DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

INSTITUTE OF ENGINEERING & MANAGEMENT, KOLKATA

B.Tech ECE

1.Curriculum Structure

5th Semester Structure (2024-2028 and onwards)

Sl. No.	Type	Subject Code	Subject Name	L	T	P	Total	Credit
1	CC	PCCEC501	Electromagnetic Waves	3	0	0	3	3
2	CC	PCCEC502	Microprocessor & Microcontroller	3	0	0	3	3
3	CC	PCCEC503	VLSI Design	3	0	0	3	3
4	CC	PCCEC504	Data Base Management System	3	0	2	3	3
5	ECEL	PEEC504	Program Elective-1: A. Information Theory & Coding; B. Power Electronics	3	0	0	3	3
6	GSC	ESPEC501	Essential Studies for Professionals (EC)-V	1	0	0	1	0.5
7	GSC	HSM576	Economics for Engineers	2	0	0	2	1
8	CC	PCCEC591	Electromagnetic Waves Laboratory	0	0	2	2	1
9	CC	PCCEC592	Microprocessor & Microcontroller Laboratory	0	0	2	2	1
10	CC	PCCEC593	VLSI Design Laboratory	0	0	2	2	1
11	CC	PCCEC594	Data Base Management System Laboratory	0	0	2	2	1
12	Sessional	OEC581	Programming in Cloud	0	0	2	2	1
13	GSC	SDP581	Skill Development for Professionals-V	0	0	1	1	0.5
14	ECP	PRJEC581	Mini Project	-	-	-	1	1
15	Mandatory Course	MAR581	Mandatory Additional Requirement (MAR)	0	0	0	0	0
16		IFC	Industry and Foreign Certification	0	0	0	0	0
Total								**23**

2. Fifth Semester Detailed Syllabi

PCCEC501: Electromagnetic Waves

Subject Code: PCCEC501	Category: CC
Subject Name: Electromagnetic Waves	Semester : 5th
L-T-P : 3-0-0 (Total Contact Hrs.3)	Credit: 3
Pre-Requisites: Mathematics, Physics, Signals and Systems	

Lecture Hours: 36 Subject Code: PCCECE501

COURSE OBJECTIVE (CO)

CO1: Understand the fundamentals of electromagnetic fields, vector calculus, Maxwell's equations, and boundary conditions.

CO2: Analyze the propagation characteristics of electromagnetic waves in different media.

CO3: Apply the principles of transmission lines and waveguides to analyze and solve engineering problems in electromagnetic and communication systems.

CO4: Understand the operating principles, radiation characteristics, and applications of various antennas used in communication systems.

COURSE OUTCOMES:

On successful completion of the course students will be able to:

- Apply the fundamental laws of electromagnetism, vector calculus, Maxwell's equations, and boundary conditions to analyze electromagnetic field problems.
- Analyze the propagation characteristics of electromagnetic waves in different media, including polarization, reflection, refraction, and power transmission.
- Apply the principles of transmission lines and waveguides to determine propagation characteristics, impedance matching, VSWR, and solve engineering problems.
- Evaluate the operating principles, radiation characteristics, and applications of various antennas for wireless communication systems.

Course Syllabus

Module number	Topic	Sub-Topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Basic laws of Electromagnetics**	Basics of Vectors, Vector calculus, Basic laws of Electromagnetic: Gauss's law, Ampere's Circuital law, Faraday's law of Electromagnetic induction. Maxwell's Equations. Boundary conditions at Media Interface.	***International Academia:*** (https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/pages/syllabus/) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:*** Software: Matlab	6	❖ Demonstrate Gauss's law, Ampere's Circuital law, and Faraday's law using MATLAB. ❖ Derive Maxwell's Equations and the Poynting Vector using MATLAB.
2	**Uniform Plane Wave and Plane Waves at Media Interface.**	A: Uniform plane wave: homogeneous unbound medium, Wave equation for time harmonic fields, Solution of the wave equation, Uniform plane wave, Wave polarization, Wave propagation in conducting medium, Phase velocity of a wave, Power flow and Poynting vector, Skin Depth. B: Plane Waves at Media Interface: Plane wave in arbitrary direction, Plane wave at dielectric interface, Reflection and refraction of waves at dielectric interface, Total internal reflection.	**International Standards** : (https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/pages/syllabus/) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:*** Software: Matlab	11	❖ Utilize MATLAB to Explore Uniform Plane Waves, Wave Polarization, Wave Propagation in Conducting Mediums, Phase Velocity Calculation, Power Flow Analysis, Poynting Vector Computation, and Skin Depth. ❖ Implement

					MATLAB Simulations for Plane Waves in Arbitrary Directions, Plane Waves at Dielectric Interfaces, Reflection and Refraction Phenomena at Dielectric Interfaces, and Total Internal Reflection

3	**Transmission Lines and Waveguide**	A: Transmission line: Concept of lump & distributed parameters, Transmission line equation & solutions, Physical significance of solutions, Propagation constants, Characteristic impedance, Wavelength, Velocity of propagation. Reflection Coefficient, Transmittance Coefficient, VSWR, Solution of problems. B: Waveguides: Introduction of waveguide, Rectangular waveguides: Analysis of waveguide-general approach, Waveguide modes, Cut-off frequency and Phase velocity.	***International Standards*** : (https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/pages/syllabus/) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:*** Hardware: Microwave Bench Software: Matlab	12	❖ Plot the Reflection coefficient magnitude for a transmission line with characteristic impedance of 50 ohm and a load impedance varying in the range 0 ohm to 1 kOhm.. ❖ Plot the Reflection coefficient magnitude and phase for a transmission line with characteristic impedance of 50 ohm and a load impedance being a Capacitor of capacitance in the

					range 1pF to 1mF. Consider a frequency of 1 MHz. ❖ Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited and terminated by a resistive load at the loadend. ❖ Input Impedance measurement of a terminated waveguide using shift in minima technique. ❖ Smith chart and its application for unknown impedance measurement. ❖ Determination of phase and group velocities in a waveguide carrying TE10 Wave from Dispersion diagram [ω−β Plot].

4	**Antennas**	Basics of Antennas: Radiation parameters of antenna, Radiations from Hertz dipole, Total power radiated by a dipole, Radiation resistance and radiation pattern of Hertz dipole. Overview of Horn Antenna, Yagi-Uda Antenna, Dipole antenna, Folded Dipole Antenna, Microstrip Patch antenna.	***International Standards:*** (https://ocw.mit.edu/courses/8-311-electromagnetic-theory-spring-2004/pages/syllabus/) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/UG-1/ug-vol1.pdf) ***Industry Mapping:*** Hardware: Yagi - Uda Antenna, Horn Antenna, Folded Dipole Antenna, Dipole Antenna. Software: Matlab, CST/ HFSS	7	❖ Measurement of Radiation Pattern of simple Dipole Antenna. ❖ Measurement of Radiation Pattern of Folded Dipole Antenna. ❖ Measurement of Radiation Pattern of Yagi - Uda Antenna. ❖ Introduction and Measurement of Radiation Pattern of Pyramidal Horn Antenna. ❖ Study of Spectrum Analyzer. ❖ Design Rectangular ❖ Waveguide in CST/ HFSS.

Text Books

1. Elements of Electromagnetics, 4th Edition, Matthew O H Sadiku, Oxford University Press.
2. Electromagnetic Field Theory & Transmission Lines, G.S.N. Raju, Pearson Education
3. Electromagnetic Waves Shevgaonkar, Tata-McGaw-Hillr –R K

Reference Books

1. Engineering Electromagnetics, 2ed Edition - Nathan Ida, Springer India
2. Fields & Waves in Communication Electronics, S. Ramo, J. R. Whinnery & T. Van Duzer, John Wiley
3. Electromagnetic Theory & Applications, A. K. Saxena, Narosa Publishing House Pvt. Ltd.
4. Electromagnetics, 2ed Edition – J A Edminister, Tata-McGraw-Hill.
5. Engineering Electromagnetics, 7thEdition-W.H.Hayt & J.A.Buck, Tata-McGraw-Hill.
6. Electromagnetic Waves and Transmission Lines- by G.Prasad, J.Prasad and J.Reddy-

CO–PO MAPPING (High = 3, Medium = 2, Low = 1)

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	-	-	2
CO2	3	3	2	2	1	-	-	-	-	-	-	2
CO3	3	3	3	3	3	-	-	-	2	-	-	2
CO4	3	3	3	3	3	2	-	-	2	1	-	2

Justification of CO–PO Mapping:

CO	Strongly Mapped POs	Justification
CO1	PO1, PO2	Builds engineering fundamentals and analytical understanding of electromagnetic field theory.
CO2	PO1, PO2, PO4	Develops analytical skills for electromagnetic wave propagation and field behavior in different media.
CO3	PO1, PO2, PO3, PO4, PO5	Applies transmission line and waveguide theories to solve practical communication engineering problems using analytical techniques.
CO4	PO1, PO2, PO3, PO4, PO5, PO6	Evaluates antenna characteristics and supports the design and selection of antennas for communication applications.

