Skills			
Offered by Department	SH-English	Structure(LTPC)	1	0	2	2
To be offered for	B.Tech	Course Type	Core			
Prerequisite	NIL	Approved In	Senate 61			
Learning Objectives	• Hone LSRW and practice critical thinking • Enable students to speak and write grammatically acceptable sentences • Train students in technical communication • Cultivate interest to learn language and to build the confidence to communicate in English • Develop an interest in updating their language skills through continuous learning • Connecting personal growth with improvement in their proficiency in English					
Learning Outcomes	• Able to communicate effectively with grammatically acceptable constructions and appropriate words in formal and informal situations • Can extract information effectively and able to think critically • Able to present technical content confidently					
Course Contents(with approximatebreakup of hours forlecture/ tutorial/ be donepractice)	• Introduction: Language, effective communication, ethics and aesthetics of communication (L1) • Phonetics – sounds, pronunciation of words, stress, intonation, listening, Varieties of English (L3, P4) • Sentence structure, concord, punctuation, stylistic errors, common errors (L3, P4) • Reading and comprehension (L2, P5) ➢ Different types of reading, analyzing the organization of the text ➢ Critical thinking- thesis statement, argument, hypothesis, order, reason, evidence, consistency,tautology, conclusion • Exercises for vocabulary enrichment (for daily practice) • Speaking (L2, P5) ➢ Barriers to effective communication, technical presentation and presentation skills, self-introduction, ➢ Requests, enquiry, suggestion in formal and informal situations, reporting an event, grouppresentation – debate • Writing (L3, P8) ➢ Writing formal letters, email, résumé, ➢ Data interpretation, reports, product description/requirements/ technical instructions, recordingobservations ➢ The language of content strategy - voice and tone strategy - the language of localization– textanalysis tools ➢ Plagiarism – the importance of documentation, different methods of note-taking ➢ Essays/story/ book & movie reviews/writing for social media/blogging/ journaling • Life lessons through stories and activities (P2)					
Essential & Supplementary Reading	1. Tebeaux, Elizabeth, and Sam Dragga. *The Essentials of Technical Communication* OUP, 2018. 2. Rizvi, M Ashraf. *Effective Technical Communication*. McGraw-Hill, 2017 3. Hancock, Mark. *English Pronunciation in Use: Intermediate Self-study and Classroom Use*.CUP,2012. 4. Cottrell, Stella. *Critical Thinking Skills: Developing Effective Argument and Analysis*. Palgrave,2005. 5. Gower, Roger. *Grammar in Practice*. CUP, 2005. 6. Paterson, Ken. *Oxford Living Grammar*. OUP, 2014. 7. Sabin, William A. *The Gregg Reference Manual:A Manual of Style, Grammar, Usage, andFormatting.* McGraw-Hill, 2011. 8. Fitikides, T. J. *Common Mistakes in English*. London: Orient Longman, 1984.					

Leech, Geoffrey and Jan Svartvik. A Communicative Grammar of English. Routledge, 2013.
9. Astley, Peter and Lewis Lansford. *Oxford English for Careers: Engineering*. OUP, 2013.
10. Savage, Alice and Patricia Mayer. *Effective Academic Writing*. OUP, 2013
11. Harari, Yuval Noah. *Sapiens: A Brief History of Humankind*. Vintage, 2014.
12. https://www.ted.com/
13. https://www.bbc.co.uk/learningenglish/features/pronunciation/tims-pronunciation-workshop-ep-13
14. https://learnenglish.britishcouncil.org/skills/listening
15. https://www.nationalgeographic.com/podcasts/overheard
16. https://www.youtube.com/user/NatureVideoChannel
17. https://www.youtube.com/watch?v=Aj-EnsvU5Q0&list=PLcetZ6gSk969oGvAI0e4_PgVnlGbm64bp
18. https://www.merriam-webster.com/word-of-the-day
19. https://www.newyorker.com/tag/book-reviews

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COURSE FORMAT

Course Code		Course Name	Differential Equations			
Offered by the Department	SH-Mathematics	Structure (LTPC)	3	1	0	4
To be offered for	B. Tech	Course Type	Core			
Pre-requisite	NIL	Approved In	Senate 61			
Learning Objectives	To provide an exposure to the theory of ODEs & PDEs and the solution techniques.					
Contents of the course	➢ Linear ordinary differential equations with constant coefficients, method of variation of parameters, Linear systems of ordinary differential equations (10L +3P) ➢ Power series solution of ordinary differential equations, Singular Points, Frobenius series solutions, Bessel and Legendre differential equations, Properties of Bessel functions and Legendre Polynomials (12L+4P) ➢ Fourier series (6L+2P) ➢ Laplace transforms: Elementary properties of Laplace transforms, inversion by partial fractions, convolution theorem, and its applications to ordinary differential equations (6L+2P) ➢ Introduction to partial differential equations, wave equation, heat equation, and diffusion equation (8L+3P)					
Essential Readings	1. Simmons G. F., Differential Equations, Tata McGraw-Hill, 2003. 2. Kreyszig E., Advanced Engineering Mathematics, Wiley, 2007.					
Supplementary Reading	1. William E. Boyce and R. C. Diprima, Elementary Differential Equations and Boundary Value Problems, John Wiley, 8th Edition, 2004. 2. Sneddon I., Elements of Partial Differential Equations, Tata McGraw-Hill, 1972. 3. Ross L. S., Differential Equations, Wiley, 2007. 4. Trench W., Elementary Differential Equations, http://digitalcommons.trinity.edu/mono					

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Semiconductor Physics</td></tr>
<tr><td>Dept./ Specialization</td><td>SH -Physics</td><td>Structure (LTPC)</td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>To be offered for</td><td>B. Tech. and DD</td><td>Status</td><td colspan="2">Core ▬</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Faculty Proposing the course</td><td>SH Faculty</td><td>Type</td><td colspan="2">New ▬</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">The objectives of the course are to
• Introduce the physics of semiconductors, and phenomena of drift and diffusion current
• Study I-V characteristics and small-signal model of p-n junction diode
• Understand operation and biasing characteristics of BJTs, MOSFETs, and solar cells.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students would be able to
• Describe the essential physics of semiconductors, and the flow of electric current
• Explain DC and AC characteristics of p-n junction diode
• Comprehend the I-V characteristics of BJT, MOSFET and Solar cells</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Semiconductor Fundamentals and Electrical Properties: Formation of Energy Bands, Electrical Conduction in Solids, drift current, electron effective mass, concept of the hole, Density of States; Fermi-Dirac distribution function, and Fermi energy; The Semiconductor in Equilibrium: charge carriers, equilibrium distribution, intrinsic and extrinsic semiconductors, doping, Law of mass action, charge neutrality and Fermi energy levels. (L12)

Carrier Transport and Nonequilibrium Dynamics: Drift current density, mobility effects, conductivity, velocity saturation; Diffusion current density, total current density, Einstein relation, and the Hall effect; Nonequilibrium Carrier Processes– excess carrier generation, recombination mechanisms, Continuity and Diffusion Equations, and Ambipolar Transport. (L8)

p-n Junction Diodes: Basic Structure and Built-in Potential, space charge width; derivation of dc and ac characteristics, Forward and reverse biasing, p-n junction current, Small-signal Model of the p-n junction, Diode current equation, Junction breakdown, metal semiconductor junction-Schottky Barrier and Ohmic contacts. (L8)

Semiconductor Devices: Bipolar Junction Transistors (BJTs)—Fundamentals and Transistor Action (basic operation, biasing, switching, current gain, amplification); Field-Effect Transistors (FETs) - MOSFETs and MOS Capacitors (device physics, threshold voltage, current-voltage characteristics, mobility and nonideal effects), Solar Cells (L14)</td></tr>
<tr><td>Text Book</td><td colspan="6">1. Neamen, Donald A., Semiconductor Physics and Devices: Basic Principles, 4th Edition, NY: McGraw-Hill, ISBN-13: 978-9354601125, 2021.
2. M K Achuthan, K N Bhat, Fundamentals of Semiconductor Devices, ISBN-13: 978-0070612204 ISBN-10: 007061220X, 2017, McGraw-Hill Education,</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. S. M. Sze., K. K. Ng, Physics of Semiconductor Devices, 3rd Edition, United Kingdom, Wiley, ISBN: 978-0471143239, 2021.
2. B. G. Streetman and S. K. Banerjee, Solid State Electronic Devices, 7th Edition, Pearson, ISBN: 9780133356038, 2015
3. M. S. Tyagi, Introduction to Semiconductor Materials and Devices, 1st Edition, John Wiley, ISBN: 9788126518678, 2008.</td></tr>
</table>

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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Engineering Graphics and Modeling</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">Mechanical Engineering Department</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>1</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. programs of CSE, ECE and Physics</td><td>Type</td><td colspan="2">Core ☒</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☐</td><td colspan="2">Modification ☒</td></tr>
<tr><td>Pre-requisite</td><td>Nil</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the basic concepts and techniques of technical drawing
• To learn 2D and 3D representation of various shapes/objects and its engineering applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students will acquire visualization skills and will be able to prepare technical drawings and 3D models using computer aided tools</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">• Role of technical drawing in product development process, Basics of technical drawing, Standards, Dimensioning principles (L2+P2)
• Computer aided drafting (L2 + P2)
• Principles of orthographic projection. 3D drawings of objects to orthographic projection (L4+P4)
• Principles of isometric projections. 2D orthographic to isometric drawings (L4+P4)
• Introduction to 3D modelling of shapes and objects (L2+P2)
• Solid Modelling– part modelling & assembly modelling; Surface modelling; NURBS modelling (L6+P6)
• 3D modelling from physical objects (L2+P2)
• Modelling of engineering applications including electrical CAD (L2+P2)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Venugopal K and Prabhu Raja V, Engineering Drawing + AutoCAD, New Age International (P) Limited. 7th Edition, 2024 (ISBN: 9360749222)
2. Narayana. K.L, and Kannaiah. P, Engineering Drawing, Scitech Publications (India) Pvt. Ltd, 3rd Edition, 2021 (ISBN: 9789385983177)</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Bertoline G.R, Wiebe E.N, Hartman N, Ross W, Technical Graphics Communication, Mcgraw-Hill College, 2008, IRWIN Graphic Series, 2008 (9780077221300)
2. Varghese P.I, Engineering Graphics, McGraw Hill Education, 2017 (ISBN: 1259081001)
3. Bhatt. N.D, Engineering Drawing – Plane and Solid Geometry, Charotar Publishing House Pvt. Ltd., 54th Edition, 2023 (ISBN: 9789385039706)</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Data Structures and Algorithms</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">CSE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech, DD</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td>--</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Given a computational problem, the focus is on design and implementation of algorithms using suitable data structures. The notion of time and space complexity, design of efficient algorithms and data structures shall also be explored. The course also focuses on exploring role of data structure for solving problems efficiently.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to design efficient algorithms and data structures for computational problems</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">ADT- Review of elementary data structures – List, Stack, Queue– time and space complexity – step count method based computation – asymptotic analysis and bounds – big oh, little oh,omega,theta notation (5L)
Analysis using recurrence relations – solving recurrence relations through guess method, recurrence tree method, Master theorem (5L)
Analysis of sorting/searching algorithms - Incremental Design - insertion sort, decremental Design - Celebrity problem - Divide and Conquer- quicksort ,merge sort- comparison/ non-comparison based sorting algorithms on restricted inputs –counting, radix sorting - discussion on inputs with best/worst case complexities (7L)
Binary Trees - Tree representation, traversal, Introduction to expression trees: traversal vs post/pre/infix notation. Recursive traversal and other tree parameters (depth, height, number of nodes etc.) (5L)
Dictionary ADT: Binary search trees, balanced binary search trees - AVL Trees. (5L)
Hashing - collisions, open and closed hashing, properties of good hash functions. Priority queue ADT: Binary heaps with application (5L)
Data Structures in Python – Strings, Lists, Tuples, Dictionary – Examples (5L)
Graphs: Representations (Matrix and Adjacency List),basic traversal such as BFS, DFS with complexity, spanning tree (5L)
Practice Component: Elementary Data Structures, Implementation of case studies involving algorithms and data structures using C, Binary Trees–Traversal –Computation of Structural parameters, Hashing–implementation of hash functions–computing collisions– Open vs closed hashing, Sorting and Searching Algorithms, Priority Queues and Heaps and its applications, Graph Traversals–BFS, DFS and its applications (28P)
Note: 30% of the practice component to be done using Python</td></tr>
<tr><td>Text Books</td><td colspan="6">1. M.A. Weiss,Data Structures and Algorithm Analysis in C,Pearson,2nd edition,2002, 978-8131714744.
2. Deitel P J and Deitel H M, Python for Programmers, Pearson Education, 2019, 978-0135224335.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Introduction to Algorithms, Prentice Hall of India, 4th Edition, 2022, 978-0262046305.
2. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Pearson, 3rd edition, 2017, 978-9332585485.
3. Horowitz, Sahni and Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2nd Edition, 2008, 978-8173716058
4. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures and Algorithms in Python, 1st edition, 2013, 978-1118290279.</td></tr>
</table>

