

SYLLABUS

(With effect from 2023 -24)

ಪಠ್ಯಕ್ರಮ

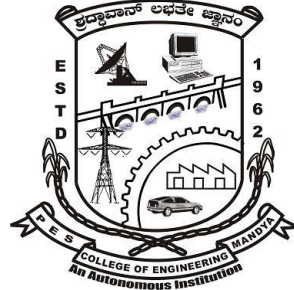
(ಶೈಕ್ಷಣಿಕ ವರ್ಷ 2023-24)

Bachelor Degree
In
Electronics & Communication Engineering

V & VI Semester

Out Come Based Education
With
Choice Based Credit System

[National Education Policy Scheme]



P.E.S. College of Engineering, Mandya - 571 401, Karnataka

*[An Autonomous Institution affiliated to VTU, Belagavi,
Grant – in – Aid Institution (Government of Karnataka),
Accredited by NBA (All UG Programs), NAAC and Approved by AICTE, New Delhi]*

ಪಿ.ಇ.ಎಸ್. ತಾಂತ್ರಿಕ ಮಹಾವಿದ್ಯಾಲಯ
ಮಂಡ್ಯ-571 401, ಕರ್ನಾಟಕ
(ವಿ.ಟಿ.ಯು, ಬೆಳಗಾವಿ ಅಡಿಯಲ್ಲಿನ ಸ್ವಾಯತ್ತ ಸಂಸ್ಥೆ)

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VISION

“PESCE shall be a leading institution imparting quality Engineering and Management education developing creative and socially responsible professionals.”

MISSION

- *Provide state of the art infrastructure, motivate the faculty to be proficient in their field of specialization and adopt best teaching-learning practices.*
- *Impart engineering and managerial skills through competent and committed faculty using outcome based educational curriculum.*
- *Inculcate professional ethics, leadership qualities and entrepreneurial skills to meet the societal needs.*
- *Promote research, product development and industry-institution interaction.*

QUALITY POLICY

Highly committed in providing quality, concurrent technical education and continuously striving to meet expectations of stake holders.

CORE VALUES

Professionalism

Empathy

Synergy

Commitment

Ethics



Department of Electronics and Communication Engineering

The department of Electronics and Communication Engineering was incepted in 1967 with an undergraduate program in Electronics and Communication Engineering. Initially, the program had an intake of 60 students, which increased to 120 in 2012, and further increased to 180 in 2019. Almost 200 students graduate every year, and the long journey of 50 years has seen satisfactory contributions to society, the nation, and the world. The alumni of this department have a strong global presence, making their alma mater proud in every sector they represent.

The department started its PG program in 2012 in the specializations of VLSI design and embedded systems. Equipped with well qualified and dedicated faculty, the department has a focus on VLSI design, embedded systems, and image processing. The quality of teaching and training has yielded a high growth rate of placement at various organizations. The large number of candidates pursuing research programs (M.Sc. and Ph.D.) is a true testimonial to the research potential of the department. The department is recognized as a research centre by VTU, and Mysore University offers a part-time and full-time Ph.D. Program.

Vision

The department of E & C would endeavour to create a pool of Engineers who would be extremely competent technically, ethically strong also fulfil their obligation in terms of social responsibility.

Mission

- M1: Adopt the best pedagogical methods and provide the best facility, infrastructure and an ambience Conducive to imbibe technical knowledge and practicing ethics.
- M2: Group and individual exercises to inculcate habit of analytical and strategic thinking to help the Students to develop creative thinking and instil team skills
- M3: MoUs and Sponsored projects with industry and R & D organizations for collaborative learning
- M4: Enabling and encouraging students for continuing education and moulding them for life-long Learning process

Program Educational Objectives (PEOs)

- **PEO1:** Graduates to exhibit knowledge in mathematics, engineering fundamentals applied to Electronics and Communication Engineering for professional achievement in industry, research and academia
- **PEO2:** Graduates to identify, analyse and apply engineering concepts for design of Electronics and Communication Engineering systems and demonstrate multidisciplinary expertise to handle societal needs and meet contemporary requirements
- **PEO3:** Graduates to perform with leadership qualities, team spirit, management skills, attitude and ethics need for successful career, sustained learning and entrepreneurship.



Program Outcomes (POs)

- **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Industrial and Production Engineering Graduates will be able to

- **PSO1:** Industrial & Production engineering graduates will be able to apply the knowledge acquired in the program about materials and finishing process
- **PSO2:** Industrial & Production engineering graduates will be able to design product based on Ergonomic Principles



Bachelor of Engineering (V –Semester)											
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week				Credits	Examination Marks		
				L	T*	P	PJ		CIE	SEE	Total
1	P21 EC 501	Management Course as per the requirement of the concerned programme.	EC	3	-	-	-	3	50	50	100
2	P21 EC 502	Digital CMOS VLSI Design	EC	3	-	-	-	3	50	50	100
3	P21 EC 503X	Professional Elective Course - I	EC	3	-	-	-	3	50	50	100
4	P21 EC 504	Digital Signal Processing	EC	3	-	2	-	4	50	50	100
5	P21 ECO505X	Open Elective - I	EC	3	-	-	-	3	50	50	100
6	P21 EC L506	Circuit Simulation Laboratory	EC	-	-	2	-	1	50	50	100
7	P21INT507	Internship - II	EC	-	-	-	-	2	-	100	100
8	P21HSMC508	Employability Enhancement Skills – V	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV509	Social Connect and Responsibility	EC	1	-	-	-	1	100	-	100
Total								21			

Professional Elective Course – I (P21EC503X)	
Course Code	Course Title
P21EC5031	Fundamentals of object oriented Language and Database Concepts
P21EC5032	System Verilog
P21EC5033	Control System
P21EC5034	ARM Processors

Open Elective – I(P21EC0505X)	
Course Code	Course Title
P21EC 05051	E-Waste Management
P21EC 05052	Principles of Communication Systems
P21EC 05053	Biometrics
P21EC 05054	Sensors and IOT

Bachelor of Engineering (VI –Semester)											
Sl. No.	Course Code	Course Title	Teaching Department	Hrs / Week				Credits	Examination Marks		
				L	T*	P	PJ		CIE	SEE	Total
1	P21EC601	Analog CMOS VLSI Design	EC	3	-	-	-	3	50	50	100
2	P21EC602X	Professional Elective Course – II	EC	3	-	-	-	3	50	50	100
3	P21EC603X	Professional Elective Course - III	EC	3	-	-	-	3	50	50	100
4	P21EC604	Microwave and Antenna	EC	3	-	2	-	4	50	50	100
5	P21ECO605X	Open Elective – II	EC	3	-	-	-	3	50	50	100
6	P21ECL606	VLSI Lab	EC	-	-	2	-	1	50	50	100
7	P21ECMP607	Mini - Project	EC	-	-	2	2	2	50	50	100
8	P21HSMC608	Employability Enhancement Skills - VI	HSMC	1	-	-	-	1	50	50	100
9.	P21UHV609	Universal Human Values and Professional Ethics	XX	1	-	-	-	1	50	50	100
Total								21			

Professional Elective Course – II (P21EC602X)	
Course Code	Course Title
P21EC6021	ITC and Multimedia Communications
P21EC6022	DSP Processor and Applications
P21EC6023	Embedded Systems
P21EC6024	Operating System

Professional Elective Course – III (P21EC603X)	
Course Code	Course Title
P21EC6031	Computer Organization
P21EC6032	Digital Image Processing
P21EC6033	Design for Testability
P21EC6034	Artificial Intelligence and Machine Learning using VLSI

Open Elective – II (P21ECO605X)	
Course Code	Course Title
P21ECO6051	Electronic Instrumentation
P21ECO6052	Introduction to Embedded Systems
P21ECO6053	Introduction to Image Processing
P21ECO6054	Automotive Electronics

*Allot Tutorial as per the course requirement subjected to the credits allotted.

L -Lecture, T - Tutorial, P- Practical/ Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination



Innovation, Entrepreneurship and Management [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21EC501	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives:. <ol style="list-style-type: none">1. Relate the role and importance of innovation in economic growth, skills of innovator, types of innovation and output forms of innovation.2. Understand various ways to create and manage intellectual property and prepare innovation proposal.3. Understand the entrepreneurial development process and recognize the core role of creativity and innovation in managing the entrepreneurial process effectively.4. Understand the fundamental concepts and principles of management, including the basic roles, skill, and functions of management.5. Understand the procedure of creating an ownership and its types.6. Express the meaning of Professional Ethics, its importance and needs.			
UNIT – I			8 Hours
Introduction to Innovation and Innovator: Introduction, understanding Innovation, Creativity and Research, Role of Innovation in economic growth of country, companies and community, phases of innovation journey, Roles of Innovator. Text 1: Chapter 1 to 5			
Self-study component:	Prepare a Case study of An Innovator: How did he/she find the problem, thought about a solution and steps/situations came across during implementation.		
UNIT – II			8 Hours
Innovator Skills and Innovation: Introduction to Innovative Skills, Types of Innovation, Introduction to patents and IP, preparing an innovation proposal Pitching an innovation proposal, Sustaining innovation. Text 1: Chapter 6 to 13			
Self-study component:	Prepare a case study of an entrepreneur around you.		
UNIT – III			8 Hours
Entrepreneurship and Entrepreneurs: Evolution of the concept of Entrepreneur, Characteristics of an Entrepreneur, Distinction between an Entrepreneur & a Manager, Functions of an Entrepreneur, Types of Entrepreneur. Concept of Entrepreneurship, Growth of Entrepreneurship in India, Role of Entrepreneurship in Economic Development. Text 2: 1.1 to 1.10, 2.1 to 2.3			
Self-study component:	Prepare a Case Study of an Entrepreneur / an Enterpriser or an Enterprise.		
UNIT – IV			8 Hours
Management and Business Ownership: Fundamentals of Management: Meaning of Management, Management as Science, Art & Profession, Importance of Management, Scope of Management, Functions of Management, Management Process, Principles of Management. Forms of Business Ownership: Sole Proprietorship, Partnership, Company, Cooperative, Selection of Appropriate Form of Ownership Structure.			



Text 2: 24.1 to 24.9 & 18.1 to 18.5	
Self-study component:	Being in different positions as an employee: Understanding Self, Self-Management & Understanding others for Effective Relationships and Communication.
UNIT – V	
8 Hours	
Engineering and Professional Ethics: Making a Case: Introduction, Role Morality, What is a Profession?, Professional Ethics, The NSPE Board of Ethical Review, Engineering Ethics as Preventive Ethics Honesty: Introduction, Ways of Misusing Truth, Why is Dishonesty Wrong? International Engineering Professionalism: Introduction, Problems in International Professionalism, Problems in Interpreting and Applying the Codes, Striking a Balance, Guidelines for Interpreting the Codes: Human Rights, Avoiding Paternalism and Exploitation and Applying the Golden Rule, Bribery-Extortion-Grease Payments and Gifts. Text 3: 1.1 to 1.6, 6.1 to 6.3 & 10.1 to 10.8	
Self-study component:	Survey and Study the importance of Professional Ethics
Text Book(s): <ol style="list-style-type: none">1. “A Conversation with the Innovator in You”, Sudeendra Koushik and Pragya Dixit, Kindle Direct Publishing, Amazon, 2017. ISBN-10: 1520512716, ISBN-13: 978-152051271.2. “Entrepreneurial Development”, by Dr S S Khanka, S Chand & Company Ltd. ISBN-10: 8121918014; ISBN-13: 978-8121918015.3. “Engineering Ethics” (2nd edition), Charles E. Harris, Michel S. Pritchard and Michel J. Rabins, Thomson Wadsworth Asia Pte Ltd, 2003. ISBN: 981-243-676-6.	
Reference Book(s): <ol style="list-style-type: none">1. “Debono, Edward: Six thinking hats”, Penguin Books (2000). ISBN 10: 0140296662 / ISBN 13: 9780140296662.2. “Entrepreneurship” by Robert D Hisrich, Micheal P Peters, Dean A Shepherd- 6/e, TataMcGraw – Hill Companies. ISBN-10: 0078029198.3. “Principles and practice of management” – L. M. Prasad. ISBN-13: 9789351610502.	



Digital CMOS VLSI Design [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21EC502	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Discuss the VLSI Design Flow, MOS Structure, and the MOS System under External Bias, Structure and Operation of MOS Transistor, MOSFET Current –Voltage Characteristics.2. Analyze the MOS Inverters, Static Characteristics, Switching Characteristics and Interconnect Effects.3. Examine the static and dynamic characteristics of Combinational MOS logic circuits and Pass Transistor Circuits.4. Explain the SR Latch Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High–Performance Dynamic CMOS Circuits.5. Examine the MOS Technology and MOS circuit design processes.			
UNIT – I			8 Hours
Introduction: Historical Perspective, VLSI Design Flow, MOS Transistor: The Metal Oxide Semiconductor(MOS) Structure, The MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), MOSFET Current –Voltage Characteristics. Text 1: – 1.1, 1.5, 3.1 to 3.4.			
Self-study component:	1. Design hierarchy 2. VLSI Design Styles		
UNIT – II			8 Hours
MOS Transistor: MOSFET Scaling and Small geometry effects, MOSFET Capacitance MOS Inverters, Static Characteristics: Introduction, CMOS Inverter: Calculation of V_{IL} , V_{IH} , and V_{th} , Design of CMOS Inverter, Supply Voltage Scaling in CMOS Inverter. Text 1: –3.5, 3.6, 5.1, 5.4,			
Self-study component:	1. Super buffer Design. 2. Switching Power Dissipation of CMOS Inverter		
UNIT – III			8 Hours
Switching Characteristics and Interconnect Effects: Introduction, Delay-Time Definitions, Calculation of Interconnect Delay. Combinational MOS Logic Circuits: Introduction, CMOS Logic Circuits, Complex Logic Circuits, Basic Principles of Pass Transistor Circuits, CMOS Transmission Gates(Pass Gates). Text 1: – 6.1, 6.2, 6.6, 7.1, 7.3, 7.4, 7.5, 9.2			
Self-study component:	Modeling of MOS Transistor using SPICE: Know about MODEL statement in SPICE. Plot O/P characteristics of N-MOS and P-MOS transistors and C-MOS inverter using, LEVEL-1 and LEVEL-2 model in SPICE and Scilab/Math lab.		



UNIT – IV		8 Hours	
Sequential MOS Logic Circuits: Introduction, SR Latch Circuit Dynamic Logic Circuits: Introduction, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High-Performance Dynamic CMOS Circuits (Including only Domino CMOS logic). Text 1: – 8.1, 8.3, 9.1, 9.3 to 9.6			
Self-study component:		1. Clocked Latch and Flip-Flop Circuits 2. CMOS D-Latch and Edge Triggered Flip-Flop	
UNIT – V		8 Hours	
Introduction to MOS Technology: nMOS Fabrication, CMOS Fabrication, Thermal Aspects of Processing, Latch-up in CMOS Circuits,. MOS Circuits Design Processes: MOS Layers, Design rules and Layout, General Observations on the Design rules. Text 2: –1.7,1.8,1.9, 2.13, 3.1, 3.3,3.4.			
Self-study component:		1. BiCMOS Technology 2. BiMOS Circuits Design Processes	
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Discuss the VLSI Design Flow, working of MOS Circuits, CMOS Circuits, MOS Technology and MOS circuit design processes.	Understand	PO1,PO2 (L1,L2)
CO2	Interpret the working of MOSFET, MOS Technology and MOS circuit design processes.	Applying	PO1 (L3)
CO3	Examine the MOSFET, MOS circuits and CMOS circuits.	Analyze	PO2 (L4)
CO4	Design the Combinational, Sequential and Dynamic circuits based on MOSFET for the given specifications.	Creating	PO2, PO3 (L6)
CO5	Modelling of a MOS transistors and its circuits using modern simulation tools.	Creating	PO5, PO9,PO12 (L6)
Text Book(s): 1. “CMOS Digital Integrated Circuits Analysis and Design”, Sung Mo Kang, Yusuf Leblebici, 3 rd edition, McGraw Hill Education 2003, ISBN-13:978-0-07-053077-5, ISBN-10:0-07-053077-7. 2. “Basic VLSI Design”, Douglas A. Pucknell, Kamran Eshraghian, 3 rd edition 2006, PHI, ISBN: 978-81-203-0986-9.			
Reference Book(s): 1. “Introduction to VLSI Circuits and Systems”, John .P. Uyemura, John Wiley, 3 rd edition 2002. ISBN: 978-81-265-0915-7 2. “Principles of CMOS VLSI Design”, Neil. H. E. Weste, Kamran Eshraghian, 3 rd edition, Pearson Education 2005, ISBN:978-81-317-6467-1.			



Web and Video link(s):

1. <https://archive.nptel.ac.in/courses/108/107/108107129/>
2. <https://www.youtube.com/watch?v=Iv4Cj2A3ldw&list=PLuv3GM6-gsE3npYPJJDnEF3pdiHZT6Kj3&index=3>

E-Books/Resources:

<http://brharnetc.edu.in/br/wp-content/uploads/2018/11/31.pdf>

D. Course Articulation Matrix (CAM)

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	3	2											3	2
#2	3												3	
#3		2												2
#4		2	2											2
#5					2				2			2		



Fundamentals of Object Oriented Language and Database Concepts [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21EC5031	Credits:	03
Teaching Hours/Week(L:T:P):	3:0:0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
<p>Course Learning Objectives: This course will enable the students to:</p> <ol style="list-style-type: none"> 1. Explain the significance of object oriented concepts 2. Describe the concept of class, objects and methods in Java 3. Apply the concepts of inheritance and interfaces in Java 4. Illustrate usage of packages, string handling and exception handling in Java 5. State the importance of DBMS and explain how DBMS is better than traditional File Processing Systems. 6. Analyze the basic structure of Database and recognize the different views of the database. 7. Draw and Investigate Data Flow and Entity Relationship Diagrams. 8. Analyze and use Relational Data Model, while comparing with other data models. 9. Formulate data retrieval queries in SQL and the Relational Algebra and Calculus. 			
UNIT–I			8Hours
<p>Fundamentals of Object Oriented Programming: Introduction, Object oriented paradigm, Basics concepts of object oriented programming, Benefits of object oriented programming, Applications of object oriented programming. Java: Features, Simple Java Program, Java Program Structure, Data types, Operators overview Decision Making and Branching: if, if else, else if ladder, nesting of if else statements, switch Decision Making and Looping: do, while, for, Jumps in loops. Text 1:1.1-1.5, 2.2, 3.2, 3.5, 4.4, 4.5, 5.1-5.9, 6.2-6.7, 7.2-7.5.</p>			
Self-study component:		How Java is different from C and C++, Java environment.	
UNIT–II			8Hours
<p>Classes, Objects and Methods: Introduction, Defining a class, Fields declaration, Methods declaration, Creating objects, Accessing class members, Constructors, Method Overloading, Static members, Nesting of Methods, Inheritance, Overriding methods. Arrays: Creating array, 1D array and 2D array. Text 1:8.1-8.12, 9.2-9.3.</p>			
Self-study component:		Understand the concept of Inheritance: Defining subclass, Subclass Constructor.	
UNIT–III			8Hours
<p>Strings: String Arrays, String Methods Interfaces: Introduction, Defining interfaces, Extending interfaces, implementing interfaces Packages: Introduction, Java API packages, Using System packages, Naming conventions, creating packages, accessing a package, using a package, adding a class to a package. Text 1: 9.5, 10.1-10.4, 11.1-11.8.</p>			
Self-study component:		Discuss the Accessing interface variables, String buffer class.	