PCCEC502: Microprocessor & Microcontroller

Subject Name: Microprocessor & Microcontroller Credit: 3 Lecture Hours: 30
Subject Code: PCCEC502
Pre-requisite: Digital Electronics

Relevant Links:

International Academia 1: https://ocw.mit.edu/courses/2-996-biomedical-devices-design-laboratory-fall-2007/resources/lec5_mcroprcsr_1/

International Academia 2: https://ocw.mit.edu/courses/2-017j-design-of-electromechanical-robotic-systems-fall-2009/resources/mit2_017jf09_lab1/

Arduino Reference: https://web.stanford.edu/class/archive/engr/engr40m.1178/arduino.html

Raspberry Pi Reference: https://ocw.mit.edu/courses/res-2-006-girls-who-build-cameras-summer-2016/resources/mitres_2_006sum16_rasppi/

AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf

COURSE OBJECTIVES:

1. To introduce the overview of microcomputer systems, their building blocks, and memory interfacing.
2. To familiarize students with the concepts of interrupts, Direct Memory Access (DMA), and the instruction sets of 8085 and 8086 microprocessors.
3. To impart knowledge of peripheral interfacing (timer, serial I/O, parallel I/O, A/D and D/A converters), arithmetic coprocessors, and system-level interfacing design.
4. To introduce virtual memory, cache memory, advanced coprocessor architectures (286, 486, Pentium), 8051 microcontroller systems, RISC processors, and ARM microcontroller interface design.

COURSE OUTCOMES:

At the end of this course, students will demonstrate the ability to:

CO1: Understand the architecture of microprocessors and microcontrollers.

CO2: Develop programs for various microcontrollers.

CO3: Interface various peripherals with microcontrollers and program them for various systems.

CO4: Design and implement real-life engineering applications.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	Overview of Microcomputer Systems & Microprocessor Instruction Sets	Overview of microcomputer systems and their building blocks Memory interfacing Concepts of interrupts and Direct Memory Access (DMA) Instruction sets of microprocessors (with examples of 8085 and 8086)	International Academia: https://ocw.mit.edu/courses/2-996-biomedical-devices-design-laboratory-fall-2007/resources/lec5_mcroprcsr_1/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf Industry Mapping: software: Tinkercad	10	8085/8086 assembly language programming exercises Memory interfacing experiments
2	Peripheral Interfacing & Advanced Processor Architectures	Interfacing with peripherals: timer, serial I/O, parallel I/O A/D and D/A converters Concepts of virtual memory and cache memory Advanced coprocessor architectures: 286, 486, Pentium Microcontrollers: 8051 systems	International Academia: https://ocw.mit.edu/courses/2-017j-design-of-electromechanical-robotic-systems-fall-2009/resources/mit2_017jf09_lab1/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf Industry Mapping: software: Tinkercad	10	Timer/serial/parallel I/O interfacing experiments A/D and D/A converter interfacing
3	RISC & ARM Processors, Coprocessors and System-level Interfacing	Introduction to RISC processors ARM microcontroller interface designs Arithmetic Coprocessors System-level interfacing design	International Academia: https://ocw.mit.edu/courses/2-017j-design-of-electromechanical-robotic-systems-fall-2009/resources/mit2_017jf09_lab1/ AICTE-prescribed syllabus: https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE%20after%20addedum.pdf Industry Mapping: software: ARM Keil MDK	10	ARM microcontroller interfacing lab System-level interfacing design exercise

Suggested Learning Resources:

Text/Reference Books

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996.
2. D A Patterson and J H Hennessy, Computer Organization and Design – The Hardware and Software Interface, Morgan Kaufmann Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.

PCCEC503: VLSI Design

Subject Name:VLSI Design **Credit: 3** **LectureHours:48**

Subject Code: PCCEC503

Pre-requisite: Electronic Devices, Analog Electronic Circuits, Digital Electronic Circuits.

Course Objectives:

1. To learn about basic CMOS circuits both in analog and digital domain
2. To learn about VLSI physical design automation
3. To learn the concepts of designing VLSI subsystems.

Course Outcomes:

CO1. Know the different IC fabrication steps.

CO2. Know how to design different CMOS digital circuits using various logic families.

CO3. Know how to design different CMOS analog circuits based on their specifications.

CO4. Know the different algorithms behind VLSI physical design.

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Device Physics & IC Fabrication Steps**	MOS device physics and modeling; Wafer processing; oxidation; epitaxy; Diffusion & Ion implantation; Photolithography; Etching; Basic n-well process; p-well process; twin tub process; Layout and stick diagram.	***International Academia:*** (https://ocw.mit.edu/courses/6-374-analysis-and-design-of-digital-integrated-circuits-fall-2003/pages/readings/) (https://coursera.org/learn/vlsi-cad-layout) (https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013843033231450112292 72_shared/overview) (https://www.coursera.org/learn/mosfet) ***AICTE-prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) ***IndustryMapping:*** **Language:**T Spice, H Spice, LT Spice, VHDL/Verilog **Software:**Cadence, Tanner EDA Tool, Xilinx ISE, Silvaco TCAD **Hardware:**FPGA Development Board (Spartan 6/ Artix-7)	12	1. MOSFET Device characteristics simulation in Silvaco TCAD 2. Simulating oxidation process step in Silvaco TCAD 3. Simulating epitaxy process step in Silvaco TCAD 4. Simulating diffusion & ion implantation process steps in Silvaco TCAD 5. Simulating photolithography process step in Silvaco TCAD 6. Simulating etching process step in Silvaco TCAD 7. Doing basic layout of different standard cells in Cadence

2	**Digital CMOS Design**	Inverter characteristics; Combinational circuit design: CMOS logic families including static, dynamic, and dual rail logic; Sequential circuit design: design of latches and flip-flops; Delay in digital circuits: RC delay model, linear delay model, logical path efforts; Basic concept of SRAM, DRAM and ROM.	**InternationalStandards**: (https://ocw.mit.edu/courses/6-374-analysis-and-design-of-digital-integrated-circuits-fall-2003/pages/readings/) (https://coursera.org/learn/vlsi-cad-logic) (https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_0138430332314 5011229272_shared/overview) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) ***IndustryMapping:*** **Language:**T Spice, H Spice, LT Spice, VHDL/Verilog **Software:**Cadence, Tanner EDA Tool, Xilinx ISE **Hardware:**FPGA Development Board (Spartan 6/ Artix-7)	12	1. CMOS inverter transfer charactersitics simulation in Cadence 2. Design of basic gates in Xilinx ISE in all programming styles 3. Design of adder/subtractor in Xilinx ISEin all programming styles 4. Design of multiplier/ divider in Xilinx ISEin all programming styles 5. Design of registers and latches in Xilinx ISE 6. Design of counters (synchronous and asynchronous) in Xilinx ISE 7. **Project :** Design of any complex digital architecture using the basic building blocks in Xilinx ISE
3	**Analog CMOS Design**	Single stage amplifiers; Differential amplifiers; Active loads; Current mirrors; Current and voltage references; Switched capacitor circuits.	***International Standards*** : (https://ocw.mit.edu/courses/6-012-microelectronic-devices-and-circuits-fall-2005/pages/lecture-notes/) (https://www.coursera.org/learn/mosfet) (https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_013843033 23145011229272_shared/overview) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) ***IndustryMapping:*** **Language:**T Spice, H Spice, LT Spice, VHDL/Verilog **Software:**Cadence, Tanner EDA Tool, Xilinx ISE **Hardware:**FPGA Development Board (Spartan 6/ Artix-7)	12	1. Design of single stage amplifiers (CS, CD, CG) in Cadence 2. Design of differential amplifiers in Cadence 3. Design of amplifiers with different active loads in Cadence 4. Design of basic and cascode current mirror in Cadence 5. Design of different current and voltage references in Cadence 6. Design of switched capacitor circuits and circuits for discrete time signal processing in Cadence 7. **Project :** Design of any complex analog circuit using the basic building blocks in Cadence