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Design Realisation</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">SIDI</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech/ DD</td><td>Type</td><td colspan="2">Core ☒</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New ☒</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td>Concepts in Engineering Design</td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To understand the user-centric design principles to identify and prioritize customer needs accurately.
• To generate creative design solutions using Morphological tools, SCAMPER, and TRIZ methodologies.
• To assess product concepts systematically through Pugh charts and concept scoring techniques.
• To learn visualization skills by producing freehand sketches and models for product development.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• Analyze customer needs through structured methods like interviews and Quality Function Deployment (QFD).
• Create innovative design concepts using tools like Morphological tool, SCAMPER, and TRIZ.
• Evaluate design concepts using Pugh charts for effective concept screening and scoring
• Design product architecture by applying configuration and industrial design principles.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Practical case studies using
• Customer need analysis, Indoor Customer interviews, Quality Function Deployment – House of quality (5L+5P)
• Tools for conceptual design - creative thinking methods - Morphological tool, SCAMPER, TRIZ (6L+6P)
• Embodiment design - Product architecture - steps in developing product architecture-configuration design-industrial design (6L+6P)
• Concept screening - concept scoring – Pugh chart (5L+5P)
• Realisation using free hand sketched and models (6L+6P)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. George E.Dieter & Linda C.Schmidt, Engineering Design, McGraw-Hill International Edition 5, 2013, ISBN-10 : 9355322259, ISBN-13 : 978-9355322258</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, Product Design and Development , Tata McGraw-Hill Education, 4th Edition, 2009, ISBN-10: 0070146799, ISBN-13 : 978-0070146792
2. Kevin Otto, Kristin Wood, Product Design, Pearson Education, Indian Reprint, 2004, ISBN-10: 0130212717, ISBN-13: 978-0130212719</td></tr>
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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Network Analysis and Synthesis</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">Electronics & Communication Engineering</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B. Tech & DD (ECE)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☐</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate- 61</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To build students' capability to analyze and solve network-related problems.
• To build students' capability to design networks and circuits for different applications.
• To introduce network-related concepts that can be directly related to industry applications.
• To introduce network-related concepts that can be directly related to research applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to
• Analyse and solve problems related to networks.
• Design, analyze, and synthesize networks and circuits for different applications.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">• Network theorems using dependent sources (Super Position Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Tellegen's Theorem, Millman's Theorem (6L+2T)
• Network topology and graph concepts, Circuit analysis using graph theory (5L + 1T)
• First-order and second-order circuits (9L+3T)
• Two-port networks, z, y, h, and transmission parameters, Symmetrical and reciprocal two-ports, cascading (8L+3T)
• Laplace transforms, Poles and Zeros, Solution of Circuits using Laplace Transform method, Network analysis, Network functions (8 L+2T)
• Analyses and synthesis of R-L-C networks. (2L+1T)
• Basic LC Filter, Filter synthesis, Butterworth and Chebyshev filters, and Active filters (4 L+2 T)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Van Valkenburg, Network Analysis, 3rd Edition, Pearson, ISBN: 9789353433123, 2019
2. Kuo, Franklin F, Network Analysis and Synthesis, 2nd Edition, Wiley & Sons, ISBN 10: 0471511188 / ISBN 13: 9780471511182, 2006</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Alexander C. and Sadiku M. N. O., Fundamentals of Electric Circuits, 7th Edition, Tata McGraw-Hill, New Delhi, ISBN: 9781260226409, 2013.
2. W. H. Hayt and T. E. Kimmerley, Engineering Circuit Analysis, 9th Edition, TMH, ISBN: 9780073545516, 2019.
3. Smarajit Ghosh, Network Theory Analysis and Synthesis, 8th Edition, Prentice Hall of India, New Delhi, ISBN:9332511040,2011.
4. Seshu and Balabanian, Linear Network Analysis, 1st edition, John Wiley & Sons, 1959.
5. Brian D. O. Anderson, and Sumeth Vongpanitlerd, Network Analysis and Synthesis: A Modern Systems Theory Approach, 5th Edition, Dover Publications, ISBN13:978 0486152172, 2013.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Electronic Devices and Circuits</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE/EP,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New ▬</td><td colspan="2">Modification □</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="2">Senate- 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the principles of semiconductor physics and operation of electronic devices.
• To develop understanding of PN junction diodes, BJTs, and MOSFETs in various configurations.
• To teach the analysis and design of basic analog circuits, including biasing and amplification.
• To enable students to evaluate small-signal and large-signal performance of simple electronic circuits.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of this course, the student will be able to
• Analyze and design rectifiers, clippers, clampers, and voltage regulator circuits.
• Describe BJT and MOSFET operation, characteristic curves, and biasing techniques.
• Model and evaluate single-stage BJT and MOSFET amplifiers.
• Compare performance and limitations of BJTs and MOSFETs in amplifier applications.
• Understand fundamental concepts of large-signal operation and basic transistor-level circuit design.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Semiconductor fundamentals: carrier transport, drift, diffusion 2L+1T
PN junction: operation, I-V characteristics, capacitance 2L+1T
Diode models and applications: rectifiers, limiters, clippers, clampers 5L+2T
BJT: operation, regions, I-V characteristics 3L+1T
BJT: biasing schemes, thermal stability, Q-point 5L+2T
BJT: Small-signal amplifier basics- CE, CB, CC 3L+1T
BJT: Load-line analysis and multistage overview 3L+1T
MOSFET: operation, regions, I-V characteristics 3L+1T
MOSFET: DC biasing, Q-point, threshold voltage effects 5L+2T
MOSFET: Small-signal models and CS amplifier fundamentals, load line 3L+1T
Comparison of BJT and MOS amplifier characteristics and
Basic Diode and transistor-level design case studies (Voltage multipliers, Zener voltage regulators, AM-demodulators, Class A,B,C Amplifiers etc.) 3L
Optoelectronic devices-LED, Laser diode, photodiode and solar cell, PhotoFET, LCD, Gas discharge display, optocouplers 5L+1T</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Nashelsky, L. and Boylestad, R.L., 2021. Electronic Devices and Circuit Theory Eleventh Edition. 9332542600, Pearson publishers.
2. Millman's Electronic Devices and Circuits, 4th Edition, McGRAW HILL publishing company; 4th edition (1 January 2015); 9789339219543</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Sedra, A.S. & Smith, K.C., Microelectronic Circuits, 7th ed., Oxford University Press, ISBN: 9780199339136
2. Neamen, D.A., Electronic Circuit Analysis and Design, 4th ed., McGraw-Hill, ISBN: 9780073380643
3. Albert Malvino and David J. Bates, Electronic Principles, 7th Edition, McGraw Hill Education; (1 July 2017), 0070634246
4. David. A .Bell, Electronic Devices And Circuits, 5TH EDN, Oxford; (30 April 2008); Oxford University Press, 019569340X</td></tr>
</table>

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Digital Circuits Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE/EP,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• Introduce the fundamental concepts of digital systems and demonstrate the application of Boolean algebra in logic analysis and design.
• Develop a comprehensive understanding of digital logic design principles and methodologies at the gate level, encompassing both combinational and sequential logic elements.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">The course would equip the students to
• Utilize Boolean algebra and related techniques to formulate and simplify logical expressions.
• Analyze and design both combinational and sequential digital systems with a systematic approach.
• Develop Digital Circuits / Systems for practical problems.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to Digital Systems: Introduction to Digital Logic, Data Representations, Number systems, Code Conversion (L3+T1)

Boolean Algebra and Logic Gates: Laws and Theorems of Boolean Algebra, Truth Table and Algebraic Form, Logic Operations and Logic Gates, Boolean Functions–Canonical and Standard Forms (L6+T2)

Gate-Level Minimization: Boolean Logic Minimization, Karnaugh Maps (K Map), Quine - McCluskey Method (QM method), Don't-care Conditions, NAND and NOR Implementations (L8+T3)

Combinational Circuit Design: Analysis and Design of Combinational Circuits, Adder, Subtractor, Multiplexer, Decoder, Encoder, Comparator, Code Converters, Parity generator, Implementation of Logic Functions using MUX. (L8+T3)

Sequential Circuit Design: Asynchronous and Synchronous Design, Flip Flops and Latches, Design of Sequential Modules– SR, D, T and J-K Flip-flops, Setup and Hold parameters, Timing Analysis, Analysis of Clocked Sequential Circuits, Mealy and Moore Models of Finite State Machines, State Reduction and Assignment (L9+T3)

Registers and Counters: Shift registers, Asynchronous and synchronous counters, Modulo counters, Applications of counters and registers (L6+T2)