UNIT-IV		8Hours
<p>Database and Database users: Introduction, An example, Characteristics of the database approach, Actors on the scene, Workers behind the scene.</p> <p>Database system concepts and architecture: Database models, Schema and Instances, Three schema architecture and data independence, Database languages and interfaces.</p> <p>Data Modeling using ER Model: Using High level conceptual data models for database design, Entity types, Entity sets, Attributes and keys, Relationship types, Relationship sets, Roles and structural constraints.</p> <p>Text 2:1.1-1.5, 2.1-2.3, 7.1, 7.3, 7.4</p>		
Self-study component:	Identify the Advantages of using DBMS approach.	

UNIT-V		8Hours
<p>Basics SQL: SQL Data Definition and Data types, Specifying constraints in SQL, Basic Retrieval Queries in SQL, Insert, Delete and Update statements in SQL.</p> <p>Relational Model and Relational Database Constraints: Relational Model concepts, Relational data model constraints and relational database schemas, Update operations, Transactions and dealing with constraint violations.</p> <p>Text 2: 3.1-3.3, 4.1-4.4</p>		
Self-study component:	Discuss the Additional features of SQL, Views in SQL.	

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed(P O#)with BTL
CO1	Apply basic knowledge of programming in understanding concepts and syntax of Java.	L4, L2	PO1 , PO5
CO2	Analyze Java programs, debug Java programs.	L3, L2	PO2 ,PO5
CO3	Implement the various concepts of Java features in the development of Java Program.	L3, L4	PO3 , PO5
CO4	Identify the basic concepts and various data model used in database design ER modeling concepts and architecture use.	L1, L1	PO1, PO5
CO5	Apply relational database theory to Design queries using SQL.	L3, L3	PO3, PO5

Text Book(s):

1. **“Programming With JAVA”:** A Primer, E Balagurusamy, 6thedition Tata McGraw Hill. ISBN 13: 978-93-5316-233-7, ISBN 10:-93-5316-233-5
2. **“Fundamentals of Database Systems”** – Elmasri and Navathe, 6th edition, Addison-Wesley, 2011. ISBN 10: 0-136-08620-9 ISBN 13: 978-0-136-08620-8

Reference Book(s):

1. **“The Complete Reference JAVA, J2SE”**, Herbert Schildt, 6th edition, TMH, 2010. ISBN: 0070598789.
2. **“C++ Primer”**, Stanley B. Lippman, Josee Lajoie, Barbara E. Moo, 5th edition, Addison Wesley, 2012. ISBN-13: 978-0-321-71411-4, ISBN-10: 0-321-71411-3.
3. **“Database Management Systems”** Raghu Ramakrishnan and Johannes Gehrke – 3rd edition, McGraw-Hill Education(India) Edition 2014. ISBN 0-07-246563-8, ISBN -0-07-115110-9.
4. **“Data Base System Concepts”** – Silberschatz, Korth and Sudharshan, 5th edition, Mc-GrawHill, 2006 ISBN 0072958863, 9780072958867



Web and Video link(s):

1. DBMS – SWAYAM - <https://nptel.ac.in/courses/106/105/106105175/>
2. Java Programming - <https://nptel.ac.in/courses/106/105/106105191/>

E-Books/Resources:

1. <https://books.google.co.in/books?id=a9q5AwAAQBAJ>
2. <https://docs.ccsu.edu/curriculumsheets/ChadTest.pdf>
<https://gfgc.kar.nic.in/sirmv-science/GenericDocHandler/138-a2973dc6-c024-4d81-be6d-5c3344f232ce.pdf>

Course Articulation Matrix(CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
#1	3				1								3	
#2		3			2									3
#3			3		3									3
#4	3				1								2	
#5			3		2									2



System Verilog [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21EC5032	Credits:	03
Teaching Hours/Week (L:T:P):	3: 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Develop an understanding of the System Verilog language constructs.2. Introduce the facilities and features of System Verilog for unified Design, testing and verification.3. Introduce the programming approach for testing and verification.4. Provide framework of System Verilog for functional coverage.			
UNIT – I			8 Hours
Verification Guidelines: The Verification Process, Basic Test Bench Functionality, Directed testing, Methodology Basics, Constrained Random Stimulus, Functional Coverage, Testbench Components, Layered Testbench. Data Types: Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Associative Arrays, Linked Lists, Array Methods, Choosing a Storage Type, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Expression Width. Procedural Statements and Routines: Procedural Statements, Tasks, Functions, and Void Functions, Task and Function Overview,Routine Arguments, Returning from a Routine, Local Data Storage, Time Values. Text 1: 1.1,1.3-1.10,2.1-2.16, 3.1-3.7.			
Self-study component:	Synthesizable constructs in systemverilog (Refer: Synthesizing SystemVerilog Busting the Myth that SystemVerilog is only for Verification by Stuart Sutherland and Don Mills)		
UNIT – II			8 Hours
Basic OOPs: Your First Class, Where to Define a Class, Creating New Objects, Object De allocation, Using Objects, Class methods, Defining methods outside of the class.Static Variables vs. Global Variables, Scoping Rules, Using One Class inside Another, Understanding Dynamic Objects, Copying Objects, Public vs. Private Straying off Course, Building a Test bench. Text 1: 5.3-5.18.			
Self-study component:	SystemVerilog Macro's and their usage		
UNIT – III			8 Hours
Randomization and Constraints: Introduction, What to Randomize, Randomization in SystemVerilog, Constraint Details, Solution Probabilities, Controlling Multiple Constraint Blocks, Valid Constraints, In-line Constraints.The pre_randomize and post_randomize Functions, Random Number Functions, Constraints Tips and Techniques, Common Randomization Problems.Iterative and Array Constraints, Atomic Stimulus Generation vs. Scenario Generation, Random Control, Random Number Generators, Random Device Configuration. Text 1: 6.1-6.17.			
Self-study component:	Methods: get_randstate and set_randstate		



UNIT – IV		8 Hours	
<p>Threads and Inter Process Communication: Working with Threads, Disabling Threads, Interprocess Communication, Events, Semaphores, Mailboxes, Building a Testbench with Threads and IPC. Text 1: 7.1-7.7.</p>			
Self-study component:	Built in class process and related methods to control the process		
UNIT – V		8 Hours	
<p>Functional Coverage:Gathering Coverage Data, Coverage Types, Functional Coverage Strategies, Simple functional Coverage examples, Anatomy of a cover group, triggering a cover group.Data Sampling, Cross coverage, Generic cover groups, Coverage Options, Analyzing Coverage Data, and Measuring Coverage Statistics during simulation, SystemVerilog Assertions. Text 1: 9.1-9.12, 4.8.</p>			
Self-study component:	Functional coverage constructs and functional coverage flow		
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom’s Taxonomy Level	Program Outcome Addressed (PO#) with BTL
CO1	Understand the System Verilog language constructs.	Understand, Apply	PO1, PO2, PO3 (L1)
CO2	Understand the System Verilog OOPs facilities and framework for the verification.	Apply , Analyze	PO2, PO3 (L1)
CO3	Develop programs by applying the System Verilog facilities and framework.	Understand , Apply	PO1, PO3, PO4 (L4)
CO4	Explore and understand modern software tools to perform different operations in System Verilog.	Apply, Analyze	PO1, PO2, PO5 (L3)
CO5	Develop the capability to learn on your own individually and in group to explore advanced technologies in system Verilog.	Understand , Apply	PO9, PO12 (L4)
<p>Text Book(s):</p> <ol style="list-style-type: none"> 1. “System Verilog for Verification: A Guide to Learning the Testbench Language Features”, Chris Spear, Springer-Verlag New York, Inc, 3rd edition, ISBN 978-1-4614-0714-0, 2012. 			
<p>Reference Book(s):</p> <ol style="list-style-type: none"> 1. “Hardware Verification with System Verilog (An Object Oriented Framework)”, Mike Mintz and Robert Ekehndal, Springer, USA, ISBN 0-387-71738-2, 2007. 2. “SystemVerilog For Design A Guide to Using SystemVerilog for Hardware Design and Modeling”, Stuart Sutherland, Simon Davidmann and Peter Falke, Springer, USA, ISBN 9781475766820, 1475766823, 2013. 			
Web and Video link(s):			
E-Books/Resources:			
<ol style="list-style-type: none"> 1. https://www.kobo.com/in/en/ebook/systemverilog-for-verification 2. https://www.chipverify.com/systemverilog/systemverilog-tutorial 			



Course Articulation Matrix

CO#	PO#	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1		1	2	1										1	2
CO2			3	1											3
CO3		1		2	1									1	
CO4		2	2			2								2	2
CO5										2			2		



Control Systems [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21EC5033	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Determine the mathematical transfer function models of electrical system, mechanical system and analogous system.2. Determine the transfer function from the block diagrams and signal flow graph techniques of different system.3. Analyze the performance of different systems by determining the time Response specifications.4. Analyze the stability of different systems by analytical and graphical means.(By sketching plots)5. Discuss the concepts of state models for different electrical systems.			
UNIT – I			8 Hours
Fundamental Concepts of Control Systems: Basic definitions of control systems, Classification, Open loop and closed loop systems, Modeling of Systems: Differential equations of physical systems, Determinations of transfer function models for Electrical, Mechanical and Analogous systems. Block Diagrams and Signal Flow Graphs: Transfer functions, Block diagram algebra, Signal Flow graphs (State variable formulation excluded). Text 1: 1.1, 2.1, 2.2, 2.4, 2.5, 2.6, 2.7.			
Self-study component:	1. Develop the Block diagram for field and armature controlled D.C. Servomotors. 2. Develop the system equations and TF model for a seated human body with applied force.		
UNIT – II			8 Hours
Time Domain (Transient and Steady State Response) Analysis of Feedback Control Systems: Standard test signals, Unit step response of First and second order systems. Time Response Specifications: Transient response specifications of second order systems, steady state errors and static error constants. Text 1: 2.4, 2.5, 2.6, 2.7, 5.1, 5.2, 5.3, 5.4, 5.5			
Self-study component:	1. Determine the transient response specifications of second order RLC systems for $R=1000$ ohms, $L=1$ Henry and $C=2\mu F$.		
UNIT – III			8 Hours
Stability Analysis: Concepts of stability, asymptotic stability, necessary conditions for stability, Routh-Hurwitz stability criterion, Routh's tabulation, special cases when Routh's tabulation terminates prematurely. Root Locus Techniques: The root locus concepts, summary of general rules for constructing Root Loci, Stability analysis. Text 1: 6.1, 6.2, 6.4, 6.5, 6.6, 7.1, 7.2, 7.3			
Self-study component:	1. Write the MATLAB program to draw the Root Locus diagrams of open loop transfer function of different systems. (Refer Text 2)		



UNIT – IV		8 Hours	
<p>Frequency-Response Analysis: Stability in the frequency domain: Introduction to frequency domain analysis, Experimental determination of transfer functions in bode plots. Assessment of relative stability using bode Plots.</p> <p>Polar Plot: Introduction to Polar plot and Nyquist plots, Nyquist stability criterion, Stability analysis using polar plot, Numerical problems.</p> <p>Text 1: 8.1, 8.4, 8.5, 8.6, 9.1, 9.2, 9.3, 9.4.</p>			
Self-study component:	<ol style="list-style-type: none"> 1. Write the MATLAB program to draw the Bode diagrams of open loop transfer function of different systems. (Refer Text 2) 2. Frequency response specifications- resonant peak, resonant frequency and bandwidth. 		
UNIT – V		8 Hours	
<p>Introduction to State variable analysis: Concepts of state, state variable and state models for electrical systems, Controllability and observability, Derivation of transfer functions from the state model, Solution of state equations.</p> <p>Text 1: 12.1, 12.2, 12.3, 12.6, 12.7</p>			
Self-study component:	Obtain the time response for different state models		
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Apply mathematical knowledge to determine the Transfer function of a system.	Remember	L3, PO1
CO2	Analyze the stability of a system using different techniques	Understanding	L4, PO2
CO3	Analyze there sponse of the system in time and frequency domain and state variable techniques	Understanding	L4,PO2
CO4	Develop the mathematical models using different techniques of state variables	Applying	L4,PO2
CO5	Design Using MATLAB software for the linear control system problems.	Applying	L5, PO4, PO9
<p>Text Book(s):</p> <ol style="list-style-type: none"> 1. “Control Systems Engineering”, I. J. Nagarath and M. Gopal, New Age International (P) Limited, Publishers, 4th edition – 2005, ISBN 10:8122420087; ISBN 13: 9788122420081. 2. “Modern Control Engineering”, K. Ogata, Pearson Education Asia/ PHI, 4th edition, 2002. ISBN 0-13-043245-8. 			
<p>Reference Book(s):</p> <ol style="list-style-type: none"> 1. “Automatic Control Systems”, Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th edition, 2008, ISBN 978-81-203-4010-7 2. “Feedback Control System Analysis and Synthesis”, J. J. D’Azzo and C. H. Houpis McGraw Hill, International student Edition, ISBN 10: 0070161755 / ISBN 13: 9780070161757. 			



Web and Video link(s):

1. NPTEL course on “Introduction to System and Control” by Prof Ramakrishna Pasumarthy, IIT Madras <https://nptel.ac.in/courses/108/106/108106098/>

E-Books/Resources:

1. https://www.google.co.in/books/edition/Control_Systems_As_Per_Latest_Jntu_Sylla/VMBWs_8hyBgC?hl=en&gbpv=1&dq=control+systems+by+ij+nagrath&printsec=frontcover
2. <http://libgen.rs/book/index.php?md5=A9371B939B494BC8D81F845420939513>

Course Articulation Matrix (CAM)

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	3												3	
#2		3												3
#3		3												3
#4			3											3
#5				1					1				2	



ARM Processor [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21EC5034	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Provide the knowledge of general architecture of ARM Cortex-M3 processor.2. Understand the Instruction set of Cortex-M3 processor.3. Understand Memory system, exceptions and interrupt control.4. Provide the knowledge of fault interrupt behavior, Cortex-M3 and Exceptions Programming.5. Provide the knowledge of Advanced Programming Features and System Behavior.			
UNIT – I			8 Hours
Introduction: What Is the ARM Cortex-M3 Processor?, Background of ARM and ARM Architecture, Instruction Set Development, The Thumb-2 Technology and Instruction Set Architecture(ISA),Cortex-M3 Processor Applications. Overview of the Cortex-M3: Fundamentals, Registers, Operation Modes, The Built-In Nested Vectored Interrupt Controller, The Memory Map, The Bus Interface, The Memory Protection Unit, The Instruction Set, Interrupts and Exceptions, Debugging Support. Text1: 1.1 - 1.5, 2.1 - 2.10.			
Self-study component:	<ol style="list-style-type: none">1. Study the C programming for advanced Cortex processors.2. Discuss the various advantages of using Cortex-M3.		
UNIT – II			8 Hours
Cortex-M3 Basics: Registers, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence. Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions. Text1: 3.1 - 3.7, 4.1 - 4.3			
Self-study component:	<ol style="list-style-type: none">1. Identify the applications of stack operation.2. Understand several useful instructions in Cortex-M3..		
UNIT – III			8 Hours
Memory Systems: Memory System Features Overview, Memory Maps, Memory Access Attributes, Default Memory Access Permissions, Bit-Band Operations, Unaligned Transfers, Exclusive Accesses, Endian Mode. Cortex-M3 Implementation Overview: The Pipeline, A Detailed Block Diagram, Bus Interfaces on the Cortex-M3, Other Interfaces on the Cortex-M3, The External Private Peripheral Bus, Typical Connections, Reset types and Reset Signals. Text1: 5.1 - 5.8, 6.1 - 6.7			
Self-study component:	<ol style="list-style-type: none">1. Identify the advantages and disadvantages of big Endian and little Endian processor.2. Identify the different reset signals in Cortex-M3.		



UNIT – IV			8 Hours
<p>Exceptions: Exception Types, Definitions of Priority, Vector Tables, Interrupt Inputs and Pending Behavior, Fault Exceptions.</p> <p>The NVIC and Interrupt Control: NVIC Overview, the Basic Interrupt Configuration, Example Procedures in Setting up an Interrupt, Software Interrupts.</p> <p>Interrupt Behavior: Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail-Chaining Interrupts, Late Arrivals, More on the Exception Return Value, Interrupt Latency, Faults Related to Interrupts.</p> <p>Text1:7.1 - 7.5, 8.1 - 8.4, 9.1 - 9.8</p>			
Self-study component:	<ol style="list-style-type: none"> 1. Discuss the applications of Systick timer. 2. Understand the concept of supervisor calls and pendable service call. 		
UNIT – V			8 Hours
<p>Cortex-M3 Programming: Overview, A Typical Development Flow, CMSIS, using Assembly, Using Exclusive Access for Semaphores, Using Bit Band for Semaphores, Working with Bit Field Extract and Table Branch.</p> <p>Exceptions Programming: Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Example of Vector Table Relocation, Using SVC, SVC Example: Use for text message output Functions, Using SVC with C.</p> <p>Advanced Programming Features and System Behavior: Running a System with Two Separate Stacks, Double-Word Stack Alignment, Nonbase Thread Enable.</p> <p>Text1:10.1 - 10.2, 10.4 - 10.8, 11.1 - 11.7, 12.1 - 12.3</p>			
Self-study component:	<ol style="list-style-type: none"> 1. Give an example of a simple C program using Real view development site. 2. Discuss what happens during lockup. 		
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO#) with BTL
CO1	Apply the knowledge of basic Controller to understand the architecture, instruction set, addressing modes and other features of ARM cortex-M3 processor.	Understand and Apply	PO1(L1)
CO2	Classify the different peripheral components associated with ARM cortex-M3 processor.	Analyze	PO2(L2)
CO3	Interpret the ARM processor based applications, interrupts and exceptions.	Evaluate	PO2(L2)
CO4	Develop the embedded system applications for the given specification using the Basic knowledge of cortex M-3 and using 'C' Programming.	Create	PO3(L2)
CO5	ARM applications using Modern tools.	Create	PO5(L2)



Text Book(s):

1. “The Definitive Guide to the ARM Cortex-M3” by Joseph Yiu, 2nd edition, Newnes, (Elsevier), ISBN:978-0-7506-8534-4,2007.

Reference Book(s):

1. “ARM Assembly Language Fundamentals and Techniques”, William Hohland Christopher Hinds, 2nd edition, ISBN 9781482229851, 2014, CRC (Taylor and Francis)
2. “ARM System-On-Chip Architecture” Steve Furber, 2nd edition, Pearson, ISBN: 9788131708408, 8131708403, 2015.

