DEPARTMENT OF AE & IE, C.V RAMAN COLLEGE OF ENGINEERING, BHUBANESWAR

Fourth Year B. Tech Structure with effect from Academic Year 2018-19

SEMESTER VII

Sl. No.	Code	Subject	Type	Teaching Scheme			Credits
				L	P	T	
S1	EI40108	VLSI Design	Theory – Core	3	-	1	4
S2	EI40109	Artificial Intelligence	Theory – Core	3	-	-	3
S3			Elective – I(programme)	3	-	-	3
S4			Elective – II(open Elective)	3	-	1	4
P1	EI40307	VLSI Design	Lab – Core	-	2	-	1
P2			Lab of Elective-I	-	2	-	1
P3	IN47404	Industrial Internship	Lab		2		1
P4	HS46323	Ethics for Engineers	Lab		2		1
MP	EI47397	Major Project Stage-II	Project	-	6	-	3
			Total:	**12**	**14**	**2**	**21**

Elective – I (programme)-(with Laboratory)	**Elective – II(open Elective)**
1. Power Electronics (EE43107/EE43307) 2. Microcontroller and Applications. (EC43164/EC43364) 3. Database Management System. (CS43162/CS43362)	Will be updated by Dean Academics

Sub. Code	ARTIFICIAL INTELLIGENCE	L	T	P	C
EI40109		3	0	0	3

Credits:03 **Teaching Scheme: -** Theory 03Hrs/Week

Prerequisites: Study of human brain and nervous system

Co-requisites: Nil

Post-requisites: Nil

Objective: To understand neural network and Fuzzy logic controllers.

Course Outcomes:

CO1: To study the characteristics of biological neurons, perceptron models and algorithms.

CO2: To study the modelling of non-linear systems using ANN.

CO3: To learn the fuzzy set theories, its operation and GA.

CO4: To apply the knowledge of fuzzy logic for modelling non-linear systems.

CO5: To apply the knowledge of ANN and fuzzy logic to design hybrid control schemes.

Course Details:

Unit – I

ARTIFICIAL NEURAL NETWORK **8Hrs**

U1.1 Review of fundamentals, Biological neuron, artificial neuron, activation function, single layer perceptron, Limitation, Multi-layer perceptron, Back propagation algorithm (BPA). Recurrent neural network (RNN), Adaptive resonance theory (ART) based network.

U1.2 Radial basis function network, online learning algorithms, BP through time, RTRL algorithms, Reinforcement learning.

Unit – II

NEURAL NETWORKS FOR MODELING AND CONTROL **7Hrs**

U2.1 Modeling of non-linear systems using ANN, Generation of training data, Optimal architecture, Model validation, Control of non-linear systems using ANN, Direct andindirect neuro control schemes.

U2.2 Adaptive neuro controller, Familiarization with neural network toolbox.

Unit – III

FUZZY SET THEORY **7Hrs**

U3.1 Fuzzy set theory, Fuzzy sets, Operation on fuzzy sets, Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, fuzzy relation, Fuzzy membership functions.

U 3.2 Aggregation, projection, composition, cylindrical extension.

Unit – IV

FUZZY LOGIC FOR MODELING AND CONTROL **7Hrs**

U4.1 Modeling of non-linear systems using fuzzy models, TSK model, Fuzzy logic controller, Fuzzification, Knowledge base, Decision making logic, Defuzzification.

U4.2 Adaptive fuzzy systems, Familiarization with fuzzy logic toolbox.

Unit – V

HYBRID CONTROL SCHEMES **7Hrs**

U5.1 to Fuzzification and rule base using ANN, Neuro fuzzy systems, ANFIS, Fuzzy neuron, Introduction GA.

U5.2 Optimization of membership function and rule base using Genetic Algorithm.

TOTAL: 36 HOURS

Text-Books:

T1. Laurence Fausett, “Fundamentals of Neural Networks”, Prentice Hall, Englewood Cliffs,N.J., 1992.

T2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 1997.

Reference Books:

R1. Goldberg, “Genetic Algorithm in Search, Optimization and Machine learning”, AddisonWesley Publishing Company Inc. 1989.

R2. Millon W.T., Sutton R.S. and Webrose P.J., “Neural Networks for Control”, MIT press,1992.

Sub. Code	VLSI DESIGN	L	T	P	C
EI40108		3	1	0	4

Credits:04 **Teaching Scheme: -** Theory 04Hrs/Week

Prerequisites: Semiconductor Devices & Circuits, Digital Electronics.

Co-requisites: Nil

Post-requisites: Analog VLSI Design

Objective: To understand the basic fundamentals of CMOS IC Fabrication and VLSI Design methods in digital backend aspects.

Course Outcomes:

CO1: Demonstrate the concepts of VLSI Design methods, styles and flow to design the digital integrated circuits.

CO2: Describe the principle of MOS System and CMOS Static Characteristics.

CO3: Discuss the analysis and logic behavior of combinational and sequential logic circuits using CMOS in VLSI design perspective.