Introduction to HDL and Design Examples (L2)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL", 6th edition, Pearson, 2018, ISBN: 9789353062019.
2. Charles H. Roth, Jr. and Larry L. Kinney, Fundamentals of Logic Design, 7th Edition, Cengage Learning, 2013, ISBN: 9781133628477.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. D. D. Givone, Digital Principles and Design, McGraw Hill, 2017, ISBN: 9780070529069.
2. Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson, 2017, ISBN: 9789332584600.
3. S.Brown and Z. Vranesic, Fundamentals of Digital Logic with VHDL Design, 3rd Edition, McGraw-Hill Education, 2017, ISBN: 97812590259760.
4. R.J.Tocci, N.S.Widmer, and G.L.Moss, Digital Systems Principles and applications, 12th Edition, Pearson Prentice Hall Edition, 2017, ISBN: 9780134220130.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Signals and Systems</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Signals and Systems equips students with the ability to analyze, design, and implement systems that process continuous-time signals.
To understand the fundamental concepts of continuous-time signals and systems, including classifications, operations, and system properties such as linearity, time-invariance, causality, and stability.
To analyze signals and systems using time-domain and frequency-domain techniques, including convolution, Fourier series, Fourier transform, and Laplace transform.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students are expected to
Students will be able to classify and analyze continuous and discrete-time signals and systems based on their fundamental properties.
Students will be able to apply transform techniques (Fourier and Laplace) to evaluate and interpret the behavior of signals and systems in both time and frequency domains.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Signals (continuous-time and discrete-time), standard signals, transformations of the independent variable, Systems (continuous-time and discrete-time): System classification (L3+T1)
Analysis of an LTI system: Natural and forced response, zero-input and zero-state solutions, step response, system stability, Impulse response of an LTI system, convolution integral, graphical convolution, system properties from impulse response, interconnection of LTI systems, evaluating impulse response from the step response (L10+T3)
Discrete-time signals and systems: Emphasize similarities and differences with continuous-time counterpart, transformations of signals, discrete-time convolution (L5+T2)
Continuous-time Fourier series (FS): Periodic signals and their properties, complex exponential as eigenfunction of LTI systems, exponential and trigonometric FS representation of periodic signals, convergence, FS of standard periodic signals, salient properties of Fourier series, FS and LTI systems, some applications of FS (L6+T2)
Continuous-time Fourier transform: Development of Fourier representation of aperiodic signals, convergence, FT of standard signals, FT of periodic signals, properties of FT, some applications of FT (L6+T2)
Laplace transform: Unilateral and Bilateral transform, ROC, relation between Fourier and Laplace transform, properties, poles and zeros of rational transfer function, zero-state and zero-input response (L8+T3)
Sampling (Bridge continuous and discrete): Sampling theorem and signal reconstruction, notion of aliasing with examples, discrete-time processing of continuous-time signals, continuous-time processing of discrete-time signals. (L4+T1)</td></tr>
<tr><td>Text Books</td><td colspan="6">Alan Oppenheim, Alan Willsky, S. Nawab, Signals and Systems: Pearson New International Edition, 2nd edition, Pearson Education Limited, 2015
B P Lathi, Principles of Linear Signals and Systems, 2nd edition, ISBN: 978-0198062271, 2009.</td></tr>
<tr><td>Reference Books</td><td colspan="6">Barry Van Veen Simon Haykin, Signals and Systems, 2ND ED, Wiley, January 2007
S. S. Soliman & M.D. Srinath, Continuous and Discrete Signals and Systems, 2nd Edition,Prentice- Hall, ISBN:0-13-774308-4,1990.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Digital Circuits Design Lab</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE/EP,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• This course aims to provide practical experience in the design and implementation of digital circuits and systems.
• Students will learn to formulate logic solutions for given problems, optimize logic using various techniques, and implement designs using logic gates and digital ICs. The process is carried out in three phases: circuit simulation using Multisim, experimental validation, and Verilog/VHDL implementation.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">The course would equip the students to
• Understand digital circuits
• Design Combinational circuits
• Design sequential circuits
• Formulate logic and design circuits for practical problems</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">• Formulating Boolean expressions and truth tables from practical statements, designing logic diagrams, simplifying using K-map, designing NAND-NAND and NOR-NOR diagrams, and verifying the same by simulation and experiment.
• Design and analysis of combinational logic circuits, including arithmetic units, multiplexers, demultiplexers, encoders, decoders, code converters, comparators, parity generator, and verifying the same by experiment.
• Implementation of sequential logic systems such as flip-flops, shift registers, counters, sequence generators, and verifying the same by Verilog and experiment.
• Exploration of the digital design flow using Hardware Description Language (HDL) Verilog.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. M. Morris Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL", 6th edition, Pearson, 2018, ISBN: 9789353062019.
2. R.J.Tocci, N.S.Widmer, and G.L.Moss, Digital Systems Principles and applications, 12th Edition, Pearson Prentice Hall Edition, 2017, ISBN: 9780134220130.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Palnitkar S. Verilog HDL: a guide to digital design and synthesis, 2nd Edition, Prentice Hall Professional, 2003, ISBN: 9788177589184.
2. S.Brown and Z. Vranesic, Fundamentals of Digital Logic with VHDL Design, 3rd Edition, McGraw-Hill Education, 2017, ISBN: 97812590259760.
3. Charles H. Roth, Jr. and Larry L. Kinney, Fundamentals of Logic Design, 7th Edition, Cengage Learning, 2013, ISBN: 9781133628477.
4. Thomas L. Floyd, Digital Fundamentals, 11th Edition, Pearson, 2017, ISBN: 9789332584600.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Electronic Devices and Circuits Lab</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE/EP,
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DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification □</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To experimentally validate the behavior of diodes, BJTs, and MOSFETs.
• To build, bias, and characterize basic electronic circuits.
• To develop proficiency in using laboratory instruments for measurement and analysis.
• To introduce simulation tools for supporting experimental observations.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">By the end of this lab course, students will be able to:
• Measure and interpret I-V characteristics of diodes, BJTs, and MOSFETs.
• Construct and test diode-based circuits and voltage regulators.
• Implement and bias single-stage BJT and MOSFET amplifiers.
• Use simulation tools to model and verify the operation of fundamental devices and circuits.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">The lab includes both simulation and hardware. The simulation can be done in any SPICE software like LTSpice.

PN and Zener diode I-V characteristics
Half-wave and full-wave rectifiers with filtering
Diode clippers and clampers
First order RC circuits, time and frequency responses
BJT output characteristics and region identification
BJT biasing: fixed bias and voltage-divider bias
CE amplifier: gain and signal swing measurement
MOSFET output characteristics and transfer curve
Biasing MOSFET in CS configuration
CS amplifier frequency response

Design-oriented mini-project (Voltage multipliers, Zener-based voltage regulators, AM-demodulators, Class A,B,C Amplifiers etc.)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Nashelsky, L. and Boylestad, R.L., 2021. Electronic Devices and Circuit Theory Eleventh Edition. 9332542600, Pearson publishers.
2. Millman's Electronic Devices and Circuits, 4th Edition, McGRAW HILL publishing company; 4th edition (1 January 2015); 9789339219543</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Sedra, A.S. & Smith, K.C., Microelectronic Circuits, 7th ed., Oxford University Press, ISBN: 9780199339136
2. Neamen, D.A., Electronic Circuit Analysis and Design, 4th ed., McGraw-Hill, ISBN: 9780073380643
3. Albert Malvino and David J. Bates, Electronic Principles, 7th Edition, McGraw Hill Education; (1 July 2017), 0070634246
4. David. A .Bell, Electronic Devices And Circuits, 5TH EDN, Oxford; (30 April 2008); Oxford University Press, 019569340X</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Data Science for Electronics Engineers</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
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<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE/EP,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ▬</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ▬</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">1. Understand the foundational concepts of Data Science and its applications.
2. Apply descriptive and inferential statistical techniques to analyze and interpret data.
3. Use predictive modeling methods to make data-driven decisions.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">1. Identify characteristics of dataset and implement effective visualization techniques to understand data distribution.
2. Describe and apply basic statistical models and machine learning techniques suitable for one and two dimensional data.
3. Perform regression, correlation, and knowledge discovery to extract insights from data.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">• Introduction to Data Science: Tools for Data Science, Data types, Data Collection, Exploratory Data Analysis –Estimates of location and variability, Data Sampling and distribution (8)
• Descriptive and Inferential Statistics –Data Visualization & Interpretation -Measures of Central Tendency & Dispersion - Basic and advanced plots such as Stem-Leaf Plots, Histograms, Pie charts, Box Plots, Violin Plots - Hypothesis Testing - Tests of Significance (t-test, ANOVA, chi-square test) –Regression and prediction, parametric and non-parametric tests (14)
• Statistical Machine Learning –Gradient Descent, Supervised and Unsupervised Learning, Classification, Regression, Clustering, Time series analytics, Signal and Image analysis, case study (8)