4	**VLSI Physical Design Automation**	Introduction to Physical Design Automation; Partitioning: problem formulation, constraints, Kernighan–Lin algorithm; Floorplanning: problem formulation, slicing and hierarchical floorplanning, simulated annealing; Placement: problem formulation, placement algorithms (simulated annealing, force-directed, partitioning-based); Routing: global routing, detailed routing, interconnect delay, routing algorithms.	***InternationalStandards:*** (https://ocw.mit.edu/courses/6-111-introductory-digital-systems-laboratory-fall-2002/resources/fpga/) ***AICTE prescribed syllabus:*** (https://www.aicte-india.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) (https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_01384303323145011229272_shared/overview) ***IndustryMapping:*** **Language:**T Spice, H Spice, LT Spice, VHDL/Verilog **Software:**Cadence, Tanner EDA Tool, Xilinx Vivado, MATLAB **Hardware:**FPGA Development Board (Spartan 6/ Artix-7)	12	1. RTL synthesis of a digital design using Cadence Genus / Xilinx Vivado. 2. Floorplanning and placement of the synthesized design using Cadence Innovus. 3. Clock Tree Synthesis (CTS) and optimization using Cadence Innovus. 4. Physical design implementation (placement, CTS, and routing) using Cadence Innovus. 5. Timing analysis and design verification using Cadence Innovus / Xilinx Vivado.

Learning Resources:

Text Books:

1. S.M.Sze, VLSI Technology, 2nd Ed, McGraw Hill Education
2. S. Mo. Kang and Y. Leblebici, CMOS Digital Integrated Circuits: Analysis & Design, 3rd Ed, Tata McGraw Hill, 2003
3. P. Allen and D. Holberg, CMOS Analog Circuit Design, 2nd Ed, Oxford University Press, 2002
4. Naveed Sherwani, Algorithms for VLSI Physical Design Automation, 3rd Ed, Springer International Edition

Reference Books:

1. N.H.E. Weste and D.M. Harris, CMOS VLSI Design: A Circuits and Systems Perspective, 4th Ed, Pearson Education India, 2011
2. C.Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley, 1979
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India, 1997
4. B. Razavi, Design of Analog CMOS Integrated Circuits, Tata McGraw Hill, 2002
5. P. Douglas, VHDL: programming by example, McGraw Hill, 2013
6. S.H.Gerez, “Algorithms for VLSI Design Automation,” John Wiley 1999

CO-PO & PSO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	3	3	3	2	2	3	3	3	3
CO2	3	3	3	3	3	2	2	3	3	2	2	3	3	3	3
CO3	3	3	3	3	3	2	2	3	3	2	2	3	3	3	3
CO4	3	3	3	3	3	2	2	3	3	2	2	3	3	3	3

1 : Weak; 2 : Medium; 3 : Strong

PCCEC504: Data Base Management System

Subject Name: Database Management System **Credit: 3** **Lecture Hours: 36**
Subject Code: PCCEC504 Pre-requisite: Data Structure & Algorithm, Computer Architecture & Organization
Relevant Links:

Study Material Coursera NPTEL Linkedin Learning

COURSE OBJECTIVE:

To understand the different issues involved in the design and implementation of a database system.

To study the physical and logical database designs, database modelling, relational, hierarchical, and network models.

To understand and use data manipulation language to query, update, and manage a database.

To develop an understanding of essential DBMS concepts such as: database security, integrity, and concurrency.

To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, designing, and implementing a DBS.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

CO1: Remember different aspects of a database management system.

CO2: Understand different issues involved in the design and implementation of a database system. CO3: Apply the knowledge of a database system for writing queries, normalizing a database, applying techniques to serialize transaction schedules in concurrent or parallel databases.

CO4: Analyze & Evaluate a database architecture, query methods suitable to it, finding suitability of normalization degrees, storage strategies, analyzing the performance of a concurrency control scheme and suitability of the security technique pertaining to the use cases of the database and also designing of a new architectural model for a simple database system and demonstrate competence with the fundamental tasks involved in modelling, designing and implementing a DBMS.

Detailed Syllabus:

Module	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment	Book Name & chapter
1a	Database System Architecture	Concepts & overview of Database Management System, Data abstraction, Data Independence Data Definition Language (DDL), Data Manipulation Language (DML).	International Academia: https://online.stanford.edu/courses/soe%20ydatabases0005-databasesrelational-%20databases-and-sql AICTE-prescribed syllabus: chromeextension://efaidnbmnnnibpcaj pcglclefindmkaj/https://www.a icteindia.org/sites/default/files/Mo del_Curriculum/AICTE%20- %20UG%20CSE.pdf Industry Mapping: Relax Relational algebra calculator: https://dbis-uibk.github.io/relax/landing SQL: PostgreSQL/MySQL/MariaDB, or SQLite in browser B+-tree visualization: https://www.cs.usfca.edu/~galles/visualiza tion/BPlusTree.html Various DB systems playground: https://www.pdbmbook.com/playground	3	Write SQL query to create schema & table. Write SQL query manipulates data.	Database System Concepts, by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw- Hill, 6th Edition. Ch-1
1b	Data Models	Entity-relationship model, design Issues, mapping constraints, keys, Entity-Relationship diagram, integrity constraints, data manipulation operations. Network model, Relational and	International Academia: https://online.stanford.edu/courses/soe%20ydatabases0005-databasesrelational-%20databases-and-sql AICTE-prescribed syllabus: chrome-chromeextension://efaidnbmnnnibpcaj pcglclefindmkaj/https://www.a icteindia.org/sites/default/files/Mo del_Curriculum/AICTE%20- %20UG%20CSE.pdf Industry Mapping: Relax Relational algebra calculator: https://dbis-uibk.github.io/relax/landing	6	Write SQL query to learn different keys.	Database System Concepts, by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw- Hill, 6th Edition. Ch-1,2,7

		Object oriented data models	SQL: PostgreSQL/MySQL/MariaDB, or SQLite in browser B+-tree visualization: https://www.cs.usfca.edu/~galles/visualization/BPlusTree.html Various DB systems playground: https://www.pdbmbook.com/playground			

2a	Relational Query Languages	Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS MYSQL,ORACLE, DB2, SQL server.	International Academia: https://online.stanford.edu/courses/soe-ydatabases0005-databases-relational-databases-and-sql AICTE-prescribed syllabus: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf Industry Mapping: Relax Relational algebra calculator: https://dbis-uibk.github.io/relax/landing SQL: PostgreSQL/MySQL/MariaDB, or SQLite in browser B+-tree visualization: https://www.cs.usfca.edu/~galles/visualization/BPlusTree.html	5	Write SQL query to create schema and create/alter/delete/truncate table. Write SQL query select/insert/ update /delete/merge data.	Database System Concepts, by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw- Hill, 6th Edition. Ch- 3,6

2b	Relation al Database Design	Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design.	International Academia: https://online.stanford.edu/courses/soe-ydatabases0005-databases-relational-databases-and-sql AICTE-prescribed syllabus: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf Industry Mapping: Relax Relational algebra calculator: https://dbis-uibk.github.io/relax/landing SQL: PostgreSQL/MySQL/MariaDB, or SQLite in browser B+-tree visualization: https://www.cs.usfca.edu/~galles/visualization/BPlusTree.html Various DB systems playground: https://www.pdbmbook.com/playground	3	Write SQL query for different Normalization.	Database System Concepts, by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw- Hill, 6th Edition. Ch- 8