Web and Video link(s):

1. NPTEL Course by Prof. Indranil Sengupta, Dept. of Computer Science and Engineering IIT Kharagpur, <https://nptel.ac.in/courses/106/105/106105193/>

E-Books/Resources:

1. http://centaur.sch.bme.hu/~holcsik_t/sem/The%20Definitive%20Guide%20to%20the%20ARM%20Cortex-M3.pdf

Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	3												3	
#2		3												3
#3		2												2
#4			2											
#5					2									



Digital Signal Processing [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21EC504	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 2	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none"> 1. Provide the knowledge of DFT/ IDFT and its various properties. 2. Explain the different Fast–Fourier–Transform (FFT) algorithms along with its applications. 3. Provide the design procedure of IIR filters and FIR filters using different techniques. 4. Provide the design of IIR filters from analog filters using different methods. 5. Provide implementation scheme of IIR and FIR filters using different methods. 6. Provide exposure to different applications of DSP. 			
UNIT – I			8 Hours
Discrete Fourier Transforms (DFT): Frequency Domain Sampling and Reconstruction of discrete-time Signals, Discrete Fourier Transforms, DFT as a linear transformation, its relationship with other transforms. Properties of DFT– Periodicity, linearity and Symmetry Properties, Multiplication of two DFTs–the circular convolution, use of DFT in linear filtering, overlap–save and overlap–add method. Text1: 7.1.1 ,7.1.2, 7.1.3, 7.1.4, 7.2.1 7.2.2, 7.2.3, 7.3.1			
Self-study component:	1. Additional properties of DFT (circular-time shift, Circular-frequency shift, Time reversal, circular convolution, parseval’s relation).		
Practical components:	<ol style="list-style-type: none"> 1. Develop MAT Lab code for Computation of the N point DFT and IDFT of a given sequence and to plot magnitude and phase spectrum. 2. Develop MAT Lab code Circular convolution of the two given sequences without using function and using DFT and IDFT. 3. Develop MAT Lab code for Linear convolution using DFT and IDFT without using inbuilt function and simulate. 		
UNIT – II			8 Hours
Fast–Fourier–Transform (FFT) Algorithms: Efficient computation of the DFT (FFT algorithms), Direct computation of DFT, Goertzel algorithm, and chirp–z transform. Radix–2 FFT algorithm for the computation of DFT and IDFT–decimation in–time and decimation–in – frequency algorithms. Text1: 8.1, 8.1.1, 8.1.2, 8.1.3, 8.1.5, 8.1.6, 8.2			
Self-study component:	Applications of FFT algorithm. (Using MATLAB or SCILAB or any similar tools)		
Practical components:	<ol style="list-style-type: none"> 1. Develop MAT Lab code for Computing the frequency spectrum of a given sequence using FFT and IFFT. 2. Develop MAT Lab code for Autocorrelation and Cross correlation of the given sequence and verification of its properties. 3. Develop MAT Lab code for voice and Music. Plot the spectrum. 		



UNIT – III		8 Hours
<p>FIR Filter Design: Characteristics of Practical Frequency Selective filters, FIR filter design: Introduction to FIR filters, design of FIR filters using – Rectangular and Hamming windows, FIR filter design using frequency sampling technique Text1: 10.1.2, 10.2.1, 10.2.2, 10.2.3, 10.4</p>		
Self-study component:	Hanning window, Blackmann window	
Practical components:	<ol style="list-style-type: none"> 1. Design and Develop MAT Lab code for FIR Filters to meet the given specifications using Simulink. 2. Experiments Using Digital Signal Processor (TMS320c54xx) And Code Composer Studio (CCS) <ol style="list-style-type: none"> a. Circular convolution of the two given sequences. 	
UNIT – IV		8 Hours
<p>Design of IIR Filters From Analog Filters (Butterworth and Chebyshev) : Characteristics of commonly used analog filters – Butterworth and Chebyshev filters., analog to analog frequency transformations. Impulse invariance method. Mapping of transfer functions: Approximation of derivative (backward difference and bilinear transformation) method. Text1: 10.3.1, 10.3.2, 10.3.3 ,10.3.4,10.4.1</p>		
Self-study component:	<ol style="list-style-type: none"> 1. Matched z transforms 2. Transform the analog filter $H(S)=\frac{S+3}{(S+1)(S+2)}$ to a digital filter using Matched Z-Transform(T=0.5sec). 	
Practical components:	<ol style="list-style-type: none"> 1. Design and develop MATLAB code for IIR Filters to meet the given specifications using Simulink. 2. Experiment Using Digital Signal Processor (TMS320C54xx) and Code Composer Studio (CCS): Computation of the N Point DFT of a given sequence. 	
UNIT – V		8 Hours
<p>Implementation of Discrete–Time Systems: Structures for IIR and FIR systems– direct form I and direct form II systems, cascade and parallel realization, Applications of DSP Text1: 9.1, 9.2, 9.3 Text 2: 12.1 to 12.8</p>		
Self-study component:	Speech processing.	
Practical components:	<ol style="list-style-type: none"> 1. Analyze the impulse response and step response of a system using MATLAB/SIMULINK 2. Analyze the operation of Basic Communication model using Simulink. 3. Noise: Add noise above 3 kHz and then remove; Interference suppression using 400 Hz tone. 	



Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Apply mathematical knowledge to understand DFT, FFT and Filters	Remembering	PO1, L2
CO2	Analyze discrete systems using DFT, FFT and filtering formulation	Understanding	PO2,L3
CO3	Design the FIR & IIR filters for given specification	Applying	PO3,L5
CO4	Implement the discrete-time systems using various approaches	Applying	PO3,L5
CO5	Conduct experiments to verify DSP concepts and applications of DSP using Hardware DSP board .	Applying	PO5,L4

Text Book(s):

1. "**Digital Signal Processing – Principles Algorithms and Applications**", Proakis & Monalakis, PHI / Pearson Education, 4th Edition, New Delhi,2007.ISBN:978-81-317-1000-5
2. "**Digital signal Processing**"–A.Nagoor Kani, McGraw hill education,2nd edition,New Delhi 2012.ISBN-13: 978-0-07-008665-4, ISBN-10: 0-07-008665-6.

Reference Book(s):

1. "**Discrete Time Signal Processing**", Oppenheim and Schaffer, PHI,2003, ISBN - 10:9332535035, ISBN-13:9789332535039.
2. "**Digital Signal Processing**", S. K. Mitra, Tata Mc–Graw Hill, 3rd Edition, 2007.ISBN: 9780070667563, ISBN-007066756X.
3. "**Digital Signal Processing**", Lee Tan, Elsevier publications, 2007.ISBN-9780124159822, ISBN-9780124158931.
4. "**Digital Signal Processing using MATLAB**",Sanjit K Mitra, TMH, 2001
5. "**Digital Signal Processing using MATLAB**", J.G. Proakis& Ingle, MGH, 2000

Web and Video link(s):

<http://acl.digimat.in/nptel/courses/video/117102060/L01.html>

E-Books/Resources:

- 1.<http://libgen.rs/book/index.php?md5=8FA146CE83BC35BE9171560760124653>
- 2.<http://libgen.rs/book/index.php?md5=D4D60EB785E913243C06C021246C2EE4>



Course Articulation Matrix (CAM)

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	3												3	
#2		3												3
#3			3											3
#4			3											3
#5	2												2	



E-Waste Management [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21ECO5051	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: <ol style="list-style-type: none">1. Understand importance of Electrical and Electronics waste management2. Awareness about global rules and standards with respect to E-waste management3. Acquire knowledge of materials used in E & E products and their disposition4. Knowledge of Recycling and Recovery technologies.5. Analysis of typical electronic devices their constituents and recyclability.6. To understand OEM and allied vendor responsibility towards recyclable products and Manufacturing standards.			
UNIT – I			8 Hours
Introduction and Overview: Introduction, WEEE–The Scale of the Problem, Legislative Influences on Electronics, Recycling, Producer Responsibility Legislation, The WEEE Directive, The RoHS Directive, Other Examples of Legislation, Treatment Options for WEEE, Material Composition of WEEE, Socio-economic Factors, Logistics of WEEE, Barriers to Recycling of WEEE, the Recycling Hierarchy and Markets for Recyclate, WEEE Health and Safety Implications. Text1: PageNo:1 to 17, 24 to 35			
Self-study component:	1. Prepare a statistical survey report on Indian scenario of electronic sales and purchase.		
UNIT – II			8 Hours
Materials Used in Manufacturing Electrical and Electronic Products: Perspective, Impact of Legislation on Materials Used in Electronics, Overview, The RoHS Directive and Prescribed Materials, Where do RoHS Prescribed Materials Occur?, Lead, Brominated Flame Retardants, Cadmium, Mercury and Hexavalent Chromium, Soldering and the Move to Lead-free Assembly, Lead-free Solder Choices, Printed Circuit Board Materials, PCB Materials, Provision of Flame Retardancy in PCBs, Non-ferrous and Precious Metals, Encapsulants of Electronic Components, Indium Tin Oxide and LCD Screens, Polymeric Materials in Enclosures, Casings and Panels, Product-related Plastic Content, WEEE Engineering Thermoplastics, Polycarbonate (PC), ABS (Acrylonitrile-Butadiene-Styrene), High Impact Polystyrene (HIPS), Poly phenylene oxide (PPO), PC/ABS Blends, Flame Retardants in Engineering Thermoplastics, Materials Composition of WEEE, Mobile Phones, Televisions, Washing Machines. Text 1: PageNo:40 to 73			
Self-study component:	1. Present a short summary on European Commission's 1991 Battery Directive (91/157/EEC) and its implications		
UNIT – III			8 Hours
Part-I Recycling and Recovery: Introduction, Separation and Sorting, Treatment, Mixed WEEE, Refrigeration Equipment, Cathode Ray Tubes, Individual Processes, Outputs and Markets, Metals, Glass, Plastics, Emerging Technologies, Separation, Thermal Treatments, Hydrometallurgical Extraction, Sensing Technologies, Plastics to Liquid Fuel, Plastics Containing Brominated Flame Retardants.			



Part-II Integrated Approach to e-Waste Recycling: Introduction, Recycling and Recovery Technologies, Sorting/Disassembly, Crushing/Diminution, Separation, Emerging Recycling and Recovery Technologies, Automated Disassembly, Comminution, Separation, Thermal Treatments, Hydrometallurgical Extraction, Dry Capture Technologies, Biotechnological Capture, Sensing Technologies, Design for Recycling and Inverse, Manufacturing Text 1: PageNo:91 to 107,111 to 120	
Self-study component:	1. Present a report on e-waste management and recycling initiatives of companies like: SONY, Philips and Samsung etc.
UNIT – IV	
8 Hours	
Sector-based Eco-design, Disassembly, Fasteners, RFIDs (Radio Frequency Identification Tags), Active Disassembly, Design Methodology and Resource Efficiency, Recycling, Constraints on Materials Selection, Eco-design Guidelines for Manufacturing.(Ch5. Pg.N0.141-160), Liquid Crystal Displays: from Devices to Recycling: Overview of Liquid Crystals Definition and Classification of Liquid Crystals, Molecular and Chemical Architecture of Liquid Crystals, The Mesophase: Types of Intermediate State of Matter, Physical Properties of Liquid Crystals and Material Requirements, Overview of Liquid Crystal Displays Based on Nematic Mesophase, Basic LCD Operating Principles, Types of Electro-optic LCD Devices, LCD Manufacturing Process, Environmental Legislation and Lifecycle Analysis. The WEEE Directive and LCDs, RoHS and REACH, Far East Environmental Measures, Lifecycle Analysis, Potentially Hazardous Constituents: Toxicity of LCD Constituents, Toxicity of Mercury and Backlighting, Toxicity of Liquid-crystal Mixture, Demanufacture and Recycling. Text 1: PageNo:180-204	
Self-study component:	1. Refer the websites: 1. https://www.epa.gov/ , 2. https://sustainabilityguide.eu Understand the significance of design for sustainability.
UNIT – V	
8 Hours	
The Role of Collective versus Individual Producer Responsibility in e-Waste Management: Key Learning's from Around the World: Brief Introduction to WEEE, The WEEE Directive, Producer Responsibility, Household and Non-household WEEE, E-waste and Its Environmental Impacts, Marking EEE Products, WEEE Collection Points, Product Categories and Waste Streams, Producer Compliance Schemes, Variations in National WEEE Laws, Background to Producer Responsibility, Defining Individual and Collective Producer, Responsibility, The WEEE Directive in Europe, The WEEE Directive's Approach to Individual and Collective Producer Responsibility, Implementation of Individual and Collective Producer Responsibility in the EU, ICT Milieu, The Netherlands, E-waste Laws and Voluntary Agreements in Other Countries, Japanese Electronics Take-back Directive, Product Take-back in the USA, Product Stewardship in Australia. Text 1: PageNo:161 to 164, 212 to 222	
Self-study component:	1. Write a short note on "A model for optimal product recovery in the context of Extended Producer Responsibility".
Text Book(s): 1. "Electronic Waste Management" edited by Ronald E. Hester, Roy M. Harrison, RSC Publishing. ISBN: 9780854041121.	



Reference Book(s):

1. "E-Waste: Management, Types & Challenges (Computer Science, Technology and Applications: Environmental Remediation Technologies, Regulations and Safety)". YuanChun Li, BanciLian Wang, Nova Science Publishers, 2012, ISBN: 1619422174.
2. "Electronic Waste: High-Impact Strategies - What You Need to Know: Definitions, Adoptions, Impact, Benefits, Maturity, Vendors, Kevin Roebuck", Emereo Publishing, 2011. ISBN: 9781743339084.

Course Outcomes

CO#	Course Outcome	Program Outcome with BTL
CO1	Apply the knowledge of basic sciences to understand the issues of Electrical and Electronic Equipment Wastes and societal responsibility.	PO1, PO7[L3]
CO2	Analysis of material used in current EEE and legislative directives.	PO2, [L3]
CO3	Knowledge of WEEE Directives, RoHS Directives, Health hazards, Recycling, Recovery technologies and future technologies.	PO1, [L4]
CO4	Analyze typical electronic ++devices and PCBs their constituent hazards, recyclability and treatment technologies.	PO2, [L3]
CO5	Understand need of waste management OEM and allied vendor responsibility towards recyclable products and Manufacturing standards and nation wise initiatives.	PO2,PO7 [L2]

Course Articulation Matrix

CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
#1	3						1							2
#2		3											1	
#3						2	1							
#4							2						2	
#5		2					2							



Principles of Communication Systems [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21ECO5052	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
A. Course Learning Objectives (CLOs): This course aims to: <ol style="list-style-type: none">1. Provide the basic knowledge on Electronic Communication Systems.2. Describe the concept of Amplitude Modulation and Frequency modulation.3. Outline the concept of Digital Communication Systems.4. Explain the concept and importance of Satellite communication.5. Discuss Fundamentals of Networking and Local Area Network6. Discuss the importance and applications of Cell phones			
UNIT – I			8 Hours
Introduction to Electronic Communication: The significance of human communication, Communication Systems, Types of Electronic Communication, Modulation and Multiplexing, The Electromagnetic Spectrum, Bandwidth Amplitude Modulation Fundamentals: AM Concepts, Modulation Index and Percentage of Modulation, Sidebands and the Frequency Domain, AM Power, Text 1:1.1-1.6, 3.1-3.4			
Self-study component:	Amplitude Demodulators, Diode Detectors, Crystal Radio Receivers, Synchronous Detection.		
UNIT – II			8 Hours
Fundamental of Frequency Modulation: Basic Principles of Frequency Modulation, , Modulation index and side bands, Frequency modulation Versus Amplitude Modulation. Digital Communication Techniques: , Basic Principles of Signal Reproduction, Super heterodyne receivers. Text 1: 5.1, 5.3, 5.5, 9.1,9.2			
Self-study component:	Principles of Phase Modulation, Digital transmission of data.		
UNIT – III			8 Hours
Multiplexing and Demultiplexing: Multiplexing Principles, Frequency division Multiplexing, Time-Division Multiplexing, Pulse-code Modulation, Duplexing Fundamentals of Networking and Local Area Networks: Network Fundamentals, LAN hardware. Text 1: 10.1-10.5, 12.1-12.2			



Self-study component:	Ethernet LANs - Topology, Encoding, Speed, Transmission Medium, and Advanced Ethernet.		
UNIT – IV			8 Hours
Satellite Communication: Satellite Orbits, Satellite communication systems, Satellite Subsystems, Ground Stations, Satellite Applications, Text 1:17.1-17.5.			
Self-study component:	Make a study of advances made by India in Satellite communication, Global Navigation System.		
UNIT – V			8 Hours
Cell Phone Technologies: Cellular Telephone Systems, A Cellular Industry Overview, 2G and 3G Digital Cell Phone Systems, Long Term Evolution and 4G Cellular Systems, Base Stations and small cells. Text 1: 20.1-20.5.			
Self-study component:	<ol style="list-style-type: none"> 1. WiMAX and Wireless Metropolitan-Area Networks. 2. Case study: To improve the quality of service in communication(Ref: Zayan EL Khaled and Hamid Mcheick, Case studies of communications systems during harsh environments: A review of approaches, weaknesses, and limitations to improve quality of service, International Journal of Distributed Sensor Networks 2019, Vol. 15(2)) 		
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Apply the basic knowledge Electronic and Communication to distinguish between analog and digital communication systems.	Apply	PO1,L2
CO2	Analyze at block level the use of various Communication Techniques.	Analyze	PO2,L3
CO3	Interpret the concept of Networking and modulation techniques.	Understand	PO1,L2
CO4	Illustrate the conceptual understanding of satellite and wireless communications.	Understand	PO1,L2
CO5	Articulate the working of Cell phone, multiplexing and de multiplexing in electronic communication systems.	Apply	PO1,L2
Text Book(s):			
1. “ Principles of Electronics Communication System ”, Louis E FrenzelJr, 4 th edition. ISBN 978-0-07-337385-0, Mcgraw Hill Publication			



Reference Book(s):

1. **“Digital Communication”**, P. Ramakrishna Rao, TATA McGraw Hill, 2011, ISBN:9780070707764.
2. **“Wireless and Mobile Communication”** by Sanjeev Kumar, New age International Publishers- 2010 Edition, ISBN(10):81-224-2354-X, ISBN(13):978-81-224-2354-9
3. **“Mobile Cellular Telecommunication”**, Lee W.C.Y, McGraw Hill, 2002, ISBN: 9780071436861, 0071436863
4. **“Satellite Communications”**, Dennis Roddy, 4th Edition, Special Indian Edition 2009, 11th reprint 2013 McGraw–Hill, ISBN13:978-0-07-007785-0, ISBN 10:0-07-007785-1

Web and Video link(s):1.https://onlinecourses.nptel.ac.in/noc22_ee05/preview

2.<https://archive.nptel.ac.in/courses/108/104/108104091/>

E-Books/Resources:<https://physicaeducator.files.wordpress.com/2018/03/principles-of-electronic-communication-system-by-luies.pdf>

D. Course Articulation Matrix (CAM)

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	3												3	
#2		2												2
#3	3												3	
#4	2												2	
#5	3												3	



Biometrics [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P18ECO5053	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course aims to: <ul style="list-style-type: none">• Provide the basic knowledge on biometrics and its modality.• Analyze the handwritten character recognition system.• Describe the concept of different physical biometrics.• Interpret biometric hand gesture recognition for Indian sign language.• Discover the privacy issues and concerns related to biometrics.• Discuss biometric cryptography and multimodal biometrics.• Explain the importance of watermarking techniques in biometrics.• Summarize the scope and future of biometrics and its standards.			
UNIT – I			08 Hours
Introduction: What is Biometrics? History of biometrics, Types of biometric traits, General architecture of biometric system, Basic working of biometric matching (Templates), Biometric system error and performance measures, Design of biometric systems, Applications of biometrics, Benefits of biometrics versus Traditional authentication methods. Handwritten Character Recognition: Introduction, Character recognition, System overview, Feature extraction for character recognition, Neural network for handwritten Character recognition, Multilayer neural network for handwritten character recognition. Text 1: 1.1-1.9 and 2.1-2.6			
Self-Study Component:	1. Devanagari numeral recognition 2. Isolated handwritten devanagari character recognition using fourier descriptor and hidden.		
UNIT – II			08 Hours
Face Biometrics: Introduction, Background of face recognition, Design of face recognition system, Neural network for face recognition, Face detection in video sequences, Challenges in face biometrics, Face recognition methods, Advantages and disadvantages. Retina and Iris Biometrics: Introduction, Performance of biometrics, Design of retina biometrics, Design of iris recognition system, Iris segmentation method, Determination of iris region, Applications of iris biometrics, Advantages and disadvantages. Text1: 3.1-3.8, 4.1-4.6, 4.8, 4.9			
Self-Study Component:	1. Face Recognition Smart Attendance System (Reference Paper: Alhaneaee, K., Alhammadi, M., Almenhali, N., & Shatnawi, M. (2021). Face recognition smart attendance system using deep transfer learning. Procedia Computer Science, 192, 4093-4102.) 2. List the challenges in capturing retina and iris information.		