<u>Practice Component:</u>
Implementation with Python - Concepts from Descriptive Statistics and Inferential Statistics -Machine Learning algorithm for supervised and unsupervised Learning, classification and regression would be offered as part of the practice exercises. Course project as case studies. (12 sessions -weekly exercises)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Joel Grus, Data Science from Scratch, Orielly, 2ndEdn, 2019, ISBN 9781492041139
2. P Bruce, Practical Statistics for Data Scientists, O'Reilly, 2017, ISBN 9789352135653</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Jake VanderPlas, O'Reilly, Python data science handbook: Essential tools for working with data, 2016, ISBN 9781491912133.
2. Jiawei Han and Micheline Kamber, Data Mining Concepts & Techniques, Elsevier, 3rd Edition, 2007, ISBN 9780123814791.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Digital Signal Processing</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
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DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">Digital Signal Processing (DSP) equips students with the ability to analyze, design, and implement systems that process discrete-time signals.
The course enables understanding of core concepts such as convolution, filtering, Fourier and Z-transforms, and frequency analysis.
Students learn to design FIR and IIR filters, apply FFT algorithms, and implement DSP techniques using tools like MATLAB or Python.
Emphasis is placed on both theoretical understanding and practical applications in areas such as audio, biomedical, and communication signal processing.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students are expected to
Understand various properties of discrete-time signals and systems
Analyze discrete time LTI systems, and their impulse responses
Synthesize discrete signals from analog signals and reconstruct analog signals from discrete signals
To understand the theoretical foundations of discrete-time signals and systems.
To apply Z-transform and Fourier techniques for signal analysis.
Analyze systems commonly used in Communications, Control, and Signal Processing</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">● Review of Signals and Systems: Basic signals, system properties (linearity, time-invariance, memory, causality, BIBO stability) (L3+T2)
● Sampling Theorem: Periodic sampling, Frequency domain representation of sampling, Reconstruction of bandlimited signals from its samples (L3+T1)
● Discrete-time Signals and Systems: Discrete-time signals, discrete-time systems, LTI systems, Linear constant-coefficient difference equations (LCCDE), Frequency domain representation of discrete-time signals and systems, Fourier Series, Fourier transforms, properties of Fourier transform (L12+T3)
● Transform Analysis of Linear Time Invariant Systems: The frequency response of LTI systems, System functions for systems characterized by LCCDE (L3+T1)
● Discrete-time Fourier Transform: Introduction to DTFT, Properties (L3+T1)
● Discrete Fourier Transform: Introduction to DFT, Properties of DFT, Linear convolution using the DFT, Fast Fourier Transform (FFT), DIT and DIF algorithms (L10+T4)
● The Z-transform: Introduction, Properties of z- transform, inverse z-transform (L8+T2)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. A.V. Oppenheim, R.W. Schafer, and J. R. Buck, Discrete-Time Signal Processing, 3rd Edition, Pearson Education, ISBN: 9780132158176, 2010.
2. S. K. Mitra, Digital Signal Processing: A Computer-Based Approach, 4th Edition, Tata Mcgraw Hill Publication, ISBN: 9781259098581, 2013.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles,Algorithms and Applications, Fourth edition, Pearson, ISBN 9780132341998, 2007.
2. L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Analog Circuit Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To study discrete analog building blocks such as differential amplifiers and feedback circuits.
• To understand op-amp circuits in linear and nonlinear configurations.
• To design signal conditioning and filtering circuits.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of this course, the student will be able to
• Analyze discrete differential pairs and bias circuits.
• Apply op-amp-based design for signal conditioning.
• Design filters and feedback amplifiers.
• Understand frequency response and stability concepts (introductory).</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Review: CE/CS amplifiers, biasing limitations 2L+1T
Discrete current mirrors: simple, Wilson 2L+1T
Differential amplifier (BJT, MOS) - DC analysis only 4L+2T
CMRR and active loads (conceptual) 3L+1T
Introduction to op-amps, characteristics 3L+1T
Op-amp negative feedback: voltage followers, inverting/non-inverting 3L+1T
Linear op-amp circuits: summing, difference, instrumentation, integrator, differentiator 3L+1T
Nonlinear op-amp circuits: precision rectifier, clipper, limiter 3L+1T
Active filters using op-amps: LPF, HPF, BPF, notch 4L+1T
Op-amp positive feedback: Oscillators, comparator basics, Schmitt trigger and Multivibrators 8L+2T
Frequency response (Bode plot), simple pole-zero basics 2L+1T
Stability concepts (phase/gain margin basics) 2L+1T
Case studies: signal chain design with op-amps 3L</td></tr>
<tr><td>Text Books</td><td colspan="6">3. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Circuits, Theory and Application, 7th Edition, Oxford University Press, ISBN 9780199476299, 2017.
4. Sergio Franco, Design With Operational Amplifiers and Analog Integrated Circuits, 4th Edition, McGraw Hill, ISBN: 9789352601943, 2016.</td></tr>
<tr><td>Reference Books</td><td colspan="6">5. Behzad Razavi, Fundamentals of Microelectronics, 2nd Edition, Wiley, ISBN 9781119695141, 2021.
6. Donald A. Neamen, Electronic Circuits: Analysis and Design, 4th Edition, McGraw Hill, ISBN: 9780073380643, 2010.
7. Robert F. Coughlin, Frederick F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, 6th Edition, Pearson, USA, ISBN-978-0130149916, 2000.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Engineering Electromagnetics</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
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DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification □</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce students to the basic principles of electromagnetic theory
• To develop theoretical and analytical skills in the domain of electromagnetics engineering
• To develop understanding of the electromagnetic theory underpinning communication systems including wireless and optical communication.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the learners are expected to do the following:
• To apply the electromagnetic wave theory to transmission line problems
• To analyze the propagation of uniform plane electromagnetic waves in free space and unbounded media
• To apply Maxwell's equation formalism to analyze electromagnetic problems
• To determine the characteristics of electromagnetic waves at interfaces and in bounded media
• To describe and recognize fundamental properties of waveguide modes</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Transmission Lines: Equations of Voltage and Current on Transmission line, Propagation constant, Characteristic impedance and reflection coefficient, Impedance Transformation, Lossless and Low Loss Transmission line, VSWR, Power transfer on Transmission line, Applications of transmission lines, Impedance Matching, Lossy transmission line, Introduction to Smith Chart (L10+T3)

Maxwell’s Equations: Review of Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface (L5+T2)

Uniform Plane Wave: Propagation of wave, Polarization, Wave propagation in lossless, lossy and conducting medium, Skin depth, Phase velocity, Power flow and Poynting vector (L9+T3)

Plane Waves at a Media Interface: Plane wave propagating in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction at interface, Total internal reflection, Reflection from a conducting boundary (L9+T3)

Waveguides: Parallel plane waveguide, Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, TE and TM Modes, Group velocity (L9+T3)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. R K Shevgaonkar, Electromagnetic Waves, 1st Edition, McGraw-Hill Education, ISBN:9780070591165, 2006.
2. William H. Hayt, John A. Buck, Engineering Electromagnetics, 8th Edition, McGraw-Hill Education, ISBN:9780073380667, 2012.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Matthew N. O. Sadiku and S. V. Kulkarni, Principles of Electromagnetics, 6th Edition, Oxford University Press, ISBN: 978-0199461851, 2015.
2. David K. Cheng, Field and Wave Electromagnetics, 2nd Edition, Pearson Education, ISBN: 9781292026565, 2014.
3. Fawwaz T. Ulaby Eric Michielssen and Umberto Ravaioli, Fundamentals of Applied Electromagnetics, 7th Edition, Pearson Education, ISBN: 9781292082486, 2015.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Microprocessors and Embedded System Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
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DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• The goal of this course is to enable students to develop a solid understanding of microprocessor programming and embedded systems, empowering them to design and implement basic embedded applications.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• By the end of this course, students will be able to:
o Develop and implement real-time applications using the 8086 microprocessor and ARM controller.
o Interface 8086 Microprocessor and ARM controllers with external peripheral devices effectively
o Design Embedded systems and apply RTOS and IoT platform</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">• Intel 8086 Microprocessor: Introduction, Internal architecture, Hardware description, Segmentation, Instruction set, addressing modes, Assembly Language Programming, Interfacing with Programmable Peripheral Interface. Introduction to advanced processors: Intel (Pentium Series, i-series), AMD (Ryzen and EPYC series). (11L+06T)
• Introduction to embedded processors- Design Process- Requirements- Specifications Hardware architecture- Software Architecture-Introduction to Harvard & Von Neuman architectures CISC & RISC Architectures. CPU Bus- Bus Protocols- Bus Organisation, Memory Devices, and their Characteristics- RAM, EEPROM-Flash Memory- DRAM. BIOS, POST, Device Drivers. ARM Microcontroller: Architecture, Hardware description, Register and Memory organization, Structure and interrupt priorities, Interfacing with external devices. (11L+06T)
• Practice includes experiments from following topics: (20P)
o Programming with 8086 and ARM processors,
Arithmetic operations, Sorting, Operations on Matrices and String, Number conversion, Interfacing-LED, LCD, Stepper motor, 7-segment display, Interrupt, ADC and DAC</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Kenneth J. Ayala, the 8086 Microprocessor: Programming and Interfacing The PC, 1st Edition, Delmar Publishers, 2007, ISBN: 9780314012425.
2. J. W. Valvano, Embedded Systems: Introduction to Arm® Cortex(TM)-M Microcontrollers, 5th Edition, Create Space, 2012, ISBN: 978-1477508992.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. K. Ray, K. M. Bhurchandi, Advanced Microprocessors and Peripherals, 3rd Edition, Tata McGraw Hill, 2007, ISBN:007014022.
2. Yu-Cheng Liu, Glenn A. Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007, ISBN-81-203-0409-8.
3. A. N. Sloss, D. Symes, C. Wright, ARM System Developer‘s Guide,1st Edition, Morgan Kaufmann,ISBN:9781493303748, 2004.
4. Muhammad Ali Mazidi, ARM Assembly Language Programming & Architecture: 1, 2016, 2nd Edition.</td></tr>
</table>

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Analog Circuit Design Lab</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To provide hands-on experience in designing and testing discrete and op-amp-based analog circuits.
• To reinforce theoretical concepts learned in the Analog Circuits course through practical experiments.
• To develop skills in analyzing frequency response, feedback, and signal conditioning circuits.
• To cultivate proficiency in using measurement instruments and simulation tools for analog design verification.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">By the end of this lab, students will be able to:
• Construct and test discrete amplifiers.
• Design and evaluate linear op-amp circuits, including amplifiers, integrators, and filters.
• Implement and analyze nonlinear op-amp circuits, such as precision rectifiers and comparators.
• Design and analyse op-amp circuits with positive feedback.
• Integrate and validate small analog signal-processing subsystems on breadboard or PCB.
• Use simulation software to compare theoretical and practical circuit performance.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">The lab includes both simulation and hardware.
Simulation could be done in any SPICE software like LT Spice.
Design and analysis of RLC circuit
DC and AC analyses of simple nonlinear networks (piecewise-linear characterization)
Common Emitter Amplifier
Common Source amplifier
Op-amp based linear circuits - Inverting and Non-Inverting Amplifier, Inverting and Non-Inverting Summer, voltage follower
Op-amp based linear Circuits -Integrator and differentiator, Difference and Instrumentation Amplifier
Op-amp based Nonlinear Circuits - rectifier, clipper, limiter, log and anti-log amplifier
Active filters using op-amps
Op-amp based Circuits with positive feedback: Oscillators, comparator basics, Schmitt trigger
Mini project on 555 timer-based circuits and applications, signal conditioning circuits with op-amp</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Adel S. Sedra, Kenneth C. Smith & Arun N. Chandorkar, Microelectronic Circuits, Theory and Application, 7th Edition, Oxford University Press, ISBN 9780199476299, 2017.
2. Sergio Franco, Design With Operational Amplifiers and Analog Integrated Circuits, 4th Edition, McGraw Hill, ISBN: 9789352601943, 2016.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Behzad Razavi, Fundamentals of Microelectronics, 2nd Edition, Wiley, ISBN 9781119695141, 2021.
2. Donald A. Neamen, Electronic Circuits: Analysis and Design, 4th Edition, McGraw Hill, ISBN: 9780073380643, 2010.
3. Robert F. Coughlin, Frederick F. Driscoll, Operational Amplifiers and Linear Integrated Circuits, 6th Edition, Pearson, USA, ISBN-978-0130149916, 2000.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="5">Control Systems</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td colspan="2">C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td colspan="2">4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ▬</td><td colspan="3">Elective ▭</td></tr>
<tr><td>Status</td><td colspan="2">New ▭</td><td colspan="3">Modification ▬</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="7">This course develops the fundamentals of feedback control using linear transfer function and state space system models. Topics covered include analysis in time and frequency domains; design in the s-plane and in the frequency domain. Students have to complete an extended design case study.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="7">This course will teach fundamentals of control design and analysis using state-space methods. By the end of the course, a student should be able to design controllers using classical and modern control methods and evaluate whether these controllers are robust to some types of modelling errors and nonlinearities. They will learn to:
Design controllers and analyze using classical tools.
Understand impact of implementation issues (nonlinearity, delay).
Indicate the robustness of control design.
Linearize a nonlinear system and analyze stability</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="7">Introduction: Scope of control, Parts of a control system, Multidisciplinary nature, Scope of present course (L2)
Mathematical modelling of physical systems: Differential equations, Transfer function, and State variable representations; Equivalence between the elements of different types of systems (L6+T2)
Linear systems and their s-domain representations: Linearity and linearization, Transfer function and its interpretation in terms of impulse and frequency responses, Block-diagram and signal flow graph manipulations. (L8+T3)
Characterization of systems: Stability - concept and definition, poles, Routh array, internal stability of coupled systems, Time domain response and Frequency domain response; Link between time and frequency domain response features. (L8+T3)
Closed loop operation - Advantages: Sensitivity, Disturbance and noise reduction, Structured and unstructured plant uncertainties. (L3+T2)
Analysis of closed-loop systems: Stability and relative stability using root-locus approach, Nyquist stability criterion, steady-state errors, and system types (L7+T2)
Compensation techniques: Performance goals, specifications, PID, lag-lead, and algebraic approaches for controller design. (L8+T2)
Case study of a closed loop system to design controller for any system.</td></tr>
<tr><td>Text Books</td><td colspan="7">1. N. S. Nise, Control Systems Engineering, 7th edition, Wiley, ISBN: 978-1-118-17051-9, 2015.
2. J. Nagrath and M. Gopal, Control System Engineering, 6th edition, New Age International Publishers, ISBN: 978-9386070111, 2018.</td></tr>
<tr><td>Reference Books</td><td colspan="7">1. Kuo, Golnaraghi:, Automatic Control Systems, 9th Edition, John Wiley, ISBN: 978-8126552337, 2014.
2. J. J. Distefano, A. R. Stubberud, and I. J. Williams, Control Systems, Schaum's outline Series, 2nd Edition, McGraw Hill, ISBN: 9780071829489, 2014.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Communication Systems</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ☐</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☐</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce Analog Modulation techniques such as AM, FM.
• To analyze Analog Communication techniques and study the super heterodyne receiver
• To investigate quantization process and study pulse modulation techniques</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to
• Understand various modulation techniques
• Apply Fourier Series and Transforms on the Signals
• Analyze Transmitter and Receiver of various modulation techniques
• Evaluate performance metrics and use them to solve problems</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Review of Signals and Systems: Signals and Vectors, Orthogonality, Correlation, Signal Representation by Orthogonal Signal Set, Orthogonal Vector/Signal Space, Fourier Series, Fourier Transform, Baseband and Passband Signals, Complex Baseband representation of Passband Signals (L8+T3)