2c	Query Processing and Optimization	Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	International Academia: https://online.stanford.edu/courses/soe-ydatabases0005-databases-relational-databases-and-sql AICTE-prescribed syllabus: chromeextension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.aicteindia.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf Industry Mapping: Relax Relational algebra calculator: https://dbis-uibk.github.io/relax/landing SQL: PostgreSQL/MySQL/MariaDB, or	6	Write SQL query using Query optimization approach. Write SQL query for different types of Joining.	Database System Concepts, by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw- Hill, 6th Edition. Ch- 12, 13

			SQLite in browser B+-tree visualization:			
3	Storage Strategi es	Indices, B- trees, hashing	International Academia: https://online.stanford.edu/courses/soe-ydatabases0005-databases-relational-databases-and-sql AICTE-prescribed syllabus: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf	6	NA	Fundamental s of Database Systems,by R. Elmasri and S. Navathe, Pearson Education, 4th Edition. CH-9

4	Transaction Processing	Concurrency control, ACID properties, Serializabilit y of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency control schemes,	International Academia:https://online.stanford.edu/courses/soe-%20ydatabases0005-databasesrelational-%20databases-and-sql AICTE-prescribed syllabus: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf Industry Mapping: Relax Relational algebra calculator:	7	NA	Fundamental s of Database Systems, by R. Elmasri and S. Navathe, Pearson Education, 5th Edition. Ch-11 Database System Concepts, by Abraham Silberschatz, Henry F. Korth, S. Sudarshan,

		Database recover				McGraw- Hill, 6th Edition. Ch-14

Text Books

Database System Concepts, by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw- Hill, 6th Edition.

Reference Books

Fundamentals of Database Systems, by R. Elmasri and S. Navathe, Pearson Education, 5th Edition.

Database Management Systems by R. Ramakrishnan and Johannes Gehrke, McGraw Hill Education, 3rd Ed.

PEEC504A: Information Theory & Coding

Subject Name: Information Theory & Coding

Subject Code: PEEC504A

Credit: 3

Lecture Hours: 36

Course Objective:

1. To introduce the basic concepts of information theory.
2. To give the idea of various coding theories and the importance of all of them in information systems in communication engineering.
3. To understand the theoretical background for implementing error-control codes.
4. To visualize the role of Cryptography in Information Security.

Course Outcome:

CO1: Calculate information, entropy, mutual information, and channel capacity for various channels.

CO 2: Implement the various types of source coding algorithms and analyze their performance.

CO 3: Explain various methods for generating and detecting different error-correcting codes, BCH and RS Codes and the decoding techniques.

CO 4: Understand the basics of cryptography and implement different algorithms for Information security.

Relevant Links:

Link for Study Material: https://drive.google.com/drive/folders/1QgNJLWTJjgl1RlDNgjdbWvSu584grNKx?usp=drive_link

Link for Coursera Course: https://www.coursera.org/learn/information-theory https://www.coursera.org/learn/crypto-info-theory

Link for NPTEL Course: https://nptel.ac.in/courses/108102117

Link for LinkedIn Learning Course: https://www.linkedin.com/learning/learning-cryptography-and-network-security-2?u=229219690

Module number	Topic	Sub-topics	Mapping with Industry and International Academia	Book Name	Lecture Hours	Assignments
1	Basics of information theory:	Entropy for discrete ensembles; Shannon's noiseless coding theorem; Encoding of discrete sources. Markov sources, Shannon's noisy coding theorem and converse for discrete channels, Calculation of channel capacity and bounds for discrete channels, application to continuous channels.	International Academia: (https://ocw.mit.edu/courses/6-441-information-theoryspring-2016/pages/syllabus/) AICTE-prescribed syllabus: (/https://www.aicte.gov.in/sites/default/files/Final_ECE.pdf) Industry Mapping: MATLAB	1.R.Bose, Information Theory Coding and Cryptography, Tata McGraw Hill Chapter 1 and 2 2. N. Abramson, Information and Coding, McGraw Hill, 1963. 2. 3. 4. 5. 3 .M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987. 4. R.B. Ash, Information Theory, Prentice Hall, 1970.	8	1. Discuss the relationship between joint entropy and Mutual information. 2. Explain how channel capacity is related to the maximum rate of reliable communication over a noisy channel. 3. How does increasing the signal-to-noise ratio (SNR) affect the channel capacity? 4. Compare and contrast the Binary Symmetric Channel (BSC) and Binary Erasure Channel (BEC) in terms of their error characteristics and reliability.

2	Techniques of coding and decoding:	Channel Coding, Block and convolutional codes; majority logic decoding; Viterbi decoding algorithm, Coding gains and performance. Huffman codes and uniquely detectable codes; Cyclic codes, convolutional arithmetic codes.	International Academia: (https://ocw.mit.edu/courses/6-441-informationtheory-spring-2016/pages/syllabus/) AICTE prescribed syllabus: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) Industry Mapping: MATLAB	1.R.Bose, Information Theory Coding and Cryptography, Tata McGraw Hill Chapter 1 and 2 2. N. Abramson, Information and Coding, McGraw Hill, 1963. 2. 3. 4. 5. 3 .M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987. 4. R.B. Ash, Information Theory, Prentice Hall, 1970 5.Sanjay Sharma, Communication Systems, S K Kataria & Sons Chapter 16	8	1. Provide an example Illustrating channel coding, block coding, how Hamming distance is calculated and used to correct errors. Explanation of Huffman code 2. Provide an example of a cyclic code and explain the process of syndrome calculation for error detection. 3. Illustrate the operation of a cyclic code encoder and decoder with a specific example. 4. Describe the structure of a convolutional encoder and how it generates code words based on input data. 5. Provide an example of encoding a data sequence using a specific convolutional code and illustrate the resulting code word generation. 6. Explain the concept of traceback and path metric computation in the context of the Viterbi algorithm

3	Network Information Theory:	Overview of multiple access channel (MAC), Achievable result for MAC using successive decoding technique, Outer bound on the capacity region of MAC and its capacity analysis, Gaussian MAC and its capacity analysis.	International Academia: (https://ocw.mit.edu/courses/6-441-information-theoryspring-2016/pages/syllabus/) AICTE prescribed syllabus: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) Industry Mapping: MATLAB	El Gamal and Y. H. Kim, Network Information Theory, Cambridge University Press, 2011	4	1.	

4	Introduction to broadcast channel:	Superposition coding scheme and its optimality for the degraded broadcast channel, Relation between the capacity region of Gaussian BC and MAC. Achievable rate for interference limited networks using conventional techniques such as timesharing and treating interference as noise.	International Academia: (https://ocw.mit.edu/courses/6-441-information-theoryspring-2016/pages/syllabus/) AICTE prescribed syllabus: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) Industry Mapping: MATLAB	El Gamal and Y. H. Kim, Network Information Theory, Cambridge University Press, 2011	6	1. Define the following terms: 2. Broadcast Channel (BC) 3. Degraded Broadcast Channel (DBC) 4. Superposition Coding 5. Capacity Region 6. Interference-Limited Network 7. Why is the degraded broadcast channel easier to analyze than a general broadcast channel? 8. Define the capacity region of a Gaussian Broadcast Channel (BC) 9. Define the capacity region of a Gaussian Multiple Access Channel (MAC). 10. Explain the concept of achievable rate in wireless communication.

5	BCH codes	Algebraic Description, Frequency Domain Description, Decoding Algorithms for BCH and RS Codes.	International Academia: https://web.stanford.edu/class/ee376a/outline.html AICTE prescribed syllabus: (https://www.aicteindia.org/sites/default/files/Model_Curriculum/Final_ECE.pdf) Industry Mapping: MATLAB	P.K. Ghosh, K. Gupta, Principles of Error Correcting Code, Platinum publisher Chapter 4	6	1. Provide an example of constructing a BCH code with a specific generator polynomial and demonstrate the decoding process using syndromes. 2. Illustrate an RS code's encoding and decoding process in the frequency domain with a numerical example. 3. Provide a detailed example demonstrating the error correction process for an RS code using one of the decoding algorithms. 4. When selecting BCH and RS codes for specific applications, analyze the trade-offs between complexity and error-correcting capability.