UNIT – III		08 Hours
<p>Vein and Fingerprint Biometrics: Introduction, Biometrics using vein pattern of palm, Fingerprint biometrics, Fingerprint recognition system, Minutiae extraction, Fingerprint indexing, Advantages and disadvantages.</p> <p>Biometric Hand Gesture Recognition for Indian Sign Language: Introduction, Basics of hand geometry, Sign language, Indian sign language (ISL), SIFT algorithm, Advantages and disadvantages.</p> <p>Text 1: 5.1 - 5.6, 5.8 and 6.1-6.5, 6.7</p>		
Self-Study Component:	<ol style="list-style-type: none">1. Study different practical hand gesture recognition techniques.2. Study Fingerprint Minutiae Extraction and Matching based on SIFT Features. (Reference Paper: Bakheet, S., Alsubai, S., Alqahtani, A., & Binbusayyis, A. (2022). Robust Fingerprint Minutiae Extraction and Matching Based on Improved SIFT Features. Applied Sciences, 12(12), 6122.)	
UNIT – IV		08 Hours
<p>Privacy Enhancement Using Biometrics: Introduction, Privacy concerns associated with biometric deployments, Identity and privacy, Privacy concerns, Biometrics with privacy enhancement, Comparison of various biometrics in terms of privacy, Soft Biometrics.</p> <p>Biometric Cryptography and Multimodal Biometrics: Introduction to biometric cryptography, General purpose cryptosystem, Modern cryptography and attacks, Symmetric key ciphers, Cryptographic algorithms, Introduction to multimodal biometrics, Basic architecture of multimodal biometrics, Multimodal biometrics using face and ear, Characteristics and advantages of multimodal biometrics.</p> <p>Text 1: 7.1-7.7 and 8.1-8.9</p>		
Self-Study Component:	<ol style="list-style-type: none">1. AADHAAR: An application of multimodal biometrics.2. Study the security of biometric data using cryptography. (Reference Paper: Thawre, A., Hariyale, A., & Chandavarkar, B. R. (2021, May). Survey on security of biometric data using cryptography. In 2021 2nd International Conference on Secure Cyber Computing and Communications (ICSCCC) (pp. 90-95). IEEE.)	
UNIT – V		08 Hours
<p>Watermarking Techniques: Introduction, Data hiding methods, Basic framework of watermarking, Classification of watermarking, Applications of watermarking, Attacks on watermarks, Performance evaluation, Characteristics of watermarks, General watermarking process, Image watermarking techniques, Watermarking algorithm.</p> <p>Biometrics Scope and Future: Scope and future market of biometrics, Biometric technologies, Applications of biometrics, Biometrics and information technology infrastructure, Role of biometrics in enterprise security, Role of biometrics in border security, Smart card technology and biometrics, Radio frequency identification (RFID) biometrics, DNA biometrics, Comparative study of various biometric techniques.</p> <p>Biometric Standards: Introduction, Standard development Organizations, Application Programming Interface (API), Information Security and Biometric Standards, Biometric Template Interoperability.</p>		



Text1: 9.1- 9.11, 10.1-10.10 and 12.1-12.5.

Self-Study Component:

1. Understand the concepts of Digital Image Watermarking (Reference Paper: Wadhera, S., Kamra, D., Rajpal, A., Jain, A., & Jain, V. (2022). A comprehensive review on digital image watermarking. arXiv preprint arXiv:2207.06909.
2. List the scope of biometric devices in future security systems.

Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Explain the basics of biometric modalities and features of the biometrics.	Analyze	L2(PO1)
CO2	Apply the various morphological operations for feature extraction in various biometrics.	Apply	L2(PO2)
CO3	Analyze the use of various biometrics.	Analyze	L4(PO3)
CO4	Understand the role of watermarking techniques in biometrics.	Understand	L2(PO2)
CO5	Summarize the privacy issues and concerns related to biometric cryptography.	Understand	L5(PO3)

Text Book(s):

1. **"Biometrics: Concepts and Applications"**, G.R.Sinha, SandeepB.Patil, Wiley, 2013 edition. ISBN: 13: 978-81-265-3865-2.

Reference Book(s):

1. Samir Nanavati, Michael Thieme, Raj Nanavati, **"Biometrics – Identity Verification in a Networked World"**, Wiley-dreamtech India Pvt Ltd, New Delhi, 2003. .ISBN: 978-0-471-09945-1
2. Paul Reid, **"Biometrics for Network Security"**, Pearson Education, New Delhi, 2004. ISBN 10: 8131716007.
3. John R Vacca, **"Biometric Technologies and Verification Systems"**, Elsevier Inc, 2007. ISBN: 9780750679671.
4. Anil K Jain, Patrick Flynn, Arun A Ross, **"Handbook of Biometrics"**, Springer, 2008. ISBN 978-0-387-71041-9

Web and Video link(s):

1. <https://www.digimat.in/nptel/courses/video/106104119/L22.html>
2. <https://www.youtube.com/watch?v=GMDggxifxqk>

E-Books/Resources:

1. <http://libgen.rs/book/index.php?md5=BD06463CF54045664E21537332BA95D4>
2. <http://libgen.rs/book/index.php?md5=57E403ABF891F363697612ED3B61161F>
3. <http://libgen.rs/book/index.php?md5=CB08E0F34881899E31B034753DD6D831>
4. <http://libgen.rs/book/index.php?md5=20A2D412E15640F3E50D132E8216BA39>
5. <http://libgen.rs/book/index.php?md5=F23D36C457D852BBD206E694400A2ACD>



Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	3												3	
#2		2												2
#3			2											2
#4		2												2
#5			1											1



Sensors and IOT [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21ECO5054	Credits:	03
Teaching Hours/Week (L:T:P):	3-0-0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: 1. To understand the fundamentals of IOT. 2. To learn about the basics of IOT Protocol. 3. Illustrate Mechanism and Key Technologies in IOT. 4. To develop IOT applications using Raspberry Pi and apply Cloud services for IOT systems. 5. To learn about the fundamentals of sensors.			
UNIT – I			8 Hours
Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT, IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies, Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates. Domain Specific IoTs: Introduction, Home Automation, Cities, Environment, Energy, Retail. Text 1: 1.1 to 1.5 and 2.1 to 2.5			
Self-study component:	Inventory management, logistics, Agriculture		
UNIT – II			8 Hours
Internet of Thing and Machine-to-Machine: Introduction, M2M, Difference between IoT and M2M, Software Defined Radio (SDR) and Network Function Virtualization (NFV). IoT Systems – Logical Design using Python: Introduction, Python data types and data structures, Control flow, Functions, Modules, Packages, File handling, Date/Time Operations, Classes. Text 1: 3.1 to 3.4.1 and 6.3 to 6.10			
Self-study component:	Need for IoT management systems, IoT management systems		
UNIT – III			8 Hours
IoT Physical Devices and Endpoints: What is an IOT device, Raspberry Pi, About the board, Linux on Raspberry Pi, Raspberry Pi interfaces, Programming Raspberry Pi with Python. IOT Physical Servers and Cloud Offerings: Introduction to Cloud storage models and communication APIS, WAMP-AutoBahn for IOT, Xively Cloud for IOT, Python Web –Application Framework-Django. Text 1: 7.1 to 7.6 and 8.1 to 8.4			
Self-study component:	1. Understand the concept of python packages of interest for IoT using Java Script Object Notation (JSON). Develop a python code parsing XML file (both creating and parsing). 2. Understand the need of different IoT devices used to implement an embedded application.		



UNIT – IV			8 Hours
<p>Introduction: Definition of Sensor and Actuator, The Domain of Physical Phenomena, Classification of Sensors and Actuators, Regarding the Energy Source, Regarding the Signal Conditioning, Regarding the Reference Value, Regarding the Complexity, Datasheets, Transfer Function, Sensitivity, Range, Accuracy, Precision, Hysteresis, Nonlinearity, Noise, Resolution, Bandwidth, Repeatability, Dead Zone, Saturation.</p> <p>Micro and Nanotechnology: Introduction, Manufacture, Use of Silicon, Creation of a silicon dioxide layer by thermal oxidation, Chemical Deposition by Vapor, Photolithography, Bulk Micro fabrication, Superficial Micro fabrication, Application Examples.</p> <p>Text 2: 1.2 to 1.5 and 2.1 to 2.3</p>			
Self-study component:		1. The specification of Vishay Semiconductors BPV10NF Photo Diode. 2. The concept of Linear Variable Differential Transformer (LVDT)	
UNIT – V			8 Hours
<p>Devices Based on the Electric Field: Introduction, Force, Electric Field and Voltage, Concept of Capacity, Capacitive Displacement Sensor, Capacitive Acceleration Sensor, Angular Velocity Sensor (Gyroscope), Capacitive Fingerprint Sensor, Electrostatic Loudspeaker, Electrostatic MEMS Actuator.</p> <p>Devices Based on Electrical Resistance: Introduction, Definition of Electric Resistance, Potentiometric Displacement Sensors, Dependence of Resistivity with Temperature and Moisture, Resistive Temperature Detector, Thermistor, Integrated Temperature Sensor, Dependence of Resistivity with Deformation, Strain Gauge.</p> <p>Text 2: 3.1 to 3.9 and 4.1 to 4.9</p>			
Self-study component:		1. The Working of Capacitive Accelerometer. 2. The working of Electrostatic Loudspeaker.	
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Discuss the Essentials and Requirements of IoT, concept of various sensors.	Remember	PO1 [L1]
CO2	Analyze the Concept of Cloud and Web services to access/control IoT devices and security of IoT devices	Understanding	PO2 [L2]
CO3	Identify and Understand the requirement of Physical devices to deploy on IoT application which connect to the cloud for real time scenario	Understanding	PO1 [L2]
CO4	Develop a Portable IOT using Raspberry PI	Applying	PO3 [L3]
<p>Text Book(s):</p> <ol style="list-style-type: none"> 1. “Internet of Things: A Hands-on Approach”, ArshdeepBahga and Vijay Madiseti, Universities Press, 2015, ISBN:978-81-7371-954-7. 2. “Sensors and Actuators”, Francisco Andre Correa Alegria, World Scientific Publishing Co. Pte. Ltd, ISBN:978-981-124-251-9. 			
<p>Reference Book(s):</p> <ol style="list-style-type: none"> 1. “Designing the Internet of Things” by Adrian McEwen, Hakim Cassimally, First Edition, Wiley Publishers. ISBN- 9781118430651 2. “The Internet of Things”, Michael Miller, First Edition, Pearson, 2015. ISBN-13: 978-0-7897-5400-4, ISBN-10: 0-7897-5400-22. “Designing Connected Products”, Claire 			



Web and Video link(s):

NPTEL course on “INTRODUCTION TO IOT” by Prof. Sudeep Misra IIT Kharagpur
(133) [INTRODUCTION TO IOT- PART-I – YouTube](#)

E-Books/Resources:

<http://libgen.rs/book/index.php?md5=C3B9C7BAFCFF42E0F9B4C3FBE631F16A>

Course Articulation Matrix (CAM)

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	2													
#2		2												
#3	2													
#4			3											
#5	2													



Circuit Simulation Laboratory [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21ECL506	Credits:	01
Teaching Hours/Week (L:T:P):	0-0-2	CIE Marks:	50
Total Number of Teaching Hours:	Lecture :2 Hr, Exam: 2Hr.	SEE Marks:	50
This course aims to:			
<ol style="list-style-type: none"> 1. Learning computer aided design and simulation tools 2. Design and verification of circuits at system level. 3. Capturing system requirements and optimize design. 			
Course Content			
The design flow must consists of the following			
PART –A			
Draw the schematic and perform			
<ul style="list-style-type: none"> • Transient analysis using Pspice simulator for given specification <ol style="list-style-type: none"> 1. Clipper and Clamper Circuit. 2. CMOS Inverter. 3. Current Controlled Voltage Source 4. Voltage Controlled Current Source. 5. Summing Amplifier 			
PART –B			
For the following set of experiments the design flow must consists of			
<ul style="list-style-type: none"> • Draw the schematic • Draw the PCB layout and verify with DRC • Generate the gerber file for given specification <ol style="list-style-type: none"> 1. Inverting amplifier 2. Design a full adder using basic gates. 3. Monostable / Astable multivibrator 4. Power supply design with regulators 5. Amplitude modulator 			
Open Ended Experiment			
<ol style="list-style-type: none"> 1. Temperature monitoring based on environmental condition. 2. Implement home automation with the help of relays. 			

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply the knowledge of the digital system to design the schematic in PspiceOrcad tools.	PO1, PO5 (L1)
CO2	Interpret the concept of transient and ac sweep analysis using Pspice Simulator	PO2, PO4 (L4)
CO3	Design PCB for the basic analog and digital circuit using Orcad tool	PO3, PO5 (L5)
CO4	Analyze and Optimize the circuit for given specification	PO2, PO3, PO4, PO5 (L4) ,(L3)



D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	3				3									
#2		3		3										3
#3														3
#4			2		3									2



Internship - II [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21INT507	Credits:	02
Teaching Hours/Week (L:T:P)	0:0:0	CIE Marks:	-
Total Number of Teaching Hours:	-	SEE Marks:	100
<p>All the students registered to III year of BE shall have to undergo a mandatory internship of 04 weeks during the vacation of IV semesters in industrial/Govt./NGO/MSME/Rural Internship/Innovation/Entrepreneurship/AICTE Intern Shala/College Partnered Industries. A Semester End Examination (Presentation followed by Question Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester grade card. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent Semester End Examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)</p> <p>Internship-II: SEE component will be the only seminar/Presentation and question answer session</p>			



Social Connect and Responsibility [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21UHV509	Credits:	01
Teaching Hours/Week (L:T:P):	1:0:0	CIE Marks:	100
Total Number of Teaching Hours:	25+5	SEE Marks:	--
Course Outcomes: This course will enable the students to: <ul style="list-style-type: none">• Identify the needs of the community and involve them in problem solving.• Demonstrate the knowledge about the culture and societal realities.• Develop sense of responsibilities and bond with the local community.• Make use of the Knowledge gained towards significant contributions to the local community and the society at large.• Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.			
PART-I			
Plantation and adoption of a tree: Plantation of a tree that will be adopted for four years by a group of BE / B.Tech students. (ONE STUDENT ONE TREE) They will also make an expert either as a documentary or a photo blog describing the plant's origin, its usage in daily life, its appearance in folklore and literature – Objectives, Visit, case study, report, outcomes.			
PART-II			
Heritage walk and crafts corner: Heritage tour, knowing the history and culture of the city, connecting to people around through their history, knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms - - Objectives, Visit, case study, report, outcomes.			
PART-III			
Organic farming and waste management: Usefulness of organic farming, wet waste management in neighboring villages, and implementation in the campus.			
PART-IV			
Water conservation: Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photoblog presenting the current practices – Objectives, Visit, case study, report, outcomes.			
PART-V			
Food walk: City's culinary practices, food lore, and indigenous materials of the region used in cooking – Objectives, Visit, case study, report, outcomes.			



Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom's Taxonomy Level	Level Indicator
CO1	Identify the needs of the community and involve them in problem solving .	Knowledge / Apply	L1 & L3
CO2	Demonstrate the knowledge about the culture and societal realities.	Understand	L2
CO3	Develop sense of responsibilities and bond with the local community	Apply	L4
CO4	Make use of the Knowledge gained towards significant contributions to the local community and the society at large.	Apply	L4
CO5	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions for individual and community problems.	Create	L6

Course Articulation Matrix

Mapping of Course Outcomes (CO) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)

Sl. No.	Course Outcome	Programme Outcomes												Programme Specific outcomes		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	Identify the needs of the community and involve them in problem solving .	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
2	Demonstrate the knowledge about the culture and societal realities.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
3	Develop sense of responsibilities and bond with the local community.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
4	Make use of the Knowledge gained towards significant contributions to the local community and the society at large.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-
5	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.	-	-	-	-	-	2	2	3	3	3	-	3	-	-	-



Guideline for Assessment Process:

Continuous Internal Evaluation (CIE) :

After completion of the social connect and responsibility course, the student shall prepare, with daily diary/ report as reference and a comprehensive report in consultation with the faculty/mentor to indicate what he has observed and learned in the social connect period.

The report shall be evaluated on the basis of the following below criteria's or other relevant criteria pertaining to the activity completed.

- Planning and scheduling the social connect.
- Information/Data collected during the social connect.
- Analysis of the information/data and report writing.
- Presentation and interaction.

CIE Rubrics for Evaluation.

Report	Video presentation	Interaction	Total
10	05	05	20

Note:

- Video presentation of **4 to 5 min** in a team to be presented and the same to be uploaded in the department YouTube channel.
- The number of students in each team can be from **4 to 5** members.
- Each activities has to be evaluated on above basis that is [20 * 5 = 100 marks] for final total marks.

Duration : A total of 25 – 30 hours engagement per semester is required for the 5th semester of the B.E./B.Tech. program. The students will be divided into groups and each group will be handled by faculty mentor.



Pedagogy – Guidelines:

Special Note: NO SEE – Semester End Exam – Completely Practical and activities based evaluation

It may differ depending on local resources available for the study as well as environment and climatic differences, location and time of execution.