Transmission of Signals: Signal Transmission Through a Linear System, Signal Distortion over a Communication Channel, Signal Energy and Energy Spectral Density, Signal Power and Power Spectral Density (L4+T1)

Amplitude Modulation (AM): Baseband and Carrier Communication, Double Sideband (DSB) modulation with Carrier and with Suppressed Carrier (DSB-SC), Single Sideband Modulation (SSB), Vestigial Sideband Modulation (VSB), Carrier Acquisition (L8+T3)

Frequency Modulation (FM), Phase Modulation (PM), Spectral Analysis Carson's Rule, Narrowband/Wideband FM Generation, Slope detector, Noise in AM/FM systems (L8+T3)

Sampling and PCM: Sampling Theorem, Pulse Code Modulation, Quantization, Uniform/Non-Uniform Quantizer, Quantization Noise, Lloyd Max Quantization Algorithm, Differential Pulse Code Modulation (DPCM), Delta Modulation (L7+T2)

RF Transceiver Impairments and Modeling: Superheterodyne Transceivers, Homodyne Transceiver, Low IF Transceiver, Digital Compensation of Analog Frontend Imperfections, Up/down Conversion Architectures, Oscillator Phase Noise, Sampling Jitter, IQ imbalance, Carrier Frequency Offset, Sampling Frequency Offset, Error Vector Magnitude, DAC/ADC Interface, Quantization Noise and Clipping, Dynamic Range, ADC Noise Floor, Non-linearities (L7 +T2)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th Edition, Oxford Univ. press, 2011, ISBN: 9780198073802.
2. S. Haykin and M. Moher, Communication Systems, 5th edition, John Wiley, 2022, ISBN: 9780471178699.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. R. E. Ziemer and W. H. Tranter, Principles of Communications -Systems, Modulation, and Noise, 7th edition, Wiley, 2015, ISBN: 9781118078914.
2. H. Taub, D. L. Schilling, and G. Saha, Taub's Principles Of Communication Systems, 4th edition, McGraw Hill New York, 2017, ISBN: 9781259029851.
3. A. B. Carlson, P. B. Crilly, J. C. Rutledge, Communication Systems, 4th Edition, McGraw Hill New York, 2002, ISBN: 978-0071210287.
2. L. Smaini, RF Analog Impairments Modeling for Communication Systems Simulation, 1st edition, Wiley, 2012, ISBN: 9781118438046.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Antenna Theory and Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification □</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td>Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• The objective of this course is to introduce the antenna fundamentals, parameters, and concepts to the students.
• It also teaches the theory and design methodology of various antennas like dipole, antenna arrays, broadband antennas, aperture antennas, and microstrip antennas etc.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">After this course, the students are expected to learn the following things:
• Understanding various antenna parameters.
• Learning the theory of conventional antennas like microstrip antennas, dipole antennas, etc., and designing them using HFSS software.
• Able to design the basic antennas as per the given specifications.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Fundamental Concepts: Physical concept of radiation, retarded potentials, Hertzian dipole; Antenna parameters: Radiation pattern, gain, directivity, effective aperture, and reciprocity; Radiation from dipoles of arbitrary length. (10 L + 4hrs P)

Antenna Arrays: Arrays of point sources, endfire and broadside arrays, pattern multiplication, synthesis of binomial and Dolph-Chebyshev arrays. (7 L + 4hrs P)

Broadband Antennas: Log-periodic and Yagi antennas, frequency-independent antennas, broadcast antennas. (6 L + 6hrs P)

Aperture and Reflector Antennas: Huygens' principle, radiation from apertures in an infinite ground plane, slot and horn antennas, parabolic reflector antennas. (9 L + 6hrs P)

Microstrip Antenna, Cell-site and Mobile Antennas (4 L + 4hrs P)

Ground wave, surface wave, and space wave propagation, tropospheric and duct propagation, Structure of ionosphere and ionospheric propagation, Multipath fading, ray bending and other propagation phenomena; Indoor propagation (6 L)

Lab experiments:

• Introduction to Ansys HFSS and CST Studio Suite
• Design of various antennas like Dipoles, Antenna Arrays, broadband antennas, aperture antennas, and microstrip antennas for the given specifications.</td></tr>
<tr><td>Text Books</td><td colspan="6">1. C. A. Balanis, Antenna Theory: Analysis and Design, 4th edition, John Wiley & Sons; (February 2016), ISBN: 9781118642061.
2. A. R. Harish and M. Sachidananda, Antenna and Wave Propagation, Oxford University Press; (2007), ISBN: 978-0-19-568666-1.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. W. L. Stutzman and G. A. Thiele, Antenna Theory and Design, 3rd edition, John Wiley & Sons; (May 2012), ISBN: 9780470576649.
2. J. D. Kraus and R. J. Marhefka, Antennas for All Applications, 3rd edition, McGraw-Hill; (2002), ISBN: 9780072321036.
3. R. S. Elliot, Antenna Theory and Design, Revised edition, Wiley-IEEE Press; (2003),ISBN: 9780471449966.
4. R. E. Collin, Antennas and Radio Wave Propagation, International Student Edition, McGraw-Hill; (1985), ISBN: 9780070118089.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Digital Signal Processing Lab</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td>Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• This practical component aims to provide hands-on experience in implementing fundamental signal processing tools and techniques.
• It begins with foundational tasks such as signal discretization and transformations in the time and frequency domains, including the application of Fourier series and Fourier transform, and gradually progresses to real-time signal processing applications to reinforce conceptual understanding through practical exposure.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students are expected to
• Students will be able to design, implement, and analyze digital signal processing algorithms using tools like MATLAB or Python, apply transforms (DFT/FFT), and develop practical solutions for real-time signal filtering, analysis, and system simulation in various application domains.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">• Introduction to MATLAB/Python for DSP – Signal generation and basic plotting
• Basic operations on discrete-time signals: scaling, shifting, reversal, and folding
• Sampling
• Linear and circular convolution implementation
• System response analysis using difference equations
• Frequency response computation using DTFT
• DFT and IDFT computation using built-in and custom methods
• FFT implementation and comparison with DFT
• Pole-zero plotting and system stability analysis
• Implementation of a DSP-based application (e.g., noise reduction, echo cancellation)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Vinay K. Ingle and John G Proakis, Digital Signal Processing Using MATLAB, 3rd Edition, Cengage Learning, ISBN: 9781111427375, 2012.
2. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Fourth edition, Pearson, ISBN: 9780131873742, 2007.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. A.V. Oppenheim, R.W. Schafer, and J. R. Buck, Discrete-Time Signal Processing, 3rd Edition, Pearson Education, ISBN: 9780131988422, 2010.</td></tr>
</table>

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Digital Communication</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To study modulator/ demodulators of various digital modulation techniques
• To learn fundamentals of digital transmissions
• To analyze receivers for probability of error
• To introduce Information Theory and study channel coding</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to
• describe a digital communication system and explain the blocks of the digital modulator/demodulators
• analyze receiver structures and compare the performance of various modulation schemes
• evaluate the BER expressions for various modulation techniques
• appreciate the role of Information Theory in Communication Theory and learn the different channel coding techniques.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to Digital communication: Sampling, Pulse Amplitude Modulation, Power Spectral Density, Basic blocks of a Digital Communication System, Additive White Gaussian Noise (AWGN) (L6+T2)

Digital Modulation: Coherent Binary Modulation Techniques, Coherent Quadrature-Modulation Techniques, Noncoherent Binary Modulation Techniques, M-ary Modulation Techniques, Power Spectra, Bandwidth Efficiency (L8+T3)

Review of Probability Theory: Probability, Conditional Probability, Random Variables, Distribution Function, Density Function, Mass Function, Characteristic Function, Vector Random Variables, Random Processes (L8+T3)

Optimum Receiver Design: Signal-to-Noise Power Ratio (SNR), Matched Filtering (MF), Maximum Likelihood (ML) and MAP Receiver, general Probability of Error, BER vs SER (L8+T3)