6	Introduction to channel coding for multi users:	Introduction, Block codes for the binary adder channel, Trellis codes for the multiple access channel.	International Academia: https://web.stanford.edu/class/ee376a/outline.html AICTE prescribed syllabus: (https://www.aicteindia.org/sites/defaul t/files/Model Curriculum/Final_ECE.pdf) Industry Mapping: MATLAB	1.R.Bose, Information Theory Coding and Cryptography, Tata McGraw Hill 2. N. Abramson, Information and Coding, McGraw Hill, 1963. 2. 3. 4. 5. 3 .M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987. 4. R.B. Ash, Information Theory, Prentice Hall, 1970	4	1. What is a Binary Adder Channel (BAC)? Draw its model and explain its working with an example. 2. What are the challenges of communication over Multiple Access Channels? 3. Compare Hamming Code and Block Codes used for Binary Adder Channels. 4. What is Trellis Coding? Explain its basic principle.

Mapping Matrix of COs and POs:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3	2	1	-	-	-	2
CO2	3	2	3	3	2	3	2	1	-	-	-	1
CO3	3	3	3	2	3	2	2	2	-	-	-	2
CO4	3	2	2	2	2	2	3	3	-	-	-	2

LEARNING RESOURCES:

Text Book:

1. R. Bose, Information Theory Coding and Cryptography, Tata McGraw Hill
2. Sanjay Sharma, Communication Systems, S K Kataria & Sons, 4th edition.
3. P.K. Ghosh, K. Gupta, Principles of Error Correcting Code, Platinum publisher

Reference Book:

1. M. Kulkarni, K.S.Shivaprakasha., Information Theory and Coding, Wiley
2. N. Abramson, Information and Coding, McGraw Hill, 1963
3. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.
4. R.B. Ash, Information Theory, Prentice Hall, 1970.
5. A. El Gamal and Y. H. Kim, Network Information Theory, Cambridge University Press, 2011

Link for Online Courses:

- https://www.coursera.org/learn/information-theory
  - Practical Introduction to Information Theory | Udemy
  - Learning Cryptography and Network Security (linkedin.com)
  - Online Course: Ethical Hacking: Cryptography from LinkedIn Learning | Class Central

PECEC504B: Power Electronics

Course Title: Power Electronics	Semester : 6th
L-T-P: 3-0-0	Credit: 3
Pre-Requisites: Basic knowledge about components Resistors, Inductors, Capacitors; Network Theorems; Basic knowledge about the operation of semiconductor devices (Transistor, Diode etc.); Fourier Analysis.	

Course Objective:

1. Different types of power semiconductor devices and their switching.
2. Operation, characteristics and performance parameters of controlled rectifiers.
3. Operation, switching techniques and basic topologies of DC-DC converters and switching regulators.
4. Different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
5. Operation of AC and DC drives.

Proposed Syllabus:

Module No.	Description of Topic	Blooms Level	PO (1..12) MAPPING	Contact Hrs.
1	Power Semiconductor Devices: -Introduction, Operation, Ratings and Static and Dynamic Characteristics of Rectifier diodes, diode, Power BJT, Power MOSFET, SCR, TRIAC, IGBT and GTO. - Concept of Fast recovery diodes, Schottky diodes as freewheeling and feedback diode. -SCR turn on and turn - off methods, Triggering circuits, SCR Commutation circuits, SCR Series and Parallel operation, Snubber Circuit.	L3 Apply	PO1, PO2, PO3, PO4, PO12	6

2	Controlled Rectifiers: -Single phase: Study of semi and full bridge converters for R, RL, RLE loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor. -Effect of source impedance, Input current, Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.	L4 Analyze	PO1, PO2, PO3, PO4, PO12	6
3	Choppers: Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, -Step up and Step down choppers, -Control techniques for choppers - Time ratio control and current limit control, -Buck, Boost, Buck-Boost and Cuk Converters, - Concept of Resonant Switching	L3 Apply	PO1, PO2, PO3, PO4, PO12	6
4	Single phase and three phase inverters: -Principle of operation of half-bridge and full-bridge square wave and quasi-square inverter, mathematical analysis for output voltage and harmonics. PWM techniques, Single pulse PWM, Multipulse PWM, Sinusoidal PWM, modified Sinusoidal PWM, mathematical analysis for output voltage and	L3 Apply	PO1, PO2, PO3, PO4, PO12	6

	harmonics, harmonic Control using PWM, Series resonant inverter. -Single phase Current Source Inverter.			
5	Switching Mode Power Supplies: -Analysis of fly back, forward converters for SMPS, - Resonant converters, -Concept of soft switching, switching trajectory and SOAR, Load resonant converter - Series loaded half bridge DC-DC converter.	L4 Analyze	PO1, PO2, PO3, PO4, PO12	5
6	Applications: -Power line disturbances, EMI/EMC, power conditioners. -Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings and sizing of UPS. -Separately excited DC motor drive. P M Stepper motor Drive.			6
Total				**34**

Course Outcome:

CO1: Build and test circuits using power devices such as SCR, Power MOSFET, IGBT etc.

CO2: Analyze and design controlled rectifiers, DC to DC converters, DC to AC inverters.

CO3: Learn how to analyse these inverters and some basic applications.

CO4: Design SMPS.

Learning Resources:

1. Muhammad H. Rashid, “Power Electronics.” Prentice Hall of India.
1. Ned Mohan and Robbins, “Power Electronics,” 3rd ed., John Wiley & Sons.
2. P. C. Sen, “Modern Power Electronics,” Chand & Co.
3. V. R. Moorthi, “Power Electronics,” Oxford University Press.
4. Cyril W. Lander, “Power Electronics,” 3rd ed., McGraw-Hill.
5. G. K. Dubey and S. R. Doradla, “Thyristorised Power Controllers,” New Age International Publishers; SCR Manual, GE, USA.

Mapping:

CO PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
ECEL-EC603B.	3	3	2	2	2	-	-	-	-	-	-	2
ECEL-EC603B.2	3	3	2	2	2	-	-	-	-	-	-	2
ECEL-EC603B.3	3	3	-	2	2	-	3	-	-	-		2
ECEL-EC603B.4	3	2	1	2	-	2	2	2	1	2	2	2
* ECEL-EC603B	3	2.75	1.25	2	1.5	0.5	1.25	0.5	0.25	0.5	0.5	2
1: Low (Slight) 2: Moderate (Medium) 3: Substantial (High)												

ESPEC501: Essential Studies for Professionals (EC)-V

Subject Name : ESP-V	Semester : 5th
L-T-P : 2-0-0 (Total Contact Hrs. 2)	Credit: 2
Pre-Requisites: Basic Physics	

Course Objective:

1. To learn about basic of network theory and circuits for professional exams
2. To learn about fundamentals of electronics devices for various exams
3. To learn about details of analog electronics circuits for professional exams
4. To learn about fundamentals of signal and systems for various exams

Course Outcomes:

At the end of the course the students will be able

1. To develop an understanding of network theory and circuits and their applications.
2. To learn all types electronics devices principle of operation and applications.
3. To understand the analog circuit theory and integrated circuits elements' principles.
4. To utilize various signals operation for different systems effectively.