Sl No	Topic	Group size	Location	Activity execution	Reporting	Evaluation Of the Topic
1.	Plantation and adoption of a tree:	May be individual or team	Farmers land/ parks / Villages / roadside/ community area / College campus etc.....	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
2.	Heritage walk and crafts corner:	May be individual or team	Temples / monumental places / Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.....	Site selection /proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
3.	Organic farming and waste management:	May be individual or team	Farmers land / parks / Villages visits / roadside/ community area / College campus etc.....	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
4.	Water conservation: & conservation techniques	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers / campus etc.....	site selection / proper consultation/Continuous monitoring/ Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty
5.	Food walk: Practices in society	May be individual or team	Villages/ City Areas / Grama panchayat/ public associations/Government Schemes officers/ campus etc.....	Group selection / proper consultation / Continuous monitoring / Information board	Report should be submitted by individual to the concerned evaluation authority	Evaluation as per the rubrics Of scheme and syllabus by Faculty



Employability Enhancement Skills (EES) - V [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – V			
Course Code:	P21HSMC508	Credits:	01
Teaching Hours/Week (L:T:P):	0:2:0	CIE Marks:	50
Total Number of Teaching Hours:	28	SEE Marks:	50
Course Learning Objectives: This course will enable students to: <ul style="list-style-type: none">• Apply programming constructs of C language to solve the real-world problem.• Explore user-defined data structures like arrays, structures and pointers in implementing solutions to problems.• Design and Develop solutions to problems using functions.			
UNIT – I			10 Hours
Problem solving through C - Flow Control: If...else, for Loop, while Loop, break and continue, switch...case, goto, Control Flow Examples, Simple Programs. Functions: Functions, User-defined Functions, Function Types, Recursion, Storage Class, Programs Arrays: Arrays, Multi-dimensional Arrays, Arrays & Functions, Programs. Self-Study: Variables and constants			
UNIT – II			10 Hours
Problem solving through C - Pointers: Pointers, Pointers & Arrays, Pointers and Functions, Memory Allocation, Array & Pointer Examples. Strings: String Functions, String Examples, Programs. Self-Study: Evaluation of Expression.			
UNIT – III			08 Hours
Problem solving through C - Structure and Union: Structure, Struct & Pointers, Struct & Function, Unions, Programs. Programming Files: Files Input/output Self-Study: Error handling during I/O operations.			



Course Outcomes: On completion of this course, students are able to:

CO – 1: Apply suitable programming constructs of C language to solve the given problem.

CO – 2: Explore user-defined data structures like arrays in implementing solutions to problems like searching and sorting.

CO – 3: Design and Develop solutions to problems using functions.

Text Book(s):

1. The C Programming Language (2nd edition) by Brian Kernighan and Dennis Ritchie.
2. C in Depth by S K Srivastava and Deepali Srivastava.
3. Computer fundamentals and programming in c, “Reema Thareja”, Oxford University, Second edition, 2017.

Reference Book(s):

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill. Brian W. Kernighan and Dennis M. Ritchie, The ‘C’ Programming Language, Prentice Hall of India.

Web and Video link(s):

1. Problem Solving through Programming in C -
<https://archive.nptel.ac.in/courses/106/105/106105171/>

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - V]

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	2	-	-	-	-	-	-	-	-	-
CO-2	2	2	2	-	-	-	-	-	-	-	-	-
CO-3	2	2	1	-	-	-	-	-	-	-	-	-



Analog CMOS VLSI Design [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC601	Credits:	03
Teaching Hours/Week (L:T:P):	3: 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: <ol style="list-style-type: none">1. Describe the basic MOS device physics and models.2. Describe method of the small signal and large signal analysis of amplifiers.3. Understanding the working of single stage MOS amplifiers with analysis.4. Describe the operation of different types of Current mirrors and their applications.5. Analysis and Design of the Operational amplifiers.6. Analyse and design of CMOS oscillators with mathematical model of VCOs.			
UNIT – I			8 Hours
Single– Stage Amplifiers: MOS Device Models, Basic Concepts, Common–Source Stage, Source Follower, Common–Gate Stage, Cascode Stage. Text 1: 2.4, 3.1 to 3.5			
Self-study component:	Design and simulate a single stage Amplifier for given requirements across different technologies, note the limitations and benefits.		
UNIT – II			8 Hours
Differential Amplifiers: Single– Ended and Differential Operation. Basic Differential Pair, Common–Mode Response, Differential Pair with MOS Loads, Gilbert Cell. Text 1: 4.1 to 4.3, 4.4 to 4.5			
Self-study component:	Explore and analyze the Difference Amplifier.		
UNIT – III			8 Hours
Passive and Active Current Mirrors: Basic Current Mirrors Cascode Current Mirrors, Active Current Mirrors. Frequency Response of Amplifiers: General Considerations: Explore and analyze the Wilson Current mirror. Miller Effect, Association of Poles with Nodes Common source stage Source Followers. Text 1: and 5.1 to 5.3 and 6.1-6.3			
Self-study component:	Study and understand the procedure of calculating Network functions along with the analysis of its Poles and Zeros (Ref: Ch.10 of Network Analysis, 3 rd edn, M.E. Van Valkenburg, PHI.)		
UNIT – IV			8 Hours
Frequency Response of Amplifiers: Common Gate stage, Cascode Stage and Differential Pair. Operational Amplifiers: General considerations, One stage op-amp, Two stage op-amp, Gain Boosting, Comparison, Common Mode feedback, Text 1: 6.4-6.6, 9.1 to 9.6			
Self-study component:	Read and explore the design of Fully differential OPAMP System of Cirrus Logic International (Patent No: US20180062583A1).		



UNIT – V		8 Hours
Operational Amplifiers: Input Range limitations, Slew rate, Power supply rejection, Noise in Op-amps. Oscillators: General Considerations, Ring Oscillators, LC Oscillators, Voltage–Controlled Oscillators, Mathematical Model of VCOs. Text 1: 9.7 to 9.9 14.1 to 14.5		
Self-study component:	Read and explore the Qualcomm VCO design.	
Text Book(s): 1. Design of Analog CMOS Integrated Circuits ”, Behzad Razavi, Tata McGraw Hill, Indian Edition, 2008, ISBN:0-07-238032-2.		
Reference Book(s): 1. “CMOS Analog Circuit Design” , Phillip E. Allen, Douglas R. Holberg, Oxford University Press, 3 rd edition 2011, ISBN:9780199765072. 2. “CMOS Circuit Design, Layout and Simulation” , R. Jacob Baker, Harry W. Li, David E. Boyce, Prentice Hall of India, 1 st edition 2005, ISBN-13:978-0780334168 ISBN-10:0780334167.		
ONLINE COURSES AND VIDEO LECTURES: 1. https://nptel.ac.in/courses/117/101/117101105/ (By Prof. A N Chandorkar, IIT, Bombay) 2. https://nptel.ac.in/courses/108/106/108106105/ (By Prof. Aniruddhan S, IIT, Madras) SWAYAM: 3. https://swayam.gov.in/nd1_noc20_ee13/preview (By Prof. Hardik Jeetendra Pandya, IISC, Bengaluru).		

Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	To Apply the knowledge of circuit elements and circuit analysis to understand the MOS devices and analog CMOS circuits	PO1 (L2)
CO2	To Analyze different Analog CMOS VLSI circuits(Amplifiers, Op-amps, Oscillators)	PO2 (L4)
CO3	To Design the analog CMOS circuits for the given Specifications.	PO3 (L4)
CO4	To Develop analog CMOS circuits for Different applications.	PO3 (L5)
CO5	To Simulate the analog CMOS circuits using modern tools.	PO5, PO9 (L5)



Course Articulation Matrix (CAM)

CO	PO1	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS
		2	3	4	5	6	7	8	9	10	11	12	O1	O2
#1	3												3	
#2		3												3
#3			2											
#4			2											
#5					3				2					



ITC and Multimedia Communications [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC6021	Credits:	03
Teaching Hours/Week (L:T:P):	3: 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none"> 1. Provide the knowledge of probability, information theory and source coding theorem. 2. Analyze the efficient data compression methods and describe the most efficient compression method. 3. Develop the channel model and channel capacity theorem. 4. Describe the linear block codes, cyclic codes and BCH codes. 5. Explain the types of multimedia network and its applications. 6. Describe the digitization principles of text and images and provide the understanding of digitization techniques of audio. 			
UNIT – I			8 Hours
Information Theory and Source Coding: Introduction to Information Theory, Uncertainty and Information, Average Mutual Information and Entropy, Information Measures for Continuous Random Variables, Relative Entropy, Source Coding Theorem, Huffman Coding, Shannon-Fano-Elias Coding, Arithmetic Coding, The Lempel-Ziv Algorithm, Run Length Encoding, Rate Distortion Function, Optimum Quantizer Design, Entropy Rate of a Stochastic Process, Introduction to Image Compression, The JPEG Standard for Lossless Compression, The JPEG Standard for Lossy Compression, Video Compression Standards. Text 1: 1.1-1.18			
Self-study component:	<ol style="list-style-type: none"> 1. Understand the properties of codes and applications of information theory. 2. Study and compare the different lossy and lossless compression. 		
UNIT – II			8 Hours
Channel Capacity and Coding: Introduction, Channel Models, Channel Capacity, Channel Coding, Information Capacity Theorem, Parallel Gaussian Channels, The Shannon Limit, and Channel Capacity for MIMO Systems. Error Control Coding (Channel Coding): Linear Block Codes for Error Correction, Introduction to Error Correcting Codes, basic definitions , Matrix Description of Linear Block, Equivalent Codes, Parity Check Matrix, Decoding of a Linear Block Code, Syndrome Decoding, Error Probability after Coding (Probability of Error Correction), Perfect Codes, Hamming Codes, Low Density Parity Check (LDPC) Codes, Optimal Linear Codes. Text 1: 2.1-2.8 , 3.1-3.12			
Self-study component:	<ol style="list-style-type: none"> 1. Identify the practical Applications of MIMO system. 2. Understand the uses of Linear and non Linear block codes. 		
UNIT – III			8 Hours
Cyclic Codes: Introduction to Cyclic Codes, Polynomials, The Division Algorithm for Polynomials, A Method for Generating Cyclic Codes, Matrix Description of Cyclic Codes, Quasi-			



Cyclic Codes and Shortened Cyclic Codes.

Bose–Chaudhuri Hocquenghem (BCH) Codes: Introduction to BCH Codes, Primitive Elements, Minimal Polynomials, Generator Polynomials in Terms of Minimal Polynomials, Some Examples of BCH Codes, Decoding of BCH Codes, Reed-Solomon Codes.

Text 1: 4.1-4.6 , 5.1-5.7

Self-study component:	<ol style="list-style-type: none"> 1. Discuss the concept of Convolutional Codes, AWGN Channel and identify the noises associated. 2. Golay Codes, CRC Codes.
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UNIT – IV	8 Hours
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Multimedia Communications: Introduction, Multimedia information representation, Multimedia networks: Telephone, data, Broadcast television, ISDN and Broadband multiservice digital networks, Multimedia applications: Interpersonal communication, Interactive applications over the internet, Entertainment applications, Application and networking terminology: Media types, Communication modes, Network types.

Text 2: 1.1 to 1.5

Self-study component:	<ol style="list-style-type: none"> 1. Multimedia Electronic mail structure. 2. Multipoint conferencing. 3. Network QoS and Application QoS.
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UNIT – V	8 Hours
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Multimedia Information Representation: Introduction, Digitization principles: Analog signals, Encoder design, and Decoder design, Text: Unformatted text, Formatted text, Hypertext, Images: Graphics, Digitized documents, Digitized pictures, Audio: PCM speech, Video: Broadcast television, Digital Video.

Text 2: 2.1 to 2.5.1, 2.6.1,2.6.2

Self-study component:	<ol style="list-style-type: none"> 1. Digital cameras and scanners. 2. CD-quality audio and Synthesized audio. 3. HDTV formats, PC video and video content.
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Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom’s Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Apply knowledge of mathematics to understand concepts of Probability, Information theory, communication channel and source codes.	Understand & Apply	PO1 (L3)
CO2	Analyze different source codes for its efficiency used with communication channels.	Apply & Analyze	PO2, PO3(L4)
CO3	Design coding schemes for a given specifications and evaluate for their error correcting capability.	Design	
CO4	Discuss different networks and types in Multimedia Communication and its applications.	Discuss	PO1 (L2)
CO5	Simulate different Source codes using modern tool.		PO1, PO2 (L3)



Text Book(s):

1. “**Information Theory, Coding and Cryptography**”, Ranjan Bose, 3rd edition. Tata McGraw. ISBN : 978-0-07-0669017, 2016
2. “**Multimedia Communications, Applications, Networks, Protocols and Standards**”, Fred Halsall, Fifth Impression, Pearson, 2011.ISBN: 978-81-317-0994-8.

Reference Book(s):

1. “**Digital Communication Systems**”, Simon Haykin, John Wiley, 4thedition.ISBN-13: 978-0130426727.
2. “**Error Control Coding**”,Shu Lin, Daniel J. Costello, Jr., 2nd Edition, Pearson.
3. “**Multimedia: Computing, Communications and Applications**”, Ralf Steinmetz and KlaraNabrsted, Pearson Education, 2004ISBN: 9788177584417.

Web and Video link(s):NPTEL Course links

1. <https://nptel.ac.in/courses/108/102/108102117/>
2. <https://nptel.ac.in/courses/117/105/117105083/#>

E-Books/Resources:

1. <https://link.springer.com/book/10.1007/978-3-642-20347-3>
2. <https://link.springer.com/book/10.1007/978-3-319-05290-8>

Course Articulation Matrix

CO#	PO#	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1		3												3	
CO2			3	2										2	3
CO3		3												3	
CO4		3	2											3	2



DSP Processor and Applications [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC6022	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none"> 1. Provide the understanding of architecture, programming and interfacing of commercially available Digital Signal Processor. 2. Discuss the effective use of Digital Signal Processor in system implementation. 3. Adopt the MATLAB tools in DSP applications. 4. Provide the understanding of architecture features of TMS320C54XX. 5. Describe the programming of TMS320C54XX for several basic DSP algorithms. 6. Understand the interfacing procedure to use programmable Digital Signal Processor. 7. Discuss the applications of programmable DSP devices. 			
UNIT – I			8 Hours
Architectures for Programmable DSP Devices: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Speed Issues. Text 1: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.8			
Self-study component:	<ol style="list-style-type: none"> 1. List and explain important features needed for external interfacing with DSP device. 2. Explain pipelining and parallel processing with real life example. Also comment on time requirement in each process. 		
UNIT – II			8 Hours
Programmable Fixed Point Digital Signal Processors: Introduction, Commercial Digital Signal– processing Devices, Data Addressing Modes of TMS320C54xx DSPs, Memory Space of TMS320C54xx Processors, Program Control, TMS320C54xx Instructions, Pipeline Operation of TMS320C54xx Processors. Text 1: 5.1, 5.2, 5.3.1, 5.3.2, 5.3.3, 5.4, 5.5, 5.6, 5.7.1 (Mentioned topics only), 5.10			
Self-study component:	<ol style="list-style-type: none"> 1. How DSP processor is different from conventional processor? Justify your answer with relevant example. 2. Study memory (internal and extended), peripherals and general purpose I/O pins characteristics of 54X processors. 		
UNIT – III		8 Hours	
Implementation of Basic DSP Algorithms: Introduction, the Q–notation, FIR Filters, IIR Filter, Interpolation Filters, Decimation Filters, PID controller, Adaptive Filters. Implementation of FFT Algorithms: Introduction, An FFT Algorithm for DFT, A Butterfly Computation, Overflow and Scaling. Text 1: 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 8.1, 8.2, 8.3, 8.4			
Self-study component:	<ol style="list-style-type: none"> 1. Study an 8-point FFT implementation on the TMS320C54XX processor. 2. Design and implement 4 tap FIR filter using Verilog. 		
UNIT – IV			8 Hours
Interfacing Memory and Parallel I/O Peripherals to Programmable DSP Devices: Introduction, External Bus Interfacing signals, Memory Interface, Parallel I/O Interface, Programmed I/O, Interrupts and I/O, Direct Memory Access (DMA). Interfacing and Applications of DSP Processor: Introduction, Synchronous Serial Interface, A			



CODEC Interface Circuit.

Text 1: 9.1, 9.3, 9.4, 9.5, 9.6, 9.7, 9.8, 10.1, 10.2, 10.5

Self-study component:	<ol style="list-style-type: none"> 1. Study of Multi-channel Buffered Serial Port Programming(McBSP). 2. A study of CODEC interface circuit and CODEC programming.
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UNIT – V

8 Hours

Programmable Floating Point Digital Signal Processors: Introduction, Features of TMS320C6713, TMS320C6713 Architecture, Linear and Circular addressing modes, Instruction set, TMS 320C6713 DSK Boards, TMS 320C6713 Programming.

Applications of DSP Devices: DSP Based Bio–telemetry DSP based Speech Processing System, Data compression in DSP Based Image Processing System.

Text 2: 23.1 to 23.4, 23.5 (23.5.1 Excluded), 23.6, 23.7.1, 23.8

Self-study component:	<ol style="list-style-type: none"> 1. Discuss why floating point processor better than fixed point processor. 2. Implement speech processing system using MATLAB.
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Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Apply the knowledge of binary math problems to understand the internal architecture and its operation of the DSP processor.	L3	PO1
CO2	Demonstrate programming proficiency using various addressing modes and data transfer instructions of DSP processor.	L3	PO1
CO3	Design and implement the basic DSP algorithms.	L4	PO3
CO4	Evaluate electrical circuitry to the DSP processor I/O ports in order to interface the processor to external devices.	L3	PO5
CO5	Analyze the application areas of DSP processor, using signal processing knowledge.	L5	PO2

Text Book(s):

1. “**Digital Signal Processing**”, Avatar Singh and S. Srinivasan, Thomson Learning, 1st edition 2004. *ISBN 10: 0534391230 / ISBN 13: 9780534391232.*
2. “**Modern Digital Signal Processing**”, V. Udayashankara, Eastern Economy Edition, 2016. *ISBN 10: 8120345673 / ISBN 13: 9788120345676.*

Reference Book(s):

1. “**Digital Signal Processors Architectures, Implementations, and Applications**” Sen M Kuo, Woon-seng Gan, Pearson Edition, 2005. *ISBN-13: 978-0130352149, ISBN-10: 0130352144.*
2. “**Digital Signal Processors- Architecture, Programming and Applications**” B Venkataramani, MBhaskar, McGraw Hill Education, 2015. *ISBN-10: 9780070702561.*



Web and Video link(s):

1. https://www.youtube.com/watch?v=0q_ncmDhIBI&list=PLOzRYVm0a65cU4xstihbncPHenmJJ7f&index=3
2. <https://www.youtube.com/watch?v=SKuywStjBLY&t=187s>

E-Books/Resources:

1. <https://www.ti.com/lit/ug/spru131g/spru131g.pdf>
2. https://www.ti.com/lit/ug/spru733a/spru733a.pdf?ts=1681711848655&ref_url=https%253A%252F%252Fwww.google.com%252F

Course Articulation Matrix (CAM)

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	3												3	
#2	3												2	3
#3			3										2	2
#4					3									
#5		3											3	3



Embedded Systems [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC6023	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ul style="list-style-type: none">• Understand basic components of embedded systems and its characteristic attributes• Partitioning design into Hardware and Software• Analyze embedded design problem• Use of Firmware design tools• Write software for the embedded system using Embedded C• Choose proper IDE for the design and follow the recent trends in the embedded system design.			
UNIT – I			8 Hours
Introduction to Embedded Systems: What is an Embedded System, Embedded Systems vs. General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Area of Embedded Systems, Purpose of Embedded Systems. Typical Embedded System: General purpose and domain specific processors, Memory, Sensors and Actuators, Other System Components. Text 1: 1.1 to 1.6, 2.1.1, 2.2, 2.3, 2.6			
Self-study component:	<ol style="list-style-type: none">1. Discuss ‘Smart’ running shoes from Adidas- the Innovative Bonding of Lifestyle with Embedded Technology.2. Understand different Communication Interfaces.		
UNIT – II			8 Hours
Characteristics and Quality Attributes of Embedded Systems: Characteristics of an embedded system, Quality attributes of embedded systems. Embedded System- Application and Domain Specific: Consumer (Washing Machine), Automotive. Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified Modeling Language. Text 1: 3.1, 3.2, 4.1, 4.2, 7.1 to 7.3			
Self-study component:	<ol style="list-style-type: none">1. Discuss How to use Or-CAD tool.2. Understand schematic design using Or-CAD Capture CIS.		
UNIT – III		8 Hours	
Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages. Programming in Embedded C: Programming in Embedded C, C vs Embedded C, Compiler vs Cross Compiler, Using C in Embedded C. Text 1: 9.1 to 9.3, 9.3.1, 9.3.2, 9.3.3.			
Self-study component:	Understand Embedded C programs to control 8051 microcontrollers.		