Linear Block Codes: Generator and Parity Check Matrices, Hamming Weight and Distance Properties, Syndrome Decoding, Hamming Codes, Cyclic codes, convolutional codes (L12+T3)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Simon Haykin, Digital Communications, 1st Edition, John Wiley & Sons, 2009, ISBN: 9789971512057.
2. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th edition, Oxford University Press, 2013, ISBN: 9780195331455.</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. J. G. Proakis, Digital Communications, 5 th edition, McGraw-Hill, 2014, ISBN: 9780072957167.
2. B.Sklar, Digital Communications, 2nd edition, Pearson Education, 2009, ISBN: 9780130847881.</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">RF and Microwave Engineering</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
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DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification □</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the students to the field theory and circuit theory concepts in the analysis and design of microwave guiding structures and passive components.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">After the completion of this course students can
• Understand the guided wave propagation.
• Study of different analytical techniques (S-Matrix) involved in the design of microwave components.
• Understanding of microwave passive circuits like power dividers, couplers, filters, ferrite components.
• Understanding of microwave sources and components</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Review of transmission lines and waveguides. Microstrip line, strip-line, coplanar waveguide. (4L)
Microwave Network Analysis: Equivalent voltages and currents, concept of impedance, impedance and admittance matrices of microwave junctions, scattering matrix representation of microwave networks, ABCD parameters, excitation techniques for waveguides, various impedance transformation techniques. (9L+ 4P)
Power Dividers and Couplers: Scattering matrix of 3- and 4-port junctions, T-junction power divider, Wilkinson power divider, qualitative description of two-hole and multi-hole waveguide couplers, hybrid junctions. (8L+4P)
Filters: Introduction to RF filter designing, filter designing using image parameters method, and insertion loss methods. Filter transformations. (9L+4P).
Ferrimagnetic Components: Permeability tensor of ferrites, plane wave propagation in ferrites, Faraday rotation, ferrite circulators, isolators and phase shifters. (6L+2P)
Microwave sources and components: Introduction to microwave tubes, Operation and circuit applications of Gunn diode, IMPATT diode, PIN Diode, and Schottky barrier diode.(6L)
List of Lab Experiments:
1. Introduction to the software: HFSS and AWR Microwave Office
2. Design of various passive microwave components like power dividers, couplers, circulators, isolators, filters, etc., using the software.
3. Hardware experiments on the Microwave test bench

*1P = 2Hrs</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Pozar, D.M., “Microwave Engineering”, 4th Ed., Wiley, (2012), ISBN:9780470631553, 0470631554
2. Liao, S.Y., “Microwave Devices and Circuits”, 3rd Ed., Pearson India. 2000, ISBN: 978-8177583533</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Collin, R.E., “Foundations for Microwave Engineering”, 2nd Ed., Wiley India Pvt. Ltd (2007), ISBN: 9788126515288, 8126515287.
2. Michael Steer, “Microwave and RF Design: A Systems Approach”, SciTech Publications, 2013, ISBN: 9781613530214, 1613530218
3. Hunter, I., “Theory and Design of Microwave Filters”, IET Electromagnetic Waves Series 48, (2001), ISBN: 978-0852967775.
4. Bahl, I. and Bhartia, P., “Microwave Solid State Circuit Design”, 2nd Ed., John Wiley & Sons, 2003.
5. A S Gilmour, “Microwave Tubes ”, Artech House, 1986, ISBN:9780890061817, 0890061815</td></tr>
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<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">VLSI Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>2</td><td>4</td></tr>
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DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification □</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the fundamental principles of CMOS-based digital VLSI design.
• To develop a clear understanding of MOSFET behavior, CMOS logic styles, and their implications on performance.
• To enable students to model basic digital circuits using HDL (Verilog) and implement them through layout.
• To provide hands-on experience in designing and simulating basic VLSI blocks through an integrated lab.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">By the end of this course, students will be able to:
1. Explain the behavior of MOS devices and CMOS logic circuits.
2. Analyze and estimate delay and power in static CMOS designs.
3. Use HDL (Verilog) to model basic combinational and sequential digital systems.
4. Draw stick diagrams and implement λ-based layouts for small logic blocks.
5. Perform schematic capture, layout, DRC, and LVS checks using EDA tools.
6. Design and test small-scale digital subsystems (e.g., counters, ALUs) in both simulation and layout environments.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Introduction to VLSI: VLSI trends, abstraction levels, Moore's Law 3L
CMOS Technology & Scaling: Process flow overview, λ-based design rules 3L
MOSFET Operation: Threshold voltage, regions of operation, switching behaviour 3L
CMOS Inverter Analysis: VTC, noise margins, sizing, delay analysis 3L
Static CMOS Logic Design: NAND/NOR/XOR gates, stick diagrams 3L
Dynamic CMOS & Pass Transistor Logic: Basic dynamic logic, transmission gates 3L
Sequential Circuits: Latches and Flip-flops, timing constraints 3L
HDL Introduction (Verilog): Syntax, combinational modelling, testbenches 3L
FSM Design in HDL: Sequential modelling, FSM coding, case studies 3L
Layout Techniques: Stick diagrams, λ-rules, DRC fundamentals 3L
Interconnect and Delay: Wire models, fanout, Elmore delay basics 3L
Power Dissipation: Dynamic and static power, capacitance estimation 3L
Labs (Each 2 hrs/week):
Digital gate design (schematic + simulation) 3P
HDL modelling and simulation (Verilog) 3P
Sequential circuit HDL and FSMs 3P
Layout design and DRC/LVS 3P
Project: FSM Based designs with both combinational and sequential building blocks</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Douglas A. Pucknell & Kamran Eshraghian, Basic VLSI Design, 3rd ed., Prentice Hall, 2009. ISBN-13: 978-0-13-197249-8
2. John P. Uyemura, Introduction to VLSI Circuits and Systems, 2nd ed., Wiley, 2003. ISBN-13: 978-0-471-31846-7</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. Neil H. E. Weste & David Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 4th ed., Pearson, 2010. ISBN-13: 978-0-321-54774-3
2. David Money Harris & Sarah L. Harris, Digital Design and Computer Architecture, 2nd ed., Morgan Kaufmann, 2012. ISBN-13: 978-0-12-394424-5</td></tr>
</table>

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Communication Systems Lab</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">B.Tech. ECE,
DD ECE (CMS),
DD ECE (MVS)</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To introduce the concepts of analog and digital communication.
• To study various modulation schemes and their performance.
• To study and understand basic channel coding techniques.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Students are expected to
• analyse different analog and digital modulation schemes
• evaluate the performance of various communication systems
• analyse error probability of various digital communication systems</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">The experiments are numerical evaluations done in a programming environment like MATLAB/GNU Octave or Python. Experiments include

1. Performance of AM Communications
2. Performance of DSB-SC Communications
3. Performance of SSB Communications
4. Performance of FM Communications
5. Analysis of White Noise
6. Design and analysis of PCM
7. Design and analysis of PAM
8. Design and analysis of MPSK
9. Design and analysis of QAM
10. Design and analysis of FSK</td></tr>
<tr><td>Text Books</td><td colspan="6">1. U. Madhow, Fundamentals of Digital Communication, Cambridge University Press, 2008, ISBN: 9780521874144.
2. J. G. Proakis and M. Salehi, Contemporary Communication Systems using MATLAB, Cengage Learning; 1st edition, 2007, ISBN: 9788131501245.</td></tr>
<tr><td>Reference Books</td><td colspan="6">3. B. P. Lathi and Z. Ding, Modern Digital and Analog Communication Systems, 4th Edition, Oxford Univ. press, 2011, ISBN: 9780198073802.
4. Simon Haykin, Digital Communications, 1st Edition, John Wiley & Sons,2009, ISBN: 9789971512057.</td></tr>
</table>

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">MOS Modeling for VLSI Circuits</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">CORE:
M.TECH MVS</td><td>Type</td><td colspan="2">Core ▬</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☐</td><td colspan="2">Modification ▬</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To demonstrate and apply basic concepts of semiconductor physics relevant to devices
• To describe and use physics-based numerical and analytical device modelling for the inclusion in circuit applications</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students would be able to
• Model any kind of MOS Devices in 2-D or 3-D
• Relate the models for further inclusion in circuits</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Semiconductors: Energy bands; Thermal equilibrium carrier concentration. Excess carriers, quasi-Fermi levels; Recombination of carriers, lifetime. Carrier transport by drift, mobility; Carrier transport by diffusion; Continuity equation. Diffusion length. (8 L + 3 T)
Quantitative theory of PN junctions: Steady state I-V characteristics under forward bias, reverse bias, and illumination. Capacitances. Dynamic behavior under small and large signals. Breakdown mechanisms. (6 L + 2 T)
Theory of Field Effect Transistors: Analysis of MOS capacitor. Calculation of threshold voltage. Static I-V characteristics of MOSFETs and their models. (6 L + 2 T)
Long-Channel MOS Transistor, Introduction All-Region Models, Strong Inversion Models, Weak Inversion Models, Effective Mobility. (7 L + 3 T)
Small-Dimension Effects - Velocity Saturation, Channel Length Modulation, Charge Sharing, Drain-Induced Barrier Lowering, Hot Carrier Effects, Velocity Overshoot Ballistic Operation, Polysilicon Depletion. (8 L + 2 T)
Small-Dimension Effects-Modelling for Circuits Simulation- Quantum-Mechanical Effects; Gate Current, Junction Leakage, Scaling and New Technologies, Approaches, and Properties of Good Models, Model Formulation Considerations (7 L + 2 T)</td></tr>
<tr><td>Text Books</td><td colspan="6">1. Nandita Dasgupta, Amitava Dasgupta, “Semiconductor Devices: Modelling and Technology”, Prentice Hall, 2004. ISBN: 9788120323988.
2. Y. Tsividis and C. McAndrew, Operation and Modeling of the MOS Transitor, Oxford University Press, 2011. ISBN: 0195170156</td></tr>
<tr><td>Reference Books</td><td colspan="6">1. BSIM Manuals available on BSIM homepage on the internet.
2. Y. Taur and T. H. Ning, Fundamentals of Modern VLSI Devices, Cambridge University Press, 2013. ISBN: 1107635713</td></tr>
</table>

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">VLSI System design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">M.TECH MVS</td><td>Type</td><td colspan="2">Core ☐</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☐</td><td colspan="2">Modification ☐</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="2">Submitted for approval</td><td colspan="3">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To provide an in-depth understanding of digital CMOS system design from register-transfer level (RTL) to gate-level implementation.
• To develop expertise in hardware modelling using HDLs for control and datapath-intensive designs.
• To introduce static timing analysis, design optimization, low-power techniques, and integration considerations in complex VLSI systems.
• To equip students with the knowledge to architect, analyze, and optimize performance-constrained and area-efficient digital designs.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">By the end of the course, students will be able to:
1. Analyze and model complex digital systems at the RTL using Verilog/VHDL.
2. Evaluate performance metrics (timing, power, area) of digital designs and apply design techniques such as pipelining, retiming, and FSM optimization for high-performance systems.
3. Describe the RTL-to-GDSII flow, synthesis constraints, floorplanning, and clocking strategies.
4. Propose low-power strategies such as clock gating and supply scaling at the system level.
5. Analyze impact of interconnect and parasitics in submicron designs using academic models.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">CMOS Logic Gate Design: Review of CMOS inverter, Gates, sizing, delay, logical effort (6L + 2T)
Sequential Logic Design: Latches and flip-flops, clocking schemes, metastability (6L + 1T)
Interconnect Modelling: RC delay, Elmore delay, wire sizing and buffer insertion (4L + 1T)
FSMs and RTL Design: FSM modelling styles, one-hot and binary encoding, RTL principles (3L + 1T)
Hierarchical Design Methodologies: Pipelining and parallelism, Top-down vs. bottom-up, module hierarchy, system abstraction levels (3L + 1T)
HDL Modelling: Basics Verilog/VHDL syntax, modules, data types, combinational logic modelling (3L + 1T)
HDL Modelling: Sequential Circuits, Sequential blocks, FSMs, test benches and simulation strategies (3L + 1T)
RTL to Gate-Level Synthesis: Behavioural vs. structural synthesis, constraints, optimization concepts (3L + 1T)
Timing Analysis Concepts: Setup/hold violations, timing arcs, clock skew and jitter basics (3L + 1T)
Static Timing Analysis (STA): Delay models, arrival/required times, slack analysis, timing reports (3L + 1T)</td></tr>
</table>