CO4: Outline the concept and techniques for dynamic logic circuits and testings.

CO5: To enhance the knowledge of HDL programming for hardware-software co-design.

Course Details:

Unit – I **8 Hrs.**

U 1.1 **Introduction to VLSI:** Historical Perspective, VLSI Design Methodologies, VLSI Design Flow, Design Hierarchy, Concept of Regularity, Modularity and Locality, VLSI Design Styles.

Fabrication of MOSFETs: Introduction, Fabrication Processes Flow – Basic Concepts, Layout Design Rules, Stick Diagrams,.

U 1.2 The CMOS n-Well Process, Full-Customs Mask Layout Design.

Unit – II **10 Hrs.**

U 2.1 **MOS Transistor:** The Metal Oxide Semiconductor (MOS) Systemunder External Bias, MOSFET Current-Voltage Characteristics, MOSFET Scaling and Small-Geometry Effects, MOSFET Capacitance.CMOS latch-up.

MOS Inverters – Static Characteristics: Introduction, Resistive-Load Inverters, Inverterswith n-Type MOSFET Load, CMOS Inverter.

U 2.2 **MOS Inverters – Switching Characteristics :**Introduction,Delay-Time Definitions, Calculation of Delay-Times, Inverter Design with Delay Constraints, Switching Power Dissipation of CMOS Inverters.

Unit – III **9 Hrs.**

U 3.1 **Combinational MOS Logic Circuits:** Introduction, MOS Logic Circuits with DepletionnMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates).

Sequential MOS Logic Circuits: Introduction, Behaviour of Bistable Elements, SR Latch Circuits,CMOS D-Latch and Edge-Triggered Flip-Flop.

U 3.2 Clocked Latch and Flip-Flop Circuits.

Unit – IV **9 Hrs.**

U 4.1 **Dynamic Logic Circuits:** Introduction, Basic Principles of Pass Transistor Circuits,

Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic CMOS Circuit Techniques, High Performance Dynamic CMOS Circuits.

Design for Testability: Introduction, Fault Types and Models, Ad Hoc Testable Design

Techniques, Scan-Based Techniques, Built-In Self-Test (BIST) Techniques, Current Monitoring I_{DDQ} Test.

U4.2 **Semiconductor Memories:** Introduction, Dynamic Random Access Memory (DRAM),Static Random Access Memory (SRAM), Non-volatile Memory, Flash Memory.

Unit – V **9 Hrs.**

U 5.1 **PRINCIPLES OF HDL:**VHDL design flow Entity- Signal and Variable – Using Subcircuits - Concurrent AssignmentStatements – Sequential Assignment Statements.

VHDL PROGRAMMING: Realizing PID controller in VHDL. Use of VHDL in process control applications.

U 5.1 High level VLSI synthesis and design tools with CAD algorithm – Overview for floor planning, placement and routing.

TOTAL: 45 HOURS

Text Books:

T1. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis andDesign, 3rd Edn., Tata McGraw-Hill Publishing Company Limited, 2003.

T2. K. Eshraghian and N.H.E. Weste, Principles of CMOS VLSI Design – a SystemsPerspective, 2nd Edn., Addison Wesley, 1993.

T3. Stephen Brown, ZvonkoVranesic, Fundamentals of Digital Logic with VHDL design, International edition 2000.

Reference Books:

R1. Jan M. Rabaey, AnanthaChandrakasan, Borivoje Nikolic, Digital Integrated Circuits– A Design Perspective,2nd Edn., PHI.

R2. Wayne Wolf, Modern VLSI Design System – on – Chip Design, 3rd Edn., PHI.

R3. Debaprasad Das, VLSI Design, Oxford University Press, New Delhi, 2010.

R4. John P. Uyemura, CMOS Logic Circuit Design, Springer (Kluwer Academic Publishers), 2001.

R5. “A VHDL Primer” ,JayramBhaskar ,Pearson Education, 3rd Edition, 2005

EI40307 **REF NO: To be filled by CD office**

VLSI DESIGN LABORATORY

Credits: 01 **Teaching Scheme: -** Laboratory 02 Hrs/Week

Prerequisites: Semiconductor Devices and Circuit Laboratory, Digital Electronics Laboratory

Co requisites: Nil

Post requisites: Analog VLSI Design Laboratory.

Objectives: The objective of this course is to introduce the students to different CAD tools available for the front end and back end design of various digital circuits with VHDL/Verilog programming needed for VLSI Design.

Course Outcome:

CO1: Design and Simulation of VHDL codes for different Combinational and sequential circuits Using CAD tools.
CO2: Synthesize different combinational and sequential circuits using CAD tools.
CO3: Extraction of DC and transient response of CMOS logic gates at the transistor level, including mask layout.
CO4: Practice the experimental skills to solve VLSI design problems.