Course Content:

Module No.	Description	Hours	Blooms Level	PO(1..12) Mapping
1.	**Networks Theory** Network solution methods: Nodal and mesh analysis; Network theorems: superposition, Thevenin and Norton's, maximum power transfer; Wye-Delta transformation; Steady state sinusoidal analysis using phasors; Time domain analysis of simple linear circuits; Solution of network equations using Laplace transform; Frequency domain analysis of RLC circuits; Linear 2-port network parameters: driving point and transfer functions; State equations for networks.	12	L1 (Remember) L2 (Understand) L4 (Analyze)	PO1,PO2, PO3,PO12
2.	**Electronic Devices** Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; Generation and recombination of carriers; Poisson and continuity equations; P-N junction, Zener diode, BJT, MOS capacitor, MOSFET, LED, photo diode and solar cell; Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography and twin-tub CMOS process.	12	L1 (Remember) L2 (Understand) L3 (Apply) L4 (Analyze)	PO1,PO2, PO3,PO12
3.	**Analog Circuits**	12	L1 (Remember) L2 (Understand) L3 (Apply)	PO1,PO2, PO3,PO12

Module No.	Description	Hours	Blooms Level	PO(1..12) Mapping
	Small signal equivalent circuits of diodes, BJTs and MOSFETs; Simple diode circuits: clipping, clamping and rectifiers; Single-stage BJT and MOSFET amplifiers: biasing, bias stability, mid frequency small signal analysis and frequency response; BJT and MOSFET amplifiers: multi-stage, differential, feedback, power and operational; Simple op-amp circuits; Active filters; Sinusoidal oscillators: criterion for oscillation, single-transistor and op-amp configurations; Function generators, wave-shaping circuits and 555 timers; Voltage reference circuits; Power supplies: ripple removal and regulation		L4 (Analyze)	
4.	**Signals and Systems** Continuous-time signals: Fourier series and Fourier transform representations, sampling theorem and applications; Discrete-time signals: discrete-time Fourier transform (DTFT), DFT, FFT, Z-transform, interpolation of discrete-time signals; LTI systems: definition and properties, causality, stability, impulse response, convolution, poles and zeros, parallel and cascade structure, frequency response, group delay, phase delay, digital filter design techniques.	6	L1 (Remember) L2 (Understand) L3 (Apply) L4 (Analyze)	PO1,PO2, PO3,PO12

Learning Resources:

Ref. Books:

1. G.K publishers GATE ELECTRONICS & COMMUNICATIONS
2. Mcgraw hill GATE 2020 ELECTRONICS & COMMUNICATIONS
3. Wiley GATE 2020 ELECTRONICS & COMMUNICATIONS

HSM576: Economics for Engineers

Subject Name : Economics for Engineers	Semester : 5th
L-T-P : 2-0-0 (Total Contact Hrs. 2)	Credit: 2
Pre-Requisites: Basics of Economics for Engineers.	

Course Objective (CO):

1. To understand economic decisions making and engineering Costs & Estimation - Overview, Problems, Role, Decision making process and different types of costs and estimation.
2. To understand Cash Flow, Interest & Equivalence and Rate of Return Analysis using diagrams, categories & computation, time value of money, debt repayment, nominal & effective interest. 3. To familiarize with Inflation & Price Change, Present Worth Analysis and Uncertainty In Future Events.
4. To analyze different types of Depreciation, Replacement Analysis and Accounting - Basic Aspects, Deterioration & Obsolescence, Depreciation and Expenses. Function, Balance Sheet, Income Statement and Financial Ratios Capital Transactions.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	1. Economic Decisions Making - Overview, Problems, Role, Decision making process. 2. Engineering Costs & Estimation - Fixed, Variable, Marginal & Average Costs, Sunk Costs, Opportunity Costs, Recurring And Nonrecurring Costs, Incremental Costs, Cash Costs vs Book Costs, Life-Cycle Costs; Types Of Estimate, Estimating Models Per Unit Model, Segmenting Model, Cost Indexes, Power-Sizing Model, Improvement & Learning Curve, Benefits.	10

2	3. Cash Flow, Interest and Equivalence: Cash Flow - Diagrams, Categories & Computation, Time Value of Money, Debt repayment, Nominal & Effective Interest. 4. Cash Flow & Rate Of Return Analysis - Calculations, Treatment of Salvage Value, Annual Cash Flow Analysis, Analysis Periods; Internal Rate Of Return, Calculating Rate of Return, Incremental Analysis; Best Alternative Choosing An Analysis Method, Future Worth Analysis, Benefit-Cost Ratio Analysis, Sensitivity And Breakeven Analysis. Economic Analysis In The Public Sector - Quantifying And Valuing Benefits & drawbacks.	10
3	5. Inflation And Price Change - Definition, Effects, Causes, Price Change with Indexes, Types of Index, Composite vs Commodity Indexes, Use of Price Indexes In Engineering Economic Analysis, Cash Flows that inflate at different Rates. Present Worth Analysis: End-Of-Year Convention, Viewpoint Of Economic Analysis Studies, Inflation & Deflation, Taxes, Economic Criteria, Applying Present Worth Techniques, Multiple Alternatives. 7. Uncertainty In Future Events - Estimates and Their Use in Economic Analysis, Range Of Estimates, Probability, Joint Probability Distributions, 6. Expected Value, Economic Decision Trees, Risk, Risk vs Return, Simulation, Real Options.	10

4	8. Depreciation - Basic Aspects, Deterioration & Obsolescence, Depreciation And Expenses, Types Of Property, Depreciation Calculation Fundamentals, Depreciation And Capital Allowance Methods, Straight-Line Depreciation Declining Balance Depreciation, Common Elements Of Tax Regulations For Depreciation And Capital Allowances. 9. Replacement Analysis - Replacement Analysis Decision Map, Minimum Cost Life of a New Asset, Marginal Cost, Minimum Cost Life Problems. 10. Accounting - Function, Balance Sheet, Income Statement, Financial Ratios Capital Transactions, Cost Accounting, Direct and Indirect Costs, Indirect Cost Allocation.	10

Books Recommended:

1. 1. James L.Riggs,David D. Bedworth, Sabah U. Randhawa : Economics for Engineers 4e , Tata McGraw-Hill
2. Donald Newnan, Ted Eschembach, Jerome Lavelle: Engineering Economics Analysis, OUP
3. John A. White, Kenneth E.Case,David B.Pratt : Principle of Engineering Economic Analysis, John Wiley
4. Sullivan and Wicks: Engineering Economy, Pearson
5. R.Paneer Seelvan: Engineering Economics, PHI
6. Michael R Lindeburg : Engineering Economics Analysis, Professional Pub

Course Outcomes:

S.NO.	DESCRIPTION	Blooms Level
	Students will be able to:	
HSMC 576.1	Relate and understand economic decisions making and engineering Costs & Estimation.	Understand and Apply (level1 and2)
HSMC 576.2	Explain Cash Flow, Interest & Equivalence and Rate of Return Analysis.	Understand (level3)
HSMC 576.3	Describe Inflation & Price Change, Present Worth Analysis and Uncertainty In Future Events.	Knowledge (level2)
HSMC 576.4	Analyze different types of Depreciation, Replacement Analysis and Accounting.	Apply (level4)

MAPPING OF CO WITH PO (DETAILED; HIGH: 3; MEDIUM: 2; LOW: 1):

S.NO	PO 1	PO2	PO 3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
HSMC576.1	3	2		1								1
HSMC576.2		1		1								1
HSMC576.3			1									2
HSMC576.4		2	2	1	3							2

* For Entire Course, PO Mapping; 1 (Low); 2(Medium); 3(High) Contribution to PO

PCCEC591: Electromagnetic Waves Laboratory

Subject Code : PCCEC591	Category : Professional Core course
Subject Name : Electromagnetic Waves Lab	Semester : 5th
L-T-P : 0-0-2 (Total Contact Hrs. 2)	Credit:1
Pre-Requisites: Mathematics, Physics, Signals and Systems	

Course Objective:

1. To help students to perform Electromagnetic Waves, Transmission Lines and Antenna related experiments assigning design problems
2. To help students realize simulation results at the end of each experiment

Course Content:

Module No.	Description of Topic	Contact Hrs.
1. A	Plotting of Standing Wave Pattern along a transmission line when the line is open-circuited, short-circuited and terminated by a resistive load at the loadend	2
1. B	Input Impedance measurement of a terminated waveguide using shift in minima technique	2
1. C	Smith chart and its application for unknown impedance measurement	2
1. D	Determination of phase and group velocities in a waveguide carrying TE 10	2
2. A	Measurement of Radiation Pattern of simple Dipole Antenna	2
2.B	Measurement of Radiation Pattern of Folded Dipole Antenna	2
2.C	Measurement of Radiation Pattern of Yagi - Uda Antenna	2
2.D	Introduction and Measurement of Radiation Pattern of Pyramidal Horn Antenna	2
3.	Study of Spectrum Analyzer	2
4.	One innovative experiment	2

Course Outcomes:

1. Students will be able to demonstrate the ability to solve practical engineering problems related to Electromagnetic Waves, Transmission Lines and Antennas.

2. Students can realize about simulation outputs for different experiments.
3. Students can be able to analyze and interpret data obtained from different experiments.