UNIT – IV			8 Hours
Real-Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of OS, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Synchronization, how to Choose an RTOS. Text 1: 10.1 to 10.5, 10.8, 10.10			
Self-study component:	<ol style="list-style-type: none">1. Analyze Threads, Processes and Scheduling: Putting them all together with programming.2. Understand different methods of task communication.		
UNIT – V			8 Hours
The Embedded System Development Environment: Types of Files Generated on Cross compilation, Disassembler / Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan. Trends in the Embedded Industry: Processor Trends in Embedded System, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks. Text 1: 13.2 to 13.6, 16.1 to 16.5			
Self-study component:	<ol style="list-style-type: none">1. Study the Integrated Development Environment (IDE).2. Analyze the embedded product development life cycle.		
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Apply the knowledge of Microcontrollers to understand and explain the concepts of Embedded systems.	Understand and Apply	PO1 (L2)
CO2	Analyze the different issues involved in embedded system development using real time operating systems.	Analyze	PO1, PO2 (L2, L3)
CO3	Relate the recent trends and overview in the Design of Embedded systems.	Evaluate	PO3 (L2)
CO4	Develop an embedded system applications for a given specification using high level and assembly level language.	Create	PO3 (L3)
CO5	Application of Embedded systems using Modern tools	Create	PO5 (L2)
Text Book(s): 1. “Introduction to Embedded Systems” , Shibu K V, Tata Mc Graw Hill Education Private Limited, 2009, 2 nd Edition, ISBN (13): 978-0-07-014589-4			
Reference Book(s): 6. “Embedded Systems – A contemporary Design Tool” , James K Peckol, John Wiley, 2008. 7. “Embedded Systems Design” , An Introduction to Processes, Tools, and Techniques by Arnold S. Berger ISBN: 1578200733 CMP Books © 2002			



Web and Video link(s):

1. Embedded Systems Design- https://youtu.be/TP1_F3IVjBc
2. Introduction to Real Time Embedded Systems- <https://nptel.ac.in/courses/108105057>

E-Books/Resources:

1. <https://pt.scribd.com/document/493077832/Embedded-Systems-Shibu#>
2. https://books.google.co.in/books/about/Introduction_to_Embedded_Systems.html?id=Et16nQAACAAJ&redir_esc=y

Course Articulation Matrix (CAM)

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	3												3	
#2	2	3											2	3
#3			2											
#4			3											
#5					2									



Operating Systems [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC6024	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none"> 1. Provide an Overview of the Operating Systems topics. 2. Examine the issues of Mutual Exclusion and deadlock. 3. Discuss the principal requirements for memory management. 4. Discuss the organization of the I/O functions. 5. Understand the spectrum of computer security attacks. 			
UNIT – I			8 Hours
Operating System Overview: Operating System Objectives and Functions, The Evolution of Operating Systems, Major Achievements, Developments Leading to Modern Operating Systems, Virtual Machines. Process Description and Control: What Is a Process?, Process States, Process Description, Process Control Text 1: 2.1-2.5, 3.1-3.4			
Self-study component:	Learn the concepts of Multicore Systems. Learn the Execution of the Operating System.		
UNIT – II			8 Hours
Concurrency: Deadlock and Starvation - Principles of Deadlock, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, An Integrated Deadlock Strategy, Dining Philosophers Problem. Text 1: 6.1 - 6.6			
Self-study component:	Learn the Concepts of Mutual Exclusion and Semaphore.		
UNIT – III			8 Hours
Memory Management: Memory Management Requirements, Memory Partitioning, Paging, Segmentation, Security Issues. Text 1: 7.1 - 7.5			
Self-study component:	Comment on Fixed and Dynamic Memory partitioning.		
UNIT – IV			8 Hours
Uniprocessor Scheduling: Types of Processor Scheduling, Scheduling Algorithms, Traditional UNIX Scheduling Text 1: 9.1 - 9.3			
Self-study component:	Learn about Multiprocessor Scheduling, Real-Time Scheduling.		
UNIT – V			8 Hours
I/O Management and Disk Scheduling: I/O Devices, Organization of the I/O Function, Operating System Design Issues, I/O Buffering, Disk Scheduling, RAID, Disk Cache. Text 1: 11.1 - 11.7			
Self-study component:	Compare the types of I/O in UNIX, LINUX and WINDOWS.		
Text Book: 1. “Operating Systems” by William Stallings, 7e, Pearson India. ISBN-13: 978-9332518803.			



Reference book(s)

1. Operating Systems” by Godbole, 3 edition, McGraw Hill India. ISBN-13: 978-0070702035

Course Outcome:

COs	Course Outcomes with Action verbs for the Course topics	Bloom’s Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Understand the basic structure of operating system	Understand	L2(PO1)
CO2	Interpret the key design areas that have been instrumental in the development of modern operating systems.	Applying	L3 (PO1) (PO2)
CO3	Examine the principal requirements for memory management and I/O management.	Applying	L3(PO2)
CO4	Distinguish among various types of security threats along with security techniques.	Analyzing	L4(PO3)

Course Articulation Matrix (CAM)

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3												3	
2	3	2											3	2
3		3												
4			3											
5														



Computer Organization [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC6031	Credits:	03
Teaching Hours/Week (L:T:P):	3:0:0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives:			
<ol style="list-style-type: none"> 1. Conceptualize the basics of Organizational issues of a digital computer and compare the performance of machine instruction. 2. Expose different ways of communication with I/O Devices. 3. Notice how to perform computer arithmetic operation. 4. Understand working of processing unit using different bus structures. 5. Illustrate different Types of memory devices with their principles. 			
UNIT – I			8 Hours
BASIC STRUCTURE OF COMPUTERS: Basic operational Concepts, Performance. INSTRUCTION SET ARCHITECTURE: Memory Location and Addresses, Memory Operations, Instruction and Instruction Sequencing, Addressing Modes, Assembly Language. Text 1: Ch 1:1.3 to 1.6 Ch 2:2.1-2.5			
Self-study component:	Functional Units of Computer, Number representation and Arithmetic Operations, Character representation.		
UNIT – II			8 Hours
INSTRUCTION SET ARCHITECTURE(Continued): Subroutines, Additional instructions. BASIC INPUT/OUTPUT: Accessing I/O Devices-I/O Device Interface, Program Controlled I/O, Interrupts-Enabling and Disabling Interrupts, Handling Multiple Devices, Exceptions. INPUT/OUTPUT ORGANIZATION: Bus Structure, Bus Operation-Synchronous Bus, Asynchronous Bus, Arbitration. Text 1: Ch 2:2.7, 2.8.Ch 3:3.1.1,3.1.2,3.2.1,3.2.2,3.2.6.Ch 7:7.1,7.2.1,7.2.2,7.3.			
Self-study component:	Stacks and Interface Circuits.		
UNIT – III			8 Hours
Memory Management: Memory Management Requirements, Memory Partitioning, Paging, Segmentation, Security Issues. Text 1: 6.1 - 6.5			
Self-study component:	Read Only Memories and Direct Memory Access		
UNIT – IV			8 Hours
BASIC PROCESSING UNIT: Some Fundamental Concepts, Instruction Execution, Hardware Components, Instruction Fetch and Execution Steps, Control Signals, Hardwired Control Text 1: Ch 5:5.1 to 5.6.			
Self-study component:	CISC Style Processors.		
UNIT – V			8 Hours
ARITHMETIC: Multiplication of Signed Numbers, Fast Multiplication-Bit Pair Recoding of Multipliers, Carry-Save Addition of Summands, Integer Division, Introduction to Floating point Numbers and Operations. Text 1: Ch 9: 9.4, 9.5.1,9.5.2,9.6,9.7.			
Self-study component:	Design of Fast Adders and Multiplication of Unsigned numbers.		

**Text Book:**

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization and Embedded Systems, 6th Edition, Tata McGraw Hill.

Reference Book(s):

1. Computer Organization & Architecture, William Stallings, 9th Edition, PHI, 2013.
2. Computer Systems Design and Architecture, Vincent P. Heuring & Harry F. Jordan, 2nd Ed. Pearson Education, 2004.

Web and Video link(s):

1. <https://nptel.ac.in/courses/106/103/106103068/>
2. <https://nptel.ac.in/content/storage2/courses/106103068/pdf/coa.pdf>
3. <https://nptel.ac.in/courses/106/105/106105163/>
4. <https://nptel.ac.in/courses/106/106/106106092/>
5. <https://nptel.ac.in/courses/106/106/106106166/>
6. <http://www.nptelvideos.in/2012/11/computer-organization.html>

Course Outcomes

COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Understand the operation and organization of a digital computer system.	Understand	L2(PO1)
CO2	Apply the knowledge of assembly language/ algorithmic techniques to solve the given problem.	Applying	L3 (PO1) (PO2)
CO3	Analyze the given assembly language code snippet.	Applying	L3(PO2)
CO4	Design memory modules.	Analyzing	L4(PO3)

D. Course Articulation Matrix (CAM)

C	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
1	3												3	
2	3	2											3	2
3		3												
4			3											
5														



Digital Image Processing [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC6032	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none"> 1. Understand the fundamentals of digital image processing. 2. Understand the image enhancement techniques used in digital image processing. 3. Understand the image restoration techniques used in digital image processing. 4. Understand the Morphological Operations and Segmentation used in digital image processing. 5. Understand the image Representation and Description in digital image processing. 			
UNIT – I			8 Hours
Digital Image Fundamentals: What is Digital Image Processing?, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception: Structure of the Human Eye, Brightness Adaption and discrimination, Image Sensing and Acquisition, Image Sampling and Quantization. Text 1: 1.1,1.3-1.5,2.1,2.3,2.4			
Self-study component:	<ol style="list-style-type: none"> 1. Comprehend the array versus matrix operations. 2. Origins of Digital Image Processing. 3. Light and the Electromagnetic Spectrum. 4. Representing digital images. 		
UNIT – II			8 Hours
Spatial Domain: The Basics of Intensity Transformation and Spatial Filtering, Some Basic Intensity Transformation Functions: Image Negatives, Log Transformations, Power-Law Transformation. Smoothing Spatial Filters: Order-Static Filters, Sharpening Spatial Filters: Using The Second derivative for image sharpening-The Laplacian, Using First-Order derivatives for image sharpening-The Gradient. Filtering in the Frequency Domain: The basic of Filtering in the Frequency Domain: Summary of steps for Filtering in the Frequency domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters. Text 1: 3.1, 3.2, 3.5, 3.6, 4.7, 4.8			
Self-study component:	<ol style="list-style-type: none"> 1. Develop an algorithm to enhance image quality using histogram equalization 2. Histogram Processing Fundamentals of Spatial Filtering. 		
UNIT – III			8 Hours
Restoration: A model of the image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering. Text 1: 5.1-5.4, 5.6-5.8.			
Self-study component:	<ol style="list-style-type: none"> 1. Develop an algorithm to add various intensity levels of a given noise to an image and remove. 2. Linear Position Invariant Degradations. 		



UNIT – IV			8 Hours
<p>Color Image Processing: Color Fundamentals, Color Models, Pseudo-color Image Processing: Intensity slicing and color coding. Morphological Image Processing: Erosion and Dilation, Opening and Closing, the Hit-or-Miss Transforms, Some Basic Morphological Algorithms: Thinning, Thicking. Text 1: 6.1 - 6.3, 9.2-9.5</p>			
Self-study component:	<ol style="list-style-type: none"> 1. Develop an algorithm to extract boundary pixels of an image using morphological operations 2. Boundary Extraction 3. Hole Filling 4. Extraction of Connected components. 		
UNIT – V			8 Hours
<p>Segmentation: Point, Line, and Edge Detection, Thresholding: Foundation Optimum global thresholding using OTSU’S Method, Region Based Segmentation. Text 1: 10.2, 10.3, 10.4</p>			
Self-study component:	<ol style="list-style-type: none"> 1. Define a procedure for estimating the median of an image from its histogram. 2. Threshold the image at the resulting median value and verify that the foreground and background partitions are of approximately equal size. 		
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom’s Taxonomy Level	Program Outcome Addressed (PO#) with BTL
CO1	Apply basic mathematical and signal processing knowledge to understand different image processing stages.	Remember	L1 (PO1)
CO2	Analyze images in the spatial/frequency domain using various methods.	Understanding	L2(PO2)
CO3	Analyze an image through image segmentation.	Understanding	L2(PO2)
CO4	Apply knowledge of image processing in Image Restoration, Color, Morphological processing and Representation and Description .	Applying	L2(PO1)
CO5	Develop algorithms to perform image processing using modern tool in a group and acquire team playing skills.	Applying	L4(PO3,PO5, PO9,PO10)
Text Book(s):			
<ol style="list-style-type: none"> 1. “Digital Image Processing”, Rafael C. Gonzalez and Richard E. Woods, Pearson4th Edition 2018, ISBN:9789353062989. 			
Reference Book(s):			
<ol style="list-style-type: none"> 1. “Digital Image Processing”,S.Jayaraman, S.Esakkirajan, T.Veerakumar, Tata McGraw Hill 2014. 2. “Fundamentals of Digital Image Processing”, A. K. Jain, Pearson 2004. 			



Web and Video link(s):

1. <https://youtu.be/ArKe6zMkXnk>
2. <https://youtu.be/iZmHHVwp0Ow>

E-Books/Resources:

1. https://sde.uoc.ac.in/sites/default/files/sde_videos/Digital%20Image%20Processing%203rd%20ed.%20-%20R.%20Gonzalez,%20R.%20Woods-ilovepdf-compressed.pdf

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO1 1	PO12	PSO1	PSO2
#1	3												3	
#2		2												2
#3		2												2
#4	3												3	
#5			2		2				2	2				



Design for Testability [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC6033	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives (CLOs)			
At the end of the course the students should be able to:			
<ol style="list-style-type: none"> 1. Understand the significance and principles of testability in Integrated Circuits. 2. Identify and categorize the faults in Integrated circuits. 3. Interpret the Test Pattern Generation and related algorithms for Combinational and Sequential Circuits. 4. Analyze the circuits and device test pattern generators for the circuits. 5. Understand the trade-offs associated with designing for testability 6. Articulate the techniques, structure and methods associated with built-in self-test (BIST), boundary scan testing, and fault injection to improve testability 			
UNIT – I			8 Hours
Introduction to Testing: Introduction, Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends Affecting Testing.			
Fault Modeling: Defects, Errors, and Faults, Functional Versus Structural Testing, Levels of Fault Models, A Glossary of Fault Models, Single Stuck-at Fault.			
Text1: 1.1 to 1.4, 4.1 to 4.5.			
Self-Learning Component:	Modeling Circuits for Simulation Algorithms for True-Value Simulation		
UNIT – II			8 Hours
TESTABILITY MEASURES: SCOAP Controllability and Observability, High-Level Testability Measures			
Combinational Circuit Test Generation: Algorithms and Representations, Redundancy Identification (RID), Testing as a Global Problem, Definitions, Significant Combinational ATPG Algorithms (Expect Advanced Algorithms).			
Text1: 6.1-6.2, 7.1 to 7.5,			
Self-Learning Component:	Advanced Test Pattern Algorithms		
UNIT – III			8 Hours
Sequential Circuit Test Generation: ATPG for Single-Clock Synchronous Circuits, Time-Frame Expansion Method, Simulation-Based Sequential Circuit ATPG.			
Memory Test: Memory Density and Defect Trends, Notation, Faults, Memory Test Levels, March Test Notation, Fault Modeling.			
Text1: 8.1 to 8.2, 9.1-9.6.2			
Self-Learning Component:	Simulation-Based Sequential Circuit ATPG Memory Testing		
UNIT – IV			8 Hours
Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design,			



Variations of Scan. Built-In Self-Test: The Economic Case for BIST, Random Logic BIST. Text1: 14.1 to14.4,15.1, 15.2.	
Self-Learning Component:	Analog and Mixed-Signal Circuit Trends
UNIT – V	
8 Hours	
Built-In Self-Test: Memory BIST, Delay Fault BIST. Boundary Scan Standard: Motivation, System Configuration with Boundary Scan, Boundary Scan Description Language. Text 1: 15.3, 15.4, 16.1-16.3.	
Self-Learning Component:	Supply current measurement based test (IDDQ TEST) for manufacturing faults in IC's.
Text Book(s): 1. Michael L. Bushnell, Vishwani D. Agrawal, “ Essentials Of Electronic Testing For Digital, Memory And Mixed-Signal VLSI Circuits ”, KLUWER ACADEMIC PUBLISHERS NEW YORK, BOSTON, DORDRECHT, LONDON, MOSCOW, 2016, ISBN13: 978-0-12-408082-9.	
Reference Book(s): 1. M. Abramovici, M. A. Breuer and A.D Friedman, “Digital Systems and Testable Design”, Jaico Publishing House. 2. P.K. Lala, “Digital Circuits Testing and Testability”, Academic Press.	
Web and Video link(s):	
E-Books/Resources:	

Course Articulation Matrix (CAM)

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	3												3	
#2		3												3
#3		3												3
#4			3											3
#5				1					1				2	