	Low Power Design Techniques: Sources of power, switching activity, clock gating, voltage scaling (3L + 1T) **SoC Design Concepts:** System integration, IP reuse, NoC intro, AMBA/AXI overview (conceptual only) (2L)
Text Books	3. Neil H. E. Weste & David Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 4th ed., Pearson, 2010. ISBN-13: 978-0-321-54774-3 4. David Money Harris & Sarah L. Harris, Digital Design and Computer Architecture, 2nd ed., Morgan Kaufmann, 2012. ISBN-13: 978-0-12-394424-5
Reference Books	3. Jan M. Rabaey, Anantha Chandrakasan & Borivoje Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd ed., Pearson, 2015. ISBN-13: 978-0-13-335672-0 4. Wayne Wolf, Modern VLSI Design: IP-Based Design, 4th ed., Pearson, 2008. ISBN-13: 978-0-13-714579-0 5. Keshab K. Parhi, VLSI Digital Signal Processing Systems: Design and Implementation, Reprint ed., Wiley, 2010. ISBN-13: 978-0-470-17035-7

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">VLSI testing and testable design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">M.TECH MVS</td><td>Type</td><td colspan="2">Core ▬</td><td colspan="2">Elective ☐</td></tr>
<tr><td>Status</td><td colspan="2">New ☐</td><td colspan="2">Modification ▬</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• The course aims at imparting skills required for the design of an efficient testable circuit and optimal test vectors to detect all faults</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• At the end of the course, the students would be able to Model the faults in the combination and sequential circuits
• Perform the fault analysis and test pattern generation using ATPG algorithm
• Build testable designs, generate and verify test vectors</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Basic of Test - Design and Test, Test Goals, ATE Architecture and Instrumentation, Testing needs, Quality – HTOL, Automotive std basics, Test Requirements (required in design) & cost driven, Future Testing methodology to address upcoming design nodes (3D IC). (3L)

Standard IEEE Test Access Methods: Boundary Scan Basics, Boundary Scan Architecture, Boundary Scan Test Instructions, Board Level Scan Chain Structure, RTL Boundary Scan and Boundary Scan Description Language. Overview of IEEE standards and IEEE P1500 & IEEE1838 IEEE 1149.1,1149.6 JTAG, RTL validation of a Spare register and understanding of JTAG FSM/IR/DR, (2L),

Design changes for testing: Additional IOs, test clock muxing, CGC logic, On chip clocking, Multisite testing and limited pin count (2L)

Fault and Defect Modeling: Fault Modeling, Structural Gate Level Faults, Issues Related to Gate Level Faults, Transition Faults, Path Delay faults, Memory Faults, Iddq, burnin test (3L)

Design for Test by Means of Scan: Making circuits Testable, Testability Insertion, Full Scan DFT Technique, Scan Architectures. (3L)

Test pattern Generation Methods and Algorithm: Test Generation Basics, Controllability and Observability, Combinational and sequential Test Generation, Static and At-speed ATPG, IDDQ (2L)

Deterministic Test Generation Algorithms: Deterministic Test Generation Methods, Sequential Circuit Test Generation, Test Data Compaction. (2L)

Logic Built-in Self-test: BIST Basics, Test Patter Generation, Output Response Analysis, BIST Architectures, RT Level BIST Design. Introduction to IOBIST (3L)

Memory Testing by Means of Memory BIST: Memory Testing, Memory Structure, Memory Repair, Redundancy, Memory Components (Sector/Bank/Array/Decoder/Sense Amp). (2L)</td></tr>
</table>

	Fault Simulation Application and Methods: Fault Simulation, Fault Simulation Applications, Fault Simulation Technologies. (2L) Test Compression: Test Data Compression, Compression Methods and Decompression Methods. (2L) Advanced topics: top level DFT, DRC, connectivity checks for DFT, Test vector generation and simulation, Test cost analysis (w.r.t Test Time), Test mode constraints, test mode timing closure, IR issues during at-speed capture, ATE debug and production testing, testing analog/mixed signal blocks (2L) Lab 1. Synthesis (4P) 2. Formal verification (4P) 3. Memory BIST insertion and verification (4P) 4. Scan Insertion (4P) 5. ATPG (4P) 6. scan verification (4P) 7. Compression and verification (4P)
Text Books	5. Michael L. Bushnell, Vishwani D. Agrawal, Essentials of Electronic Testing for Digital, Memory, and Mixed-Signal VLSI Circuits, Springer, 2004. ISBN: 79237991-8 **6. VLSI Test Principles and Architectures: Design for Testability,** Laung-Terng Wang, Cheng-Wen Wu, Xiaoqing Wen, Elseveir ISBN: 9781493300860
Reference Books	6. ZainalabedinNavabi, Test and Testable Design using HDL Models and Architecture, 1st edition, Springer, 2010, ISBN: 978-1-4419-7547-8. 7. M. Abramovici, M. A. Breuer and A. D. Figriieta, Digital Systems Testing and Testable Design, Wiley-IEEE Press, 1994, ISBN: 978-0-7803-1062-9. 8. Niraj K. Jha, Sandeep Gupta, Testing of Digital Systems, 1st edition, Cambridge University Press, 2003. ISBN: 0521-77356-3

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">Device Modelling and Simulation Lab</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">Electronics and Communication Engineering</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>1</td><td>2</td><td>2</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">M.TECH MVS</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To make the students familiar with semiconductor device Physics.
• To impart a flavour of different semiconductor device modelling with the help of simulation tools.
• The lab is intended to teach students about device structure and provide confidence to design the device structure and plotting necessary characteristics in relevant device modelling tools.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, students would be able to:
• Familiarize with Industry-Standard TCAD Tools
• Simulate and analyse structure, doping profile, terminal characteristics, and distributions of carriers, current, field, potential and energy band diagrams within 2-dimensional device structures</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">1. Overview of TCAD Tools (1P)
• Introduction to Technology Computer-Aided Design (TCAD) and its significance in semiconductor device modeling.
• Inputs and outputs of process and device simulations.
• Overview of common TCAD tools (e.g., Synopsys Sentaurus, Silvaco Atlas).
2. Device Simulation using SDE (Structure Editor) (2P)
• Designing 2D and 3D semiconductor structures using scripting languages.
• Implementation of analytical doping profiles.
• Strategies for meshing in 2D/3D simulations to ensure numerical accuracy and efficiency.
3. Device Simulation using SDevice (3P)
• Implementation of physics-based models for device simulation.
• Mathematical foundation of device equations (Poisson's equation, continuity equations, transport models).
• Detailed understanding of the solve section for electrical simulations.
4. Process Simulation (3P)
• Simulation of semiconductor fabrication steps.
• Observation and analysis of: Final device structure, Doping profiles across the device
5. Electrical Characterization (3P)</td></tr>
</table>

	• Extraction and analysis of I-V and C-V characteristics of a 3-Terminal MOS (3T MOS) device. • Electrical characterization techniques for Silicon-On-Insulator (SOI) MOSFETs. • Parameter Extraction, Compact Models, Benchmark Tests, Small Signal Modelling including conductance parameters.
Text Books	1. C K Maiti, "Introducing Technology Computer-Aided Design (TCAD): Fundamentals, Simulations, and Applications", Jenny Stanford Publishing; 1st Edition, 2017, ISBN: 978-9814745512. 2. Wu, Yung-Chun, Jhan, Yi- Ruei, "3D TCAD Simulation for CMOS Nanoeletronic Devices", Springer, 2017, ISBN 978-981-10-3066-6.
Reference Books	1. C K Sarkar, "Technology Computer Aided Design: Simulation for VLSI MOSFET", CRC Press, 1st Edition, 2013, ISBN: 978-1466512658. 2. J.-P. Colinge, "FinFETs and Other Multi-Gate Transistors", Springer, 2008, ISBN: 978- 0-387-71751-7 3. TCAD Manual (Available Online)

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">CMOS Analog VLSI Design</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">M.TECH MVS</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To develop a strong foundation in CMOS analog circuit design and analysis.
• To train students in designing biasing circuits, amplifiers, and operational amplifiers using CMOS technology.
• To provide analytical and practical understanding of frequency response, stability, and noise in analog circuits.
• To introduce layout strategies for precision analog design with emphasis on matching and parasitic minimization.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">By the end of the course, students will be able to:
1. Analyze MOSFET behavior in analog operation and derive small-signal models.
2. Design current mirrors, differential amplifiers, and multi-stage op-amps.
3. Evaluate gain, bandwidth, stability, and compensation techniques for analog circuits.
4. Analyze thermal and flicker noise in analog blocks and optimize for low-noise design.
5. Apply layout practices such as common-centroid structures for precision and symmetry.
6. Simulate and validate analog designs using EDA tools and interpret performance metrics.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">MOSFET Modeling and Device Physics: MOS I-V equations, second-order effects, small-signal model, gm, ro (2L + 1T)
Biasing and Current Mirrors: Simple mirror, cascode mirror, Wilson mirror (1L + 1T)
Single-Stage Amplifiers: CS, CG, source follower, gain, impedance, Miller effect (2L + 1T)
Differential Pairs and Active Loads: Operation, differential gain, CMRR, input/output resistance (3L + 1T)
Fully Differential Amplifiers and CMFB: CMFB design, fully differential op-amps, biasing strategies (5L + 1T)
Frequency Response: Transfer function, poles/zeros, Bode plots, dominant pole approx. (3L + 1T)
Stability and Compensation: Phase/gain margin, feedback stability, Miller compensation (3L + 1T)
Op-Amp Architectures: Two-stage and telescopic op-amps, gain/swing/slew rate (7L + 2T)
Advanced Op-Amp Design: Folded cascode, gain boosting, output stages (3L + 1T)</td></tr>
</table>