Learning Resources:

1. Laboratory manual provided from the organization
2. Sadiku & Kulkarni, Principles of Electromagnetics, 6e, Asian edition, Copyright © 2015 by Oxford University Press
3. MATLAB/https://octave-online.net

PCCEC592: Microprocessor & Microcontroller Laboratory

Subject Code : PCCEC592	Category: Professional Core course
Subject Name : Microcontrollers Lab	Semester : 4th
L-T-P : 0-0-2 (Total Contact Hrs. 2)	Credit:1
Pre-Requisites:	

Course Objective:

1. To introduce the basic concepts of microprocessor and to develop in students the assembly language programming skills and real time applications of Microprocessor as well as microcontroller .
2. To Study the Architecture of 8051 microcontrollers.

Module No.	Description of Topic	Contact Hrs.	Blooms Level
1.	Introduction to 8085 microprocessor architecture. Comparison between microprocessor and microcontroller. Students are introduced with the operation of microprocessor (8085) trainer kit and simulator 8085.	2	L2 (Understand)
2.	Study of basic instruction set used in 8085 microprocessor program (data transfer,Load/store,Arithmetic,logical).	2	L2 (Understand) L3 (Apply)
3.	Study of 8085 microprocessor program (16- bit) for interchanging the nibbles, assemble, compliment, multiplication, maximum, minimum.	2	L2(Understand) L3 (Apply)
4.	Study of 8085 program using LOOK UP TABLE,PUSH POP instruction.	2	L2 (Understand) L3 (Apply)
5.	Study of 8085 program for addition and subtraction of BCD numbers.	2	L2 (Understand) L3 (Apply)
6.	Study of 8085 program for sorting of array in ascending and descending order, division of 8-	2	L2 (Understand) L3 (Apply)
	bit nos, BCD multiplication, SUBROUTINE CALL,		
7.	Study of 8051 microcontroller IC and writing programs.	2	L2 (Understand) L3 (Apply)

Course Outcomes:

CO1: Students will be able to compare micro-processors (8085) and microcontrollers (8051).

CO2: Students will be able to explain the architecture of microprocessors.

CO3: Students will be able to write programs of different problems.

CO4: Students will be able to design real time applications using micro-controllers.

S.NO	PO 1	PO2	PO 3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
1	1	3	3	2								
2	1	3	3	3								
3	1	3	3	3								
4	1	2	1	1								
5	1	3	3	3								
6	1	3	3	3								
7	1	3	3	3								

Learning Resources :

1. Microprocessor architecture, programming and application with 8085 R. Gaonkar (Penram International) (strongly recommended)
2. Microprocessors & interfacing D. V. Hall (Tata McGraw-hill)
3. Ray & Bhurchandi, Advanced Microprocessors & Peripherals, TMH
4. The 8051 microcontroller and Embedded systems - Mazidi, Mazidi and McKinley (PEARSON)

PCCEC592: VLSI Design Laboratory

Subject Code	PCCEC593
Subject Name	VLSI Design Laboratory
L-T-P	0-0-2 (Total Contact Hrs. 2)
Pre-Requisites	Electronic Devices, Analog Electronic Circuits, Digital Electronic Circuits, Basic Verilog HDL

Course Objective

- To familiarize students with CMOS analog and digital circuit design using industry-standard EDA tools.
- To provide hands-on experience in Verilog HDL design, RTL synthesis, FPGA implementation, and ASIC physical design flow.

Course Content

Module No.	Description of Topic	Contact Hrs.
2	Design of CMOS inverter. Verify truth table, determine inverter transition voltage, and measure propagation delay using Cadence Virtuoso (gpdk180).	2
2	Design a resistive-loaded Common Source amplifier for a specified gain. Verify DC operating point and AC response.	2
2	Design a resistive-loaded differential amplifier. Measure differential gain, common-mode gain and calculate CMRR.	2
3	Design a current reference circuit and analyze current variation under PVT corners.	2
3	Design and simulate a switched-capacitor circuit equivalent to a resistor.	2
4	Verilog HDL modeling and functional simulation of basic combinational circuits with testbench.	2
4	Design, simulation and RTL synthesis of a 4-bit ALU using Verilog HDL.	2
4	Design and FPGA implementation of a 4-bit synchronous counter.	2
1	RTL synthesis, timing analysis and report generation using Cadence Genus.	2
1	ASIC physical design flow using Cadence Innovus (Floorplanning, Placement, CTS, Routing and Timing Verification).	2

Course Outcomes

1. Design and simulate CMOS analog and digital circuits using Cadence Virtuoso.
2. Develop, simulate and verify digital circuits using Verilog HDL.
3. Perform RTL synthesis, timing analysis and evaluate digital circuit performance.
4. Implement the complete ASIC physical design flow using Cadence Genus and Innovus.

Learning Resources

5. Laboratory manual provided by the department.
6. Neil H. E. Weste and David Harris, CMOS VLSI Design: A Circuits and Systems Perspective.
7. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis and Design.
8. Behzad Razavi, Design of Analog CMOS Integrated Circuits.
9. Cadence Virtuoso, Cadence Genus, Cadence Innovus, Xilinx Vivado/ModelSim User Guides.

PCCEC594: Data Base Management System Laboratory

Objective:

To explain basic database concepts, applications, data models, schemas and instances.
To demonstrate the use of constraints and relational algebra operations.
Describe the basics of SQL and construct queries using SQL.
To emphasize the importance of normalization in databases.
To facilitate students in Database design.
To familiarize issues of concurrency control and transaction management.

Course Outcome:

Upon completion of the course, the students will be able to:
CO1: Apply the basic concepts of Database Systems and Structured Query Language to create table and database.
CO2: Handle Table and Records within the table.
CO3: Retrieve Data from a Database and manage the database.
CO4: Design & implement a commercial relational database system (Oracle, MySQL) by writing SQL.

List of Experiments:

Serial No.	Experiment No.	Experiment Name
1	1	Create a database table, add constraints (primary key, unique, check, Not null), insert rows, update and delete rows using SQL DDL and DML commands.
2	2	Create a set of tables, add foreign key constraints and incorporate referential integrity.
3	3	Query the database tables using different 'where' clause conditions and also implement aggregate functions.
4	4	Query the database tables and explore sub queries and simple join operations.
5	5	Query the database tables and explore natural, equi and outer joins.
6	6	Write user defined functions and stored procedures in SQL.
7	7	Execute complex transactions and realize DCL and TCL commands.

8	8	Write SQL Triggers for insert, delete, and update operations in a database table.
9	9	Create View and index for database tables with a large number of records.
10	10	Case Study using any of the real-life database applications from the following list: a) Inventory Management for a EMart Grocery Shop b) Society Financial Management c) Cop Friendly App – Eseva d) Property Management – eMall e) Star Small and Medium Banking and Finance

OEC581: Programming in Cloud

Subject Name – Programming in Cloud (OEC581) **Lecture Hours – 36**

1. Course Objectives

- Establish the relevance of being exposed to the fundamental understanding of cloud computing for Electronics engineering students.
- Develop cloud literacy: terminology, service models, deployment models, virtualization and infrastructure concepts.
- Build hands-on familiarity with the four core cloud pillars — compute, storage, database and networking — using industry standard cloud platform free-tier services.
- Introduce foundational security, monitoring and containerization practices needed to use cloud resources safely and effectively.
- Conclude with application of cloud computing to IoT, Industry 4.0 and SCADA-related electronics use cases, integrating the skills built across the course.

2. Course Outcomes

On successful completion of this course, students will be able to:

- CO1 (Understand): Explain cloud computing fundamentals, service models (IaaS/PaaS/SaaS) and deployment models.
- CO2 (Understand): Describe virtualization basics and identify core cloud infrastructure components (regions, availability zones).
- CO3 (Apply): Launch and access a virtual machine using a free-tier cloud service.
- CO4 (Apply): Create and use basic object-storage and managed-database resources on a public cloud platform.
- CO5 (Apply): Configure basic cloud networking (virtual network, subnet, security rule).
- CO6 (Apply): Apply fundamental IAM security practices and use basic cloud monitoring dashboards.
- CO7 (Apply): Containerize and run a simple application using Docker.
- CO8 (Analyse): Connect a simulated sensor to a cloud service and visualize the data, relating the exercise to IoT, Industry 4.0 and SCADA applications in electronics engineering.