Artificial Intelligence and Machine Learning in VLSI [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC6034	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will aims to: <ol style="list-style-type: none"> 1. Understand about Neural Network and Deep Learning 2. Introduce to the concepts of NVIDIA GPU, Tensor Processing Unit. 3. Learn streaming graph Theory. 4. Learn In-Memory Computation. 5. Familiarize Near-Memory Architecture. 6. Introduce Machine learning concepts in physical verification and design. 7. Understand statistical analysis using Machine learning. 			
UNIT – I			8 Hours
Introduction: Development History, Development History, Neural Network Classification, , Neural Network Framework.			
Deep Learning: Neural Network Layer, Deep Learning Challenges.			
Text 1: • Chapter 1 and Chapter 2			
Self-study component:	<ol style="list-style-type: none"> 1. Study introduction to AI and ML 2. Write a sample code in python for a neural network application. 		
UNIT – II			8 Hours
Parallel Architecture: Intel Central Processing Unit (CPU), NVIDIA Graphics Processing Unit (GPU), NVIDIA Deep Learning Accelerator (NVDLA), Google Tensor Processing Unit (TPU). Microsoft Catapult Fabric Accelerator			
Streaming Graph Theory: Blaize Graph Streaming Processor, Graph core Intelligence Processing Unit			
Text 1: • Chapter 3 and Chapter 4			
Self-study component:	Study the introduction to NVIDIA GPU applications, Tensor flow.		
UNIT – III			8 Hours
In-Memory Computation: Neuro cube Architecture, Tetris Accelerator, Neuro Stream Accelerator			
Near-Memory Architecture: DaDianNao Supercomputer, Cnvlutin Accelerator.			
Text 1: • Chapter 6 and Chapter 7			
Self-study component:	Study the supercomputer architectures		
UNIT – IV			8 Hours
Machine Learning in Physical Verification, Mask Synthesis, and Physical Design: Introduction, Machine Learning in Physical Verification, Machine Learning in Physical Design			
Machine Learning-Based Aging Analysis: Introduction, Negative Bias Temperature Instability, Related Prior Work, Proposed Technique, Offline Correlation Analysis and Prediction Model, Runtime Stress Monitoring, Results, Conclusions			
Text 2: • 4.1, 4.2, 4.4 and Chapter 9			
Self-study component:	Study the Machine Learning Applications in VLSI routing.		
UNIT – V			8 Hours



Extreme Statistics in Memories: Cell Failure Probability: An Extreme Statistic, Extremes: Tails and maxima

Fast Statistical Analysis Using Machine Learning: Introduction: Logistic Regression-Based Importance Sampling Methodology for Statistical Analysis of Memory Design, Application to State-of-the-Art Fin FET SRAM Design

Text 2: • 10.1, 10.2, 10.4, 11.1,11.5

Self-study component:	Study the Machine Learning regression techniques and sampling algorithms.
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Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Understand the concepts of Neural Network and Deep learning	L2	PO1
CO2	Understand the concepts of Parallel Architecture and Streaming Graph Theory	L2	PO2
CO3	Analyze and Understand In-memory computation and Near-memory architecture.	L3,L2	PO4
CO4	Apply the knowledge of Machine Learning in Physical verification, physical design and aging analysis.	L4	PO4
CO5	Analyze the statistical analysis in memories.	L3	PO3

Text Book(s):

2. Albert Chun Chen Liu, Oscar Ming Kin Law, “**Artificial Intelligence Hardware Design: Challenges and Solutions**”, IEEE Press, Wiley, ISBN: 9781119810452
3. Ibrahim(Abe)M.Elfael,DuaneS.Boning, Xin_Li, “**Machine Learning in VLSI Computer- Aided Design**”,Springer, ISBN 978-3-030-04665-1

Reference Book(s):

1. Stuart J. Russell and Peter Norvig , “**Artificial Intelligence :A Modern Approach**”, *Prentice Hall,4th Edition,1995.*
2. Sandeep Saini, Kusum Lata, and G.R. Sinha, “**VLSI And Hardware Implementations Using Modern Machine Learning Methods**”, CRC Press 2022, ISBN: 978-1-032-06171-9 (hbk) ISBN: 978-1-032-06172-6 (pbk) ISBN: 978-1-003-20103-8 (ebk) DOI: 10.1201/9781003201038

Web and Video link(s):

1. <https://www.youtube.com/watch?v=aircAruvnKk>
2. <https://www.youtube.com/watch?v=aircAruvnKk>
3. <https://www.youtube.com/watch?v=pMKuULBKxXY>

E-Books/Resources:

https://www.google.co.in/books/edition/AI_and_Machine_Learning_for_Coders/gw4CEAAAQBAJ?hl=en&gbpv=1&dq=books+on+ai+and+ml&printsec=frontcover
https://www.google.co.in/books/edition/Machine_Learning_and_Artificial_Intellig/ybyxDwAAQBAJ?hl=en&gbpv=1&dq=books+on+ai+and+ml&printsec=frontcover
https://www.google.co.in/books/edition/Artificial_Intelligence_and_Machine_Lear/IW5DwAAQBAJ?hl=en&gbpv=1&dq=books+on+ai+and+ml&printsec=frontcover



https://www.google.co.in/books/edition/Deep_Learning/omivDQAAQBAJ?hl=en&gbpv=1&dq=books+on+deep+learning&printsec=frontcover
https://www.google.co.in/books/edition/Neural_Networks_and_Deep_Learning/achqDwAAQBAJ?hl=en&gbpv=1&dq=books+on+deep+learning&printsec=frontcover

Course Articulation Matrix (CAM)

C O	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
#1	3												3	
#2		3												3
#3		3												3
#4			3											3
#5				1					1				2	



Microwaves and Antennas [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21EC604	Credits:	04
Teaching Hours/Week (L:T:P):	3 : 0 : 2	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Total Laboratory Hours:	24		
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Provide the basic knowledge of Microwave transmission lines, Rectangular waveguides and planar transmission lines.2. Discuss the working of Microwave active and passive devices.3. Explain the concepts of types of antenna and parameters of antenna.4. Discuss the field due to dipole antenna and array of antenna.5. Describe the structure and working of helical, log-periodic and micro strip antennas and its Design procedure.			
UNIT – I			8 Hours
Microwave Transmission Lines: Introduction, Transmission lines equations, Characteristic and input impedances, Reflection and transmission coefficients, Standing waves, Planar transmission lines, Strip lines, Rectangular waveguides, TE and TM wave solutions, dominant and degenerate modes. Text 1: 3.1- 3.5, 3.10, 3.10.1, 3.11 - 3.11.4.			
Self-study component:	3. Smith Chart. 4. MIC Manufacturing, Microwave radiation hazards.		
Practical Topics: (3 Hours)	1. Measurement of frequency, guide wavelength, power, VSWR and attenuation in a microwave test bench.		
UNIT – II			8 Hours
Microwave Passive Devices: Attenuators, phase shifters - Precision phase shifter, MIC phase shifter, reciprocal and non-reciprocal phase shifter, Hybrid or magic Tee, Application of Magic – T (excluding E-Plane Tee & H-Plane Tee). Microwave Solid State Devices: Transferred electron devices (TED) - Gunn diodes, modes of operation, gunn diode oscillator, TRAPATT diodes and Tunnel diodes- equivalent circuit, Tunnel diode Amplifiers, and Tunnel diode oscillator. Text 1: 6.4.14, 6.4.15, 6.4.16, 10.3-(10.3.1, 10.3.2), 10.4.3, 10.5, 10.5.1, 10.5.2, 10.5.3.			
Self-study component:	3. Avalanche transit time devices (ATTD)-IMPATT Diode 4. Directional couplers, Power Dividers and Microstrip Ring Resonator.		
Practical Topics: (9 Hours)	1. Determination of coupling and isolation characteristics of a micro–strip directional coupler. 2. Measurement of power division and isolation characteristics of a micro–strip 3dB power divider. 3. Measurement of resonance characteristics of a micro– strip ring resonator and determination of dielectric constant of the substrate.		



UNIT – III		8 Hours
Introduction: Types of Antennas – Wire, Aperture, Micro-strip, Array, Reflector and Lens antennas, Radiation Mechanism – Single wire, Two-Wires and Dipole. Fundamental Parameters of Antennas: Introduction, Radiation Pattern – Isotropic, Directional, and Omnidirectional Patterns, Principal Patterns, Radiation Pattern Lobes, Field Regions, Radian and Steradian, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna Efficiency, Half-Power Beamwidth, Beam Efficiency. Text 2: 1.1, 1.2, 1.3 –(1.3.1, 1.3.2, 1.3.3), 2.1 to 2.5, 2.7 to 2.10.		
Self-study component:	3. Bandwidth and Radiation efficiency of antenna. 4. Friis Transmission Equation and Radar Range Equation.	
Practical Topics: (3Hours)	1. Plot the Radiation pattern and measure the Directivity of Dipole antenna.	
UNIT – IV		8 Hours
Linear Wire Antennas: Introduction, Infinitesimal Dipole – Radiated Fields, Power density and Radiation resistance, Radian Distance and Sphere, Near-field, Intermediate and Far – field region, Directivity. Antenna Arrays: Introduction, Two- Element Array, N-Element Linear Array – Uniform Amplitude and Spacing-Broadside array, ordinary End fire array and Phased array. Text 2: 4.1, 4.2, 6.1, 6.2, 6.3, 6.3.1 to 6.3.3.		
Self-study component:	3. N element linear array: Directivity. 4. Planar Array: Array Factor, Beam width, Directivity.	
Practical Topics: (2Hours)	1. Design and Simulate Dipole antenna using Matlab and Plot the Radiation pattern, Directivity and Impedance graph.	
UNIT – V		8 Hours
Broadband Antennas: Helical Antenna- Design Concepts, Log-periodic Antennas – planar and wire surfaces and dipole array. Micro strip Antennas: Introduction- Basic Characteristics, Feeding Methods, Rectangular Patch - Transmission line model. Text 2: 10.3, 10.3.1, 11.4, 11.4.1, 11.4.2, 14.1, 14.2, 14.2.1.		
Self-study component:	3. Log periodic dipole array – Design Concepts. 4. Yagi-Uda & circular patch Antenna– Design Concepts.	
Practical Topics: (7 Hours)	1. Plot the Radiation pattern and measure the Directivity of Micro strip-Rectangular Patch antenna. 2. Design and Simulate Microstrip rectangular patch antenna using Matlab and Plot the Radiation pattern, Directivity and Impedance graph. 5. Measurement of Pitch angle alpha (in degrees), Axial ratio (AR),HPBW (in degrees) and Directivity (dimensionless and in dB)of Helical Antenna using Matlab	



Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Discuss the properties of transmission lines, microwave devices, the parameters of antennas and field due to antenna.	Understand	PO1(L1,L2) PO6,PO7
CO2	Interpret the working and performance of microwave devices, microwave transmission lines, different types of antennas and antenna arrays.	Applying	PO1,PO2(L3)
CO3	Examine the working and performance of microwave transmission lines, devices, antenna and antenna arrays.	Analyze	PO2(L4)
CO4	Design the helical ,Log-periodic dipole antennaand microstrip antennas	Creating	PO2,PO3(L6)

Text Book(s):

1. **“Microwave Engineering”**, Annapurna Das, Sisir K Das, 2nd edition-2009, T.M.H, ISBN (13): 978-0-07-066738-9. ISBN (10): 0-07-066738-1.
2. **“Antenna Theory Analysis and Design”**, C. A. Balanis, 2nd edition – 2001, John Wiley, ISBN: 9971-51-233-5.

Reference Book(s):

1. **“Microwave engineering”**, David M Pozar, 2nd edition – 2004, John Wiley, ISBN: 9780470631553.
2. **“Foundations for Microwave Engineering”**, Robert E Collin, 2nd edition – 2009, John Wiley & Sons Inc (Sea) Pte Ltd, ISBN: 9788126515288.
3. **“Microwave Devices and Circuits”**, Samuel Y Liao, 3rd edition – 2004, ISBN: 9780135846810.
4. **“Antennas for all Applications”**, John D Kraus, Ronald J Marheka, Ahmad s Khan, 3rd edition- 2006, T.M.H, ISBN:9780070601857.

Web and Video link(s):

1. NPTEL course: **“Antennas”**, by Prof. Girish Kumar, IIT Bombay.
<https://nptel.ac.in/noc/courses/noc17/SEM1/noc17-ee03/>

E-Books/Resources:

<https://www.studocu.com/in/document/dr-ambedkar-institute-of-technology/mobile-adhoc-network/annapurna-das-sisir-k-das-microwave-engineering-mc-graw-hill-india-2014/32304541>



D. Course Articulation Matrix (CAM)

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
#1	3					2	2						3	
#2	3	2											3	2
#3		3												3
#4		3	2											3



Course Title: Electronic Instrumentation [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21ECO6051	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives This course aims to 1. Discuss the concepts of signal conditioning and data acquisition system 2. Explain the different types of transducers and measurement errors 3. Differentiate between the DC and AC voltmeters 4. Analyze different types of digital voltmeter 5. Analyze the operation of ADC and different types of digital instruments. 6. Describe the operation of instrumentation amplifier and its applications.			
UNIT – I			8 Hours
Qualities of Measurements: Introduction, Performance Characteristics, Static Characteristics, Error in Measurement, Types of Static Error, Sources of Error, Dynamic Characteristics. Voltmeters and Multimeters: Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter, Extending Voltmeter Ranges, Loading, AC Voltmeter Using Rectifiers, AC Voltmeter Using Half Wave Rectifier, AC Voltmeter Using Full Wave Rectifier, Peak Responding Voltmeter, True RMS Voltmeter. Text 1: 1.1 to 1.7, 4.1 to 4.6, 4.12 to 4.14, 4.17, 4.18			
Self-study component:	List out the companies that manufacture standard voltmeters and ammeters, range of operation and their salient features.		
UNIT – II			8 Hours
Digital Voltmeters: Introduction, RAMP Technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly Used Principles of ADC, Successive Approximations, Digital Instruments: Introduction, Digital Multimeters, Digital Frequency Meter, Digital Measurement of Time, Universal Counter, Decade Counter, Electronic Counter. Text 1: 5.1 to 5.6, 5.11, 6.1 – 6.7			
Self-study component:	1. List few practical applications of digital Instruments 2. Design a digital meter to measure light intensity(Block diagram approach)		
UNIT – III			8 Hours
Transducers: Introduction, Electrical Transducer, Selecting a Transducer, Resistive Transducer, Resistive Position Transducer, Strain Gauges, Resistance Thermometer, Thermistor, Inductive Transducer, Differential Output Transducers, Linear Variable Differential Transducer, Piezo Electrical Transducer. Text 1: 13.1 to 13.11 and 13.15.			
Self-study component:	1. List out few electronic and fiber optic sensors which work on the principal of Transducers. 2. Design a weighing machine using single strain gage (Block diagram approach)		
UNIT – IV			8 Hours
Signal Conditioning: Introduction, operational amplifier, basic instrumentation amplifier, Applications of instrumentation amplifiers, chopped and modulated DC amplifier. Recorders: Introduction, strip chart recorder, galvanometer type recorder, null type recorder, circular chart			



recorder, X-Y recorder. Text 1: 14.1 to 14.5, 12.1 to 12.6	
Self-study component:	1. Design an op-amp which amplifies every signal by a factor of 2.5 using any simulator tool ((Multisim, LTspiceetc)
UNIT – V	
8 Hours	
Data Acquisition System (DAS): Introduction, Objective of a DAS, Signal Conditioning of the Inputs, Single Channel Data Acquisition System, Multi-Channel DAS, Computer Based DAS, Digital to Analog and Analog to Digital Converters, Data Loggers, Sensors Based Computer Data Systems. Text 1: 17.1 to 17.9	
Self-study component:	1. Gather information about data acquisition systems and its uses in fiber optic receivers 2. Simulate an ADC and DAC using any simulator (Multisim, LTspiceetc.)
TEXT BOOK: 1. “ Electronic Instrumentation ”, H. S. Kalsi,3 rd edition, McGraw Hill, 2010 ISBN: 9780-07-070206-6 ISBN: 0-07-070206-3	
REFERENCE BOOKS: 1. “ Electronic Instrumentation and Measurements ”, David A. Bell, 3rd edition, Oxford University Press, 2015. ISBN:978-0-19-5669614-1 2. “ Modern Electronic Instrumentation and Measuring Techniques ”, Cooper, Helfrick, Prentice Hall of India.	

C. Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply the knowledge of basic electrical engineering in understanding basic principles of data acquisition system, measuring systems, transducers, instrumentation amplifier and recorders	PO1 (L2)
CO2	Apply appropriate measuring techniques in measuring electrical and mechanical parameters	PO1 (L2)
CO3	Identify and Determine various measuring errors and other measurable parameters in measuring instruments	PO1 (L2), PO2 (L3)
CO4	Analyze the working principle of various electronic measuring instruments.	PO2(L3)
CO5	Design a system for the desired specification in electronic instrumentation.	PO3 (L3)

D. Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	3													
#2	2													
#3	3	2												
#4		2												
#5		2												



Introduction to Embedded Systems [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21ECO6052	Credits:	03
Teaching Hours/Week (L:T:P):	3: 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Provide the knowledge about basic concepts of embedded systems.2. Outline the concepts of typical embedded systems and its applications.3. Describe the characteristics and quality attributes of embedded systems.4. Provide the knowledge of software hardware co–design and EDLC.5. Describe the concepts of real time operating system based embedded systems.			
UNIT – I			8 Hours
Introduction to Embedded Systems: What is an Embedded system? Embedded System vs. General Computing Systems, History of Embedded Systems, Classification of Embedded Systems, Major Application Areas of Embedded Systems, Purpose of Embedded Systems, Wearable Devices-The Innovative Bonding of Lifestyle with Embedded Technologies. The Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators, Communication Interface, Embedded Firmware, Other System Components. Text 1: 1.1 to 1.7, 2.1 to 2.6			
Self-study component:	<ol style="list-style-type: none">1. Study and understand the working operation of the following input devices: (i) IR proximity sensor (ii) Temperature sensor (iii) Humidity sensor.2. Study the working of Hydraulic and Rotatory Actuators to understand the operation of output devices.		
UNIT – II			8 Hours
Characteristics and Quality Attributes of Embedded Systems: Characteristics of an embedded system, Quality attributes of embedded systems. Embedded Systems- Application and Domain Specific: Washing Machine – Application-Specific Embedded System, Automotive – Domain Specific Examples of Embedded System Hardware Software Co-Design and Program Modeling: Fundamental Issues in Hardware Software Co-Design, Computational Models in Embedded Design, Introduction to Unified modeling Language (UML), Hardware Software Trade-offs. Text 1:3.1, 3.2, 4.1, 4.2, 7.1 to 7.4			
Self-study component:	<ol style="list-style-type: none">1. List the different areas that UML has been used.2. Write the state diagram that shows how UML can be used for designing a door system (that can only be opened and closed).		
UNIT – III			8 Hours
Real-Time Operating System (RTOS) based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Communication (Excluding Programs), Device Drivers. Text 1: 10.1 to 10.5, 10.7, 10.9			



Self-study component:	<ol style="list-style-type: none"> 1. Understand the basics of Real time operating systems. 2. Implement the multithread application to satisfy i) Two child threads are created with normal priority ii) Thread 1 receives and prints its priority, sleeps for 50 msec and then quits.
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UNIT – IV		8 Hours
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Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages
The Embedded System Development Environment: The Integrated Development Environment(IDE), Types of Files Generated on Cross compilation, Disassembler/ Decompiler, Simulators, Emulators and Debugging, Target Hardware Debugging, Boundary Scan.
Text 1: 9.1, 9.2, 13.1 (excluding sub articles), 13.2 to13.6

Self-study component:	<ol style="list-style-type: none"> 1. List different IDE tools used for the development of embedded systems with proper examples. 2. Understand the concept of software for Embedded Systems
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UNIT – V		8 Hours
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The Embedded Product Development Life Cycle (EDLC): What is EDLC, Why EDLC, Objectives of EDLC, Different phases of EDLC, EDLC Approaches.
Trends in the Embedded Industry: Processor Trends in Embedded System, Embedded OS Trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks.
Text 1:15.1 to 15.5, 16.1 to 16.5

Self-study component:	<ol style="list-style-type: none"> 1. Discuss the recent key trends used in embedded systems market. 2. Understand the different categories of EDLC.
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Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO#) with BTL
CO1	Apply the knowledge of Microcontrollers to understand and explain the concepts of Embedded systems.	Understand and Apply	PO1 (L2)
CO2	Analyze the different issues involved in embedded system development using real time operating systems.	Analyze	PO1,PO2 (L2,L3)
CO3	Relate the recent trends and overview in the Design of Embedded systems.	Evaluate	PO3 (L2)
CO4	Develop an embedded systems applications for a given specification using high level and assembly level language.	Create	PO3(L3)

Text Book(s):
1. "Introduction to Embedded Systems" Shibu K V, Second edition, Tata McGraw Hill Education Private Limited, 2009, 2nd Edition, ISBN (13): 978-0-07-014589-4.