	Bandgap Reference Circuits: basic bandgap idea, V_{BE}-referenced sources, constant-gm biasing, startup circuits (4L + 1T) **Noise in CMOS Circuits:** Thermal, flicker noise, input-referred noise, low-noise design (3L + 1T) **Mismatch and Layout for Analog Design:** Systematic and random mismatch, common-centroid layout, routing, guard rings (4L + 1T) **Case Studies:** Op-amp, comparator design, biasing networks, Low Dropout regulator (2L + 1T)
Text Books	1. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd ed., McGraw-Hill Education, 2016. ISBN-13: 978-0-07-252493-2; ISBN-10: 0072524934 2. Philip E. Allen & Douglas R. Holberg, CMOS Analog Circuit Design, 2nd ed., Oxford University Press, 2002. ISBN-13: 978-0-19-511644-1; ISBN-10: 0195116445
Reference Books	1. R. Jacob Baker, CMOS: Circuit Design, Layout, and Simulation, 3rd ed., Wiley, 2019. ISBN-13: 978-1-119-45804-1 2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis & Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 6th ed., Wiley, 2019. ISBN-13: 978-1-119-82988-8 3. David A. Johns & Ken Martin, Analog Integrated Circuit Design, 1st ed., Wiley, 1997. ISBN-13: 978-0-471-33250-2

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">High level verification with system verilog and UVM</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">M.TECH MVS</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To impart in depth knowledge and hands-on on the Design, Simulation and Verification Flow of Digital Circuits & Systems. verification of complex VLSI circuits with digital building blocks.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">• At the end of the course, the students would be able to understand complex RTL designs, understand verification requirements, write testplan, build testbench in System Verilog and UVM, run simulations and debug issues</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">1. Introduction to verification: test- bench, DUT, test plan, various verification technologies, verification pan, coverage, quick review of verilog based TBs (2L+1P)

2. Basic System Verilog: SystemVerilog Overview, Standard Data Types and Literals, Procedures and Procedural Statements, Operators, User-Defined Data Types and Structures, Hierarchy and Connectivity, Static Arrays, Tasks and Functions, Interfaces, Simple Verification Features, Clocking Blocks, Random Stimulus, Generate & analyze functional coverage, code coverage, line coverage & FSM coverage (3L + 5 P)

3 Advanced system verilog: Basic Classes, Polymorphism and Virtuality, Class-Based Random Stimulus, Interfaces in Verification, Covergroup, Coverage, Queues and Dynamic and Associative Arrays (QDA), Introduction to Assertion-Based Verification (ABV), Introduction to SystemVerilog Assertions (SVA), Threads and interprocess communication (10L+8 P)

4. Universal Verification Methodology (ŪVM)

SV Interfaces and BFM, Object Oriented Programming, UVM Test bench components: Driver, Sequence, Sequencer, Monitor, Scoreboard, UVM Phases, Configurations, Reporting, TLM, Agent, Env and Test, Test Scenarios and sequences',UVM Test bench Execution with test scenarios, Register Abstraction Layer (RAL) (13L+ 14P)</td></tr>
<tr><td>Text Books</td><td colspan="6">7. Chris Spear and Greg Tumbush, SystemVerilog for Verification: A Guide to Learning the Testbench Language Features, 3rd edition, Springer. 2012: ISBN 978-1-4614-0714-0
8. UVM Primer: A Step-by-Step Introduction to the Universal Verification Methodology, 2013, ISBN: 0974164933.</td></tr>
<tr><td>Reference Books</td><td colspan="6">9. SystemVerilog for Design: A Guide to Using SystemVerilog for Hardware Design and Modeling, 2nd Edition, ISBN-13: 978-0387333991
10. Donald Thomas, Logic Design and Verification Using SystemVerilog, 2016, ISBN: 1523364025</td></tr>
</table>

	11. Stuart Sutherland, Simon Davidmann, Peter Flake: System Verilog for design - A Guide to Using SystemVerilogor Hardware Design and Modeling, 2nd Edition, Springer, ISBN 978-1-4757-6684-4 12. Janick Bergeron: Writing Testbenches using **SystemVerilog, Sprunger, ISBN** 0-387-29221-7 13. Srikanth Vijayaraghavan & Meyyappan Ramanthan Srikanth Vijayaraghavan & Meyyappan Ramanthan, A Practical Guide for SystemVerilog Assertions, Springer, ISBN 0-387-26049-8

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY
DESIGN AND MANUFACTURING (IIITDM) KANCHEEPURAM

COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">IC Fabrication/VLSI Technology Theory and Lab</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE/Dr. Tejendra Dixit</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>4</td><td>4</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">M.TECH MVS</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New □</td><td colspan="2">Modification ■</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To integrate the perspectives of Circuits and Systems on technology.
• To provide an in-depth comprehension of the design of intricate VLSI devices and synthesis techniques for manufacturing.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">At the end of the course, the students will be able to
• Recognize the complexities inherent in VLSI circuit fabrication.
• Comprehend the diverse methods required for the fabrication of VLSI devices.
• Acquire hands-on experience and knowledge of the fabrication processes for current and forthcoming generation devices.</td></tr>
<tr><td>Contents of the course
(With approximate break-up of hours for L/T/P)</td><td colspan="6">Theory
• Introduction to VLSI Design, Bipolar Junction Transistor Fabrication, MOSFET Fabrication. (2L)
• Crystal Structure of Si, Defects in Crystal, Crystal growth (2L)
• Epitaxy, Vapour phase Epitaxy, Doping during Epitaxy, Molecular beam Epitaxy (4L)
• Oxidation –Kinetics, Rate constants, Dopant Redistribution, Oxide Charges (5L)
• Diffusion-Theory of Diffusion, Doping Profiles, Diffusion Systems, Ion Implantation- Process, Annealing of Damages, Masking during Implantation (4L)
• Lithography, immersion lithography, e-beam lithography (5L)
• Etching- Wet Chemical Etching, Dry Etching, Plasma Etching, Si, SiO_2, SiN and other materials (3L)
• Deposition-Plasma Deposition, Metallization, Problems in Aluminium Metal contacts, Copper interconnects (3L)
• MOSFET - Metal gate vs. Self-aligned Poly-gate, Tailoring of Device Parameters, CMOS Technology, Latch - up in CMOS, MOSFET structures with strained channels and high-k gate dielectrics, Bi-CMOS Technology (6L)
Practice:
Characterization
• Electrical: Semiconductor parameter analyser and probe station
• Thickness: Surface profilometer
• Optical: UV-visible spectrometer and Raman Characterization
• Morphology: SEM and Optical Microscope</td></tr>
</table>

	Device Type: • Si/SiO_2/Metal based MOS capacitor; Bottom gate top contact MOSFET • Si based photodetector; Si based Schottky diode • Si/SiO_2 based memristor • Si/SiO_2 based humidity sensor; Si/SiO_2 based temperature sensor • Wet and Dry oxidation of Si • Wet etching of Si and SiO_2 • CVD growth of epitaxial layers
Text Books	9. Sorab K. Ghandhi, VLSI Fabrication Principles- Silicon and Galium Arsenide, Wiley; Second edition, ISBN: 978-8126517909, 2008. 10. James D. Plummer, Peter B. Griffin, Integrated Circuit Fabrication: Science and Technology, 1st Edition, Cambridge University Press, ISBN: 978-1009303583, 2023.
Reference Books	14. S. M. Sze, VLSI Technology, McGraw-Hill Education, Second edition, ISBN: 978-0070582910, 2017. 15. J. Plummer, M. D. Deal, P. B. Griffin, Silicon VLSI Technology, Fundamentals, Practice and Modeling, Pearson Higher Education, 1st Edition, ISBN: 978-0130850379, 2000. 16. Stephen A. Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford Univ, Second edition, ISBN: 978-0195136050, 2001.

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COURSE FORMAT

<table>
<tr><td>Course Code</td><td></td><td>Course Title</td><td colspan="4">CMOS VLSI Design Lab</td></tr>
<tr><td rowspan="2">Dept./Faculty proposing the course</td><td rowspan="2">ECE</td><td rowspan="2">Structure (LTPC)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td rowspan="2">To be offered for</td><td rowspan="2">M.TECH MVS</td><td>Type</td><td colspan="2">Core ■</td><td colspan="2">Elective □</td></tr>
<tr><td>Status</td><td colspan="2">New ■</td><td colspan="2">Modification □</td></tr>
<tr><td>Pre-requisite</td><td></td><td colspan="3">Submitted for approval</td><td colspan="2">Senate 62</td></tr>
<tr><td>Learning Objectives</td><td colspan="6">• To provide hands-on experience in analog and digital CMOS design using industry-grade EDA tools.
• To reinforce theoretical concepts through schematic capture, simulation, layout, and post-layout analysis.
• To introduce design practices for parasitic-aware design and layout verification.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">By the end of this course, students will be able to:
1. Design and simulate basic digital gates, sequential circuits, and analog building blocks.
2. Create full-custom layouts for analog and digital circuits following design rules.
3. Perform DRC and LVS checks and resolve schematic-layout mismatches.
4. Extract parasitics and analyze their effect on timing and gain in post-layout simulations.
5. Apply layout techniques for matching and symmetry in analog designs.
6. Complete a mini-project integrating schematic, layout, and verification of a CMOS subsystem.</td></tr>
<tr><td>Contents of the course (With approximate break-up of hours for L/T/P)</td><td colspan="6">Tool & Environment Setup: Familiarization with CMOS process PDKs, EDA flow overview (1P)
Digital Schematic Design: Inverter, NAND, NOR, XOR design and simulation 1P
Digital Layout and Post-Layout Analysis: Layout of logic gates, DRC and LVS checks, Floor planning, and placement, Parasitic extraction and delay analysis (1P)
RTL Simulation and Synthesis in HDL: Combinational and sequential logic simulation using Verilog/VHDL (2P)
Clock/Power Routing: Routing, guard rings, metal stack usage, bond pads for I/O (1P)
Schematic Simulation of Analog Blocks: Current mirror, bias circuit, CS amplifier: DC, AC, transient simulation (1P)
Analog Layout and Post-Layout Simulation: Current mirror, differential pair layout, Extracted simulation of analog blocks (1P)
PVT and ESD: for Analog and Digital modules (1P)
Complete ASIC Design from RTL/Schematic to GDS flow with analog/digital blocks standard/custom design 4P (Op-amp, comparators, OTA, biasing networks, ALU, MAC, ADCs, simple ASICs)
Project Review and End Semester Exam: (1P)
Students do one Analog Design and one Digital Design or a Mixed signal design as the project.</td></tr>
</table>

Text Books	1. R. Jacob Baker, CMOS: Circuit Design, Layout, and Simulation, 3rd ed., Wiley, 2019. ISBN-13: 978-1-119-45804-1 2. David A. Hodges, Horace G. Jackson & Resve A. Saleh, Analysis and Design of Digital Integrated Circuits, 5th ed., McGraw-Hill Education, 2020. ISBN-13: 978-0-07-802768-0
Reference Books	1. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd ed., McGraw-Hill, 2016. ISBN-13: 978-0-07-252493-2 2. Philip E. Allen & Douglas R. Holberg, CMOS Analog Circuit Design, 2nd ed., Oxford University Press, 2002. ISBN-13: 978-0-19-511644-1 3. Eby G. Friedman, Clock Distribution Networks in VLSI Circuits and Systems, Wiley-IEEE Press, 2007. ISBN-13: 978-0-470-12019-2