3. Detailed Curriculum Table

Module #	Module Name	Topics	Subtopics (Theory)	Subtopics (Lab)	Mapping with Industry and International Academia	Lecture Hours
1	Cloud Computing Basics	• Cloud computing overview • Relevance for Electronics Engineers	• What is cloud computing: on-demand access, elasticity, pay-per-use (NIST definition) • Traditional IT vs Cloud IT; key benefits • Relevance for Electronics Engineers: cloud enables remote monitoring, IoT dashboards and scalable storage for sensor/embedded systems — this connection underlies every module that follows	• Sign up for a cloud free-tier account (AWS/Azure/GCP) and explore the management console	• NIST SP 800-145 Cloud Definition • AWS Cloud Practitioner Essentials	4
2	Cloud Service Models & Deployment Models	• IaaS, PaaS, SaaS • Public, Private, Hybrid	• IaaS / PaaS / SaaS definitions with examples — EC2 (IaaS), Elastic Beanstalk (PaaS), Gmail (SaaS) • Public, private, hybrid and multi-cloud deployment models and when each is used	• Worksheet: classify familiar tools/services as IaaS, PaaS or SaaS, and select a deployment model for a sample scenario	• AWS Cloud Practitioner Essentials – Module 2 • Microsoft Learn: Azure Fundamentals (AZ-900)	8
	Virtualization & Cloud Infrastructure	• Hypervisors and VMs • Regions and Availability Zones	• What is virtualization; Type-1 (bare-metal) vs Type-2 (hosted) hypervisors • Regions, availability zones and edge locations; basic SLA/uptime idea	• Create and run a virtual machine using VirtualBox; explore the AWS/Azure global infrastructure map	• AWS EC2 – Instances & Virtualization concepts • Kai Hwang, “Distributed and Cloud Computing” (Ch. 3)	
3	Compute Services	• Virtual Machines • Basic Cloud Hosting	• EC2 / Azure VM / Compute Engine basics; instance types and common use cases	• Launch a free-tier VM (e.g. AWS EC2 t2.micro); connect via SSH/browser • Install a simple web server; stop and terminate the instance	• AWS EC2 documentation & AWS Academy Cloud Foundations • Microsoft Learn: Azure Compute (AZ-900)	12
	Storage Services	• Object Storage • File Storage	• Object storage (S3) concepts: buckets and objects; file storage basics	• Create an S3 bucket; upload/download files; configure basic access permissions	• AWS S3 documentation & AWS Academy • Microsoft Learn: Azure Storage fundamentals	
	Database Services	• Managed SQL Database • Database-as-a-Service	• Relational database recap; managed SQL services (RDS / Azure SQL / Cloud SQL); the DBaaS concept	• Create a free-tier managed SQL database; run basic insert/select queries on sample data OR demo Database-as-a-Service	• AWS RDS documentation • Microsoft Learn: Azure SQL Database	
	Networking in Cloud	• Virtual Networks • Subnets • Security Rules	• Virtual network / VPC concepts; subnets; security groups / security rules for controlling traffic	• Create a simple virtual network with a subnet; configure a security rule to allow specific traffic	• AWS VPC documentation • Microsoft Learn: Azure Virtual Network (AZ-900/AZ-104)	

Module #	Module Name	Topics	Subtopics (Theory)	Subtopics (Lab)	Mapping with Industry and International Academia	Lecture Hours
4	IAM, Security & Monitoring	• IAM Users and Roles • Monitoring Dashboards	• IAM concepts: users, roles, policies and least privilege • Monitoring basics: metrics, logs and alarms	• Create an IAM user with a basic policy; view a monitoring dashboard for a running VM	• AWS IAM & CloudWatch documentation • Microsoft Learn: Security Fundamentals (SC-900) / Azure Monitor	12
	Introduction to Containers	• Docker Basics	• Containers vs VMs (brief); Docker images and containers concept	• Install Docker; run a pre-built container (e.g. a simple web app)	• Docker official documentation • AWS ECS overview (awareness level)	
	Cloud for IoT and Electronics Applications	• IoT-Cloud integration • Industry 4.0 / SCADA applications	• IoT architecture: device → gateway → cloud; overview of AWS IoT Core / Azure IoT Hub • Industry 4.0, SCADA and smart-manufacturing use cases	• Simulate sensor data with a simple script and push it to a cloud IoT service; visualize it on a basic cloud dashboard (use Python simulation)	• AWS IoT Core documentation • Industry 4.0 reference frameworks	

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1			1							2
CO2	3	2			2							2
CO3	2	2	2		3				1	1		2
CO4	2	2	2		3				1	1	1	2
CO5	2	2	2		3	1			1	1		2
CO6	2	2			3	1		3	1	1		2
CO7	2	2	2		3				1	1		2
CO8	3	3	3	2	3	2	2	1	2	2	2	2

4. Textbooks

- Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi — “Mastering Cloud Computing”, McGraw Hill Education, 2013.
- Arshdeep Bahga, Vijay Madisetti — “Cloud Computing: A Hands-On Approach”, Universities Press, 2014 (lab-oriented, beginner-friendly).
- Ben Piper, David Clinton — “AWS Certified Cloud Practitioner Study Guide”, Sybex, latest edition.

5. Reference Books / Online Resources / URLs

- AWS Skill Builder / AWS Academy Cloud Foundations — https://skillbuilder.aws
- AWS Free Tier — https://aws.amazon.com/free
- Microsoft Learn — Azure Fundamentals (AZ-900) — https://learn.microsoft.com/training/azure/
- Google Cloud Skills Boost — https://www.cloudskillsboost.google
- NPTEL — Cloud Computing, IIT Kharagpur — https://onlinecourses.nptel.ac.in
- Coursera — “Google Cloud Digital Leader” / “AWS Cloud Technical Essentials” (audit access) — https://www.coursera.org
- edX — “Introduction to Cloud Computing” (audit access) — https://www.edx.org
- Docker Documentation and Get-Started guide — https://docs.docker.com/get-started/

SDP581: Skill Development for Professionals-V

L-T-P : 2-0-0 (Total Contact Hrs. 2)	Credit: 1
Pre-Requisites: Basic Mathematics, General English from primary to high school.	

Course Objective:

1. To enhance the aptitude & analytical skill of students with multiple tricky approaches.
2. To prepare the students for various competitive examinations & professional exams

Course Content:

1. To enhance their problem solving skills, to improve the basic mathematical & Logical Skills for any type of competitive examinations.
2. To get best possible training for the them students through continuous training module.
3. To find themselves sound for the campus recruitment program's aptitude test.
4. To enhance problem solving skill using fast track techniques without using calculator.

Module No.	Description	Hours	Blooms Level	PO(1..12) Mapping
1.	Quantitative Aptitude & Data Interpretation- Miscellaneous	12	L1 (Remember) L2 (Understand) L4 (Analyse)	PO1,PO2, PO3,PO4
2.	Logical Reasoning 1) Statement And Assumption, 2) Statement And Conclusion, 3) Statement And Course Of Action, 4) Cause And Effect, 5) Drawing Inference	12	L1 (Remember) L2 (Understand) L3 (Apply) L4 (Analyze)	PO1,PO2, PO3,PO4
3.	Verbal English 1. Sentence Correction 2. Fill the blanks with appropriate words/articles/preposition/verbs/adverbs/conjunction.	12	L1 (Remember) L2 (Understand) L3 (Apply) L4 (Analyze)	PO1, PO2, PO3, PO4

	Reading Comprehension (Advance Level) Vocabulary.			
4	Data interpretation: Advanced Level	6	L1 (Remember) L2 (Understand) L3 (Apply) L4 (Analyze)	PO1, PO2, PO3, PO4

Learning Resources:

Reference Books:

1. Objective General English - S.P Bakshi
2. English Grammar and Competition - S.C Gupta
3. Fast Track Objective Arithmetic - Rajesh Verma
4. Advance Maths - Rakesh Yadav
5. Verbal and Non-Verbal Reasoning - R.S Agarwal
6. A new approach to Reasoning - BS Sijwali
7. Quantitative Aptitude - R.S Agarwal