Reference Book(s):

1. “Embedded Systems – A Contemporary Design Tool” James K Peckol, John Wiley, 2008.
2. “Embedded Systems Design: An Introduction to Processes, Tools, and Techniques ” by Arnold S. Berger ISBN: 1578200733 CMP Books © 2002

Web and Video link(s):

1. <https://www.edx.org/learn/embedded-systems>
2. <https://www.youtube.com/watch?v=KfFBEBN5UHU>

E-Books/Resources:

1. <https://www.electronicsforu.com/special/cool-stuff-misc/eight-free-ebooks-embedded-systems>
2. <https://link.springer.com/book/10.1007/978-3-030-60910-8>

Course Articulation Matrix

CO#/PO#	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
CO1	3												3	
CO2	2	3											2	3
CO3			2											
CO4			3											



Introduction to Image Processing [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code	P21ECO6053	Credits	03
Teaching Hours/Week (L:T:P)	3 : 0 : 0	CIE Marks	50
Total Number of Teaching Hours	40	SEE Marks	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. Understand the fundamentals of digital image processing2. Understand the image enhancement techniques used in digital image processing3. Understand the image restoration techniques and methods used in digital image processing4. Understand the Morphological Operations and Segmentation used in digital image processing			
UNIT – I			8 Hours
Digital Image Fundamentals: What is Digital Image Processing?, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sampling and Quantization. Text 1: 1.1, 1.4, 1.5, 2.1, 2.2, 2.4			
Self-study component:	Prepare a report on basic relationships between pixels of an image.		
UNIT – II			8 Hours
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing. Text 1: 3.1-3.3			
Self-study component:	Comprehend the local Histogram Processing techniques.		
UNIT – III			8 Hours
Spatial Filters: Fundamentals of Spatial Filtering, Smoothing Spatial Filters. Restoration: A model of the image Degradation/Restoration Process, Noise models. Text 1: 3.4 - 3.5, 5.1- 5.2			
Self-study component:	Develop an algorithm to add various intensity levels of salt and pepper noise to an image and remove.		
UNIT – IV			8 Hours
Segmentation: Fundamentals, Point, Line, and Edge Detection, Thresholding, Region Based Segmentation. A case study on impulse noise and Morphological Image Processing. (Refer, Ref1 and Ref2) Text 1: 10.1, 10.2.1 - 10.2.5, 10.3-10.3.2, 10.4.			
Self-study component:	Develop an algorithm to show dilation and erosion of an image.		
UNIT – V			8 Hours
Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, the Hit-or-Miss Transforms, Some Basic Morphological Algorithms. Color Image Processing: Color Fundamentals, Color Models. A case study on Enhancement of Images using image processing methods.(Refer: Ref-3). Text 1: 9.5.1, 9.5.5, 9.5.6, 6.1-6.2.			
Self-study component:	Develop an algorithm to convert colors of an image from RGB to HIS and vice versa.		



Course Outcomes: On completion of this course, students are able to:

COs	Course Outcomes with <i>Action verbs</i> for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Apply basic mathematical and signal processing knowledge to understand different image processing stages/components.	Remember	PO1[L1]
CO2	Examine various types of images, intensity transformations and spatial filtering.	Understand	PO2[L2]
CO3	Evaluate the techniques for image enhancement, segmentation and image restoration in the spatial domain.	Understand	PO2[L2]
CO4	Identify the different causes for image degradation and overview of image restoration techniques.	Apply	PO2 [L2]
CO5	Analyze the different feature extraction techniques for image analysis and recognition.	Apply	PO3 [L4]

Text Book(s):

- Digital Image Processing-** Rafael C Gonzalez and Richard E. Woods, PHI 3rd Edition 2010.
 Ref-1: A Case Study of Impulse Noise Reduction Using Morphological Image Processing with Structuring Elements by V. Elamara et.al., Asian Journal of Scientific Research / DOI: 10.3923/ajsr.2015.291.303
 Ref-2: Image Analysis Using Mathematical Morphology by Robert M. Haralicket. al., IEEE Transactions on Pattern Analysis and Machine Intelligence, Volume: PAMI-9, Issue: 4, July 1987, DOI: 10.1109/TPAMI.1987.4767941.
 Ref-3: Enhancement of Images using Morphological Transformations by K.Sreedhar and B.Panlal International Journal of Computer Science & Information Technology (IJCSIT) Vol 4, No 1, Feb 2012.

Reference Book(s):

- Digital Image Processing-** S.Jayaraman, S.Esakkirajan, T.Veerakumar, TataMcGraw Hill 2014.
- Fundamentals of Digital Image Processing-**A. K. Jain, Pearson 2004.

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	3													
#2		2												
#3		2												
#4		2												
#5			2											



Automotive Electronics [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21ECO6054	Credits:	03
Teaching Hours/Week (L:T:P):	3 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	40	SEE Marks:	50
Course Learning Objectives: This course will enable the students to: <ol style="list-style-type: none">1. To understand the concepts of Automotive Electronics and its evolution and trends.2. To learn and understand the various application of electronics systems and ECU in automotive.3. To learn and understand principles and applications of sensors and actuators in automotive electronics systems.4. To learn and understand various control systems in automotive.5. To learn and understand the various communication protocols in automotive.6. To learn and understand the modern advanced technologies and trends in automotive.			
UNIT – I			8 Hours
Architecture: - Overview, Vehicle system architecture. Electronic control unit: - Operating conditions, Design, Data processing, Digital modules in the control unit Control unit software, Software Development. Text 1			
Self-study component:	1. Study of Basic fundamental of Automotive. 2. Study of Automotive Networking in different Application.		
UNIT – II			8 Hours
Basic principles of networking: - Network topology, Network organization, OSI reference model, Control mechanisms. Automotive networking: -Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, Coupling of networks, Examples of networked vehicles. Bus systems: - Controller Area Network. Text 1			
Self-study component:	1. Study of Basic working of electronic engine 2. Comparative study of different types of electronic ignition.		
UNIT – III			8 Hours
Bus systems: - LIN bus, Bluetooth, MOST bus, TTP/C, Flex Ray, Diagnosis interfaces. Automotive sensors: - Basics and overview, Automotive applications, Features of vehicle sensors, Sensor classification, Main requirements, trends, Overview of the physical effects for sensors, Overview and selection of sensor technologies. Vehicle security systems: -Acoustic signaling devices, Central locking system, Locking systems, Biometric systems Text 1			
Self-study component:	1. Angular Rate Sensor and Flex-Fuel Sensor. 2. Automotive Engine Control Actuators.		
UNIT – IV			8 Hours
Electronic Transmission Control: -Drive train Management, Market Trends, Control of Automated Shift Transmission AST, Control of Automatic Transmissions, Control of Continuously Variable Transmission, ECUs for Electronic Transmission Control, Thermo-Management, Processes and Tools Used in ECU Development. Antilock Braking System (ABS): - System overview, Requirements placed on ABS, Dynamics of a braked wheel, ABS control loop, Typical control cycles.			



Text 1			
Self-study component:		<ol style="list-style-type: none"> 1. Study of Design Engine control system. 2. Study of Program control units. 	
UNIT – V			8 Hours
<p>Electronic Diesel Control (EDC): - System overview, Common-rail system for passenger cars, Common-rail system for commercial vehicles, Data processing, Fuel-injection control, Lambda closed-loop control for passenger-car diesel engines, Torque-controlled EDC systems, Data exchange with other systems, Serial data transmission (CAN)</p> <p>Automatic brake functions, Sensotronic brake control (SBC): -Overview. Standard function. Additional functions, Purpose and function, Design, Method of operation.</p> <p>Active steering: -Purpose, Design, Method of operation, Safety concept, Benefits of active steering for the driver.</p>			
Text 1			
Self-study component:		<ol style="list-style-type: none"> 1. Study of Electronic Control System Diagnostics. 2. Study of Lane Departure Monitor and Tyre Pressure Monitoring System. 	
Course Outcomes: On completion of this course, students are able to:			
COs	Course Outcomes with Action verbs for the Course topics	Bloom's Taxonomy Level	Program Outcome Addressed (PO #) with BTL
CO1	Understand an overview of automotive components, subsystems, and basics of Electronic Engine Control in today's automotive industry	Remember	L3 (PO1)
CO2	Apply available automotive sensors and actuators in various electronic control systems while designing automotive system design	Understanding	L3(PO2)
CO3	Analyze the networking of various modules in automotive systems and communication protocols of interfacing different electronics components, systems and mechanical counterparts.	Understanding	L3(PO2)
CO4	Analyze the different automotive control systems and Safety-Related Systems	Applying	L4(PO3)
Text Book(s):			
<p>1. Automotive Mechatronics Automotive Networking, Driving Stability Systems, Electronics. Springer vieweg. ISBN 978-3-658-03974-5 ISBN 978-3-658-03975-2(eBook) DOI 10.1007/978-3-658-03975-2 Library of Congress Control Number: 2014946887</p>			
Reference Book(s):			
<ol style="list-style-type: none"> 1. Automotive Electronics Design Fundamentals – Nazamuz Zaman, 2015, Springer Publications. ISBN: 978-3-319-17584-3. 			
Web and Video link(s):			
<ol style="list-style-type: none"> 1. Automotive Electronics- https://youtu.be/BOP8qLQzhDc 3. Fundamentals of Automotive System-https://youtu.be/hs7bABMtOMI. 2. 3. Electric Vehicles – Design & Development-https://youtu.be/zzpOtJA-Rqw 			
E-Books/Resources:			
<ol style="list-style-type: none"> 1. https://www.elsevier.com/books/understanding-automotive-electronics/ribbens/978-0-12-810434-7 2. https://www.academia.edu/42742205/Bosch_Professional_Automotive_Information 			



Analog and Digital VLSI Design Laboratory [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21ECL67	Credits:	01
Teaching Hours/Week (L:T:P):	0: 0 : 2	CIE Marks:	50
Contact Period:	Lecture :2 Hr, Exam: 2Hr.	SEE Marks:	50
A. Course Learning Objectives (CLOs)			
This course aims to:			
<ol style="list-style-type: none">1. Explore the CAD tool and understand the flow of the Full Custom IC design cycle.2. Learn DRC, LVS and Parasitic Extraction of the various designs.3. Design and simulate the various basic CMOS analog circuits and use them in higher circuits like operational amplifiers using design abstraction concepts.4. Design and simulate the various basic CMOS digital circuits and use them in higher circuits like adders and shift registers using design abstraction concepts5. Understand simulation and synthesis of digital design.6. Analyze the ASIC Design flow.7. RTL Design, simulate and verify digital circuits			
Course Content			
Part A: Digital VLSI Design			
ASIC-Digital Design / FPGA Digital Design: the following experiments involve synthesis and verification for logical equivalence.			
<ol style="list-style-type: none">1. Develop Verilog Code for ALU.2. Develop Verilog code for Universal Shift Register.3. Develop Verilog Code for Serial adder.4. Develop Verilog Code for Radix-4 Booth Multiplier.5. Develop Verilog Code for Parallel adder.6. Develop Verilog code for State Machine.			
Part B. Analog VLSI Design			
Analog Design Flow:			
Perform the following steps for experiments listed below:			
Steps			
<ol style="list-style-type: none">1. Draw the schematic and verify the following: DC Analysis, Transient Analysis.2. Draw the Layout and verify the DRC, ERC, and check for LVS.3. RC extraction			
Experiments			
<ol style="list-style-type: none">1. Design a NAND and NOR gate with given specification.2. Design the following amplifiers in different topologies, for the given specification<ul style="list-style-type: none">➤ Common source amplifier➤ Common Drain amplifier.3. Design an OPAMP for given specifications using Differential Amplifier.			
Open Ended Experiment			
<ol style="list-style-type: none">1.Design and simulate Gilbert cell for Analog multiplication			



Course Outcomes

CO #	Course Outcome	Program Outcome Addressed (PO #) with BTL
CO1	Apply the knowledge of the digital system to design of the schematic and layout in cadence tools.	PO1 (L1)
CO2	Interpret the outcome of DC Analysis, AC Analysis and Transient Analysis in analog circuits.	PO4, PO9 (L4)
CO3	Design and simulate basic CMOS circuits like inverter, common source amplifier and differential amplifiers.	PO3, PO5, PO8, (L5)
CO4	Analysis of the design for power, timing and area.	PO2, PO5 (L4)
CO5	Develop 4/8-bit Carry Ripple Adder, Carry Look Ahead adder and Booth Multiplication using Verilog code.	PO3, PO5, PO7, (L5)

Course Articulation Matrix

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
#1	3												3	
#2				2					3					
#3			2		3			2						
#4		3			3									3
#5			2		3		2							



Mini - Project [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21ECMP607	Credits:	02
Teaching Hours/Week (L:T:P)	0:0:2	CIE Marks:	50
Total Number of Teaching Hours:	26	SEE Marks:	50
<p>Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students. (or Mini Project is a laboratory-oriented course which will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications)</p> <p>CIE procedure for Mini-project:</p> <p>(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.</p> <p>(ii) Interdisciplinary: CIE shall be group-wise at the college level with the participation of all the guides of the college through Dean (III). The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.</p> <p>SEE for Mini-project:</p> <ul style="list-style-type: none">▪ Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department through Viva-Voce examination.• Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) through Viva-Voce examination conducted separately at the departments to which the student/s belongs to.			



Employability Enhancement Skills (EES) - VI <i>[As per Choice Based Credit System (CBCS) & OBE Scheme]</i> SEMESTER – VI			
Course Code:	P21HSMC608	Credits:	01
Teaching Hours/Week (L:T:P):	0:2:0	CIE Marks:	50
Total Number of Teaching Hours:	28	SEE Marks:	50
Course Learning Objectives: This course will enable students to: <ul style="list-style-type: none">• Explain the basic concepts in Race and games, Linear equations, mensuration, height and distance.• Apply the logical skills in decoding Number, letter series and Game based assessments.• Calculations involving Time, Speed and distance, HCF & LCM, Averages and Partnerships			
UNIT – I			10 Hours
Quantitative Aptitude: Race and games, Linear equations			
Logical Reasoning: Number and letter series			
Self-Study: Types of cryptarithm.			
UNIT – II			10 Hours
Quantitative Aptitude: Mensuration, Height & distance.			
Logical Reasoning: Game based assessments.			
Self-Study: Inferred meaning, Chain rule.			
UNIT – III			08 Hours
Quantitative Aptitude: Time, Speed and distance, HCF & LCM, Averages and Partnerships			
Self-Study: Decimal fractions			
Course Outcomes: On completion of this course, students are able to:			
CO – 1:	Solve the problems based on Race and games, Linear equations, mensuration, height and distance.		
CO – 2:	Solve logical reasoning problems based on Number, letter series and Game based assessments.		
CO – 3:	Solve the problems based on HCF & LCM, averages and partnerships.		
Text Book(s): <ol style="list-style-type: none">1. Quantitative aptitude by Dr. R. S Agarwal, published by S.Chand private limited.2. Verbal reasoning by Dr. R. S Agarwal, published by S. Chand private limited.			



Reference Book(s):

1. Quantitative Aptitude by Arun Sharma, McGraw Hill Education Pvt Ltd
2. A Modern Approach to Verbal & Non-Verbal Reasoning by R.S. Agarwal.
3. CAT Mathematics by Abhijith Guha, PHI learning private limited.

COURSE ARTICULATION MATRIX [Employability Enhancement Skills (EES) - VI]

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	2	2	-	-	-	-	-	-	-	-	-	2
CO-2	2	2	-	-	-	-	-	-	-	-	-	2
CO-3	2	2	-	-	-	-	-	-	-	-	-	2



Universal Human Values and Professional Ethics [As per Choice Based Credit System (CBCS) & OBE Scheme] SEMESTER – VI			
Course Code:	P21UHV609	Credits:	01
Teaching Hours/Week (L:T:P):	1 : 0 : 0	CIE Marks:	50
Total Number of Teaching Hours:	25 + 5	SEE Marks:	50
Course objectives: This course is intended to: <ol style="list-style-type: none">1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.4. This course is intended to provide a much-needed orientation input in value education to the young enquiring minds.			
Teaching-Learning Process (General Instructions) These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes. <ol style="list-style-type: none">1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.2. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied skills.3. State the need for UHV activities and its present relevance in the society and Provide real-life examples.4. Support and guide the students for self-study activities.5. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.6. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student in every activity, leading to continuous selfevolution.7. Encourage the students for group work to improve their creative and analytical skills.			
Module - 1			
Introduction to Value Education		(3 hours)	
Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations			



Module - 2
Harmony in the Human Being : (3 hours) Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health
Module - 3
Harmony in the Family and Society : (3 hours) Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order
Module - 4
Harmony in the Nature/Existence : (3 hours) Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence
Module - 5
Implications of the Holistic Understanding – a Look at Professional Ethics : (3 hours) Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession
Course outcome (Course Skill Set) At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); <ul style="list-style-type: none">• They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.• They would have better critical ability.• They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).• It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction. <p>Expected to positively impact common graduate attributes like:</p> <ol style="list-style-type: none">1. Ethical human conduct2. Socially responsible behaviour3. Holistic vision of life4. Environmentally responsible work5. Having Competence and Capabilities for Maintaining Health and Hygiene6. Appreciation and aspiration for excellence (merit) and gratitude for all



Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous internal Examination (CIE)

- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.
- CIE paper shall be set for 25 questions, each of the 02 marks. The pattern of the question paper is MCQ (multiple choice question). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

The sum of two tests, will be out of 100 marks and will be scaled down to 50 marks

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for **50 questions**, each of the 01 marks. **The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

Suggested Learning Resources:

Books for READING:

Text Book and Teachers Manual

- The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
- The Teacher's Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantik, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.



16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
20. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
21. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Web links and Video Lectures (e-Resources):

Value Education websites,

- <https://www.uhv.org.in/uhv-ii>,
- <http://uhv.ac.in>,
- <http://www.uptu.ac.in>
- Story of Stuff,
- <http://www.storyofstuff.com>
- Al Gore, An Inconvenient Truth, Paramount Classics, USA
- Charlie Chaplin, Modern Times, United Artists, USA
- IIT Delhi, Modern Technology – the Untold Story
- Gandhi A., Right Here Right Now, Cyclewala Productions
- https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
- https://fdp-si.aicte-india.org/8dayUHV_download.php
- <https://www.youtube.com/watch?v=8ovkLRYXIjE>
- <https://www.youtube.com/watch?v=OgdNx0X923I>
- <https://www.youtube.com/watch?v=nGRcbRpvGoU>
- <https://www.youtube.com/watch?v=sDxGXOgYEKM>