Course Details:

List of Practicals:

1. Design Entry and simulation of combinational logic circuits (8 bit adders, 4 bit multipliers, address decoders, multiplexers), Test bench creation, functional verification, and concepts of concurrent and sequential execution to be highlighted.
2. Design Entry and simulation of sequential logic circuits (counters, PRBS generators, accumulators). Test bench creation, functional verification, and concepts of concurrent and sequential execution to be highlighted.
3. Synthesis, P&R and Post P&R simulation for all the blocks/codes developed in Expt. No. 1 and No. 2 given above. Concepts of FPGA floor plan, critical path, design gate count, I/O configuration and pin assignment to be taught in this experiment.
4. Generation of configuration/fuse files for all the blocks/codes developed as part of Expt.1. and Expt. 2. FPGA devices must be configured and hardware tested for the blocks/codes developed as part of Expt. 1. and Expt. 2. The correctness of the inputs and outputs for each of the blocks must be demonstrated at least on oscilloscopes (logic analyzer preferred).
5. Design a schematic and simple layout for CMOS Inverter, parasitic extraction and simulation.
6. Design a schematic and simple layout for CMOS NAND gate, parasitic extraction and simulation.
7. Design a schematic and simple layout for CMOS NOR gate, parasitic extraction and simulation.
8. Design an ALU or a 4-bit Microprocessor with limited instructions.

Text Books:

T1. "A VHDL Primer", JayaramBhasker, Pearson, 3rd Edition, 2005.
T2. "VHDL: Programming by examples", Douglas L. Perry, Tata Mcgraw Hill, 4th Edition,
T3. K. Eshraghian and N.H.E. Weste, *Principles of CMOS VLSI Design – a SystemsPerspective*, 2nd Edn., Addison Wesley, 1993.

Reference Books

R1. Sung-Mo Kang and Yusuf Leblebici, *CMOS Digital Integrated Circuits: Analysis andDesign*, 3rdEdn., Tata McGraw-Hill Publishing Company Limited, 2003

Sub. Code	VLSI DESIGN TUTORIAL	L	T	P	C
EI40108		0	1	0	1

Credits: 01 **Teaching Scheme: -** Theory 01Hr/Week

Prerequisites: Semiconductor Devices & Circuits, Digital Electronics.

Co-requisites: Nil

Post-requisites: Analog VLSI Design

Objective: To understand the basic fundamentals of CMOS IC Fabrication and VLSI Design methods in digital backend aspects.

Course Outcomes:

CO1: Demonstrate the concepts of VLSI Design methods, styles and flow to design the digital integrated circuits.

CO2: Describe the principle of MOS System and CMOS Static Characteristics.

CO3: Discuss the analysis and logic behavior of combinational and sequential logic circuits using CMOS in VLSI design perspective.

CO4: Outline the concept and techniques for dynamic logic circuits and testings.

CO5: To enhance the knowledge of HDL programming for hardware-software co-design.

Tutorial Details:

Tutorial-1: VLSI design styles using FPGA and CPLD.

Tutorial-2: CMOS fabrication process using well and LOCOS method.

Tutorial-3: MOSFET small-geometry effects and CMOS latch-up.

Tutorial-4: MOS inverter with resistive-load inverter.

Tutorial-5: MOS inverter With n-type MOSFET load.

Tutorial-6: Design of CMOS inverter.

Tutorial-7: CMOS transmission gate.

Tutorial-8: CMOS D-latch and edge-triggered flip-flop.

Tutorial-9: Dynamic CMOS circuit Techniques.

Tutorial-10: High performance dynamic circuits.

Tutorial-11: VHDL design example using sequential assignment statements.

Tutorial-12: Examples for process control application using VHDL.

Text – Books:

T1. Sung-Mo Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits: Analysis andDesign, 3rd Edn., Tata McGraw-Hill Publishing Company Limited, 2003.

T2. K. Eshraghian and N.H.E. Weste, Principles of CMOS VLSI Design – a SystemsPerspective, 2nd Edn., Addison Wesley, 1993.

T3. Stephen Brown, Zvonko Vranesic, Fundamentals of Digital Logic with VHDL design, International edition 2000.

Reference Books:

R1. Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Digital Integrated Circuits– A Design Perspective,2nd Edn., PHI.

R2. Wayne Wolf, Modern VLSI Design System – on – Chip Design, 3rd Edn., PHI.

R3. Debaprasad Das, VLSI Design, Oxford University Press, New Delhi, 2010.

R4. John P. Uyemura, CMOS Logic Circuit Design, Springer (Kluwer Academic Publishers), 2001.

R5. “A VHDL Primer”, Jayram Bhaskar ,Pearson Education, 3rd Edition, 2005

Sub. Code	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
CS43162		3	0	0	3

Credits: 3 **Teaching Scheme: -** Theory 3 Hrs/Week

Prerequisites:

1. Computer Programming

2. Knowledge of Data Structures

Objectives:

To introduce database systems and learn the techniques of data modelling, database design, data retrieval and database management.

Course Outcomes:

Upon completion of the course, graduates will be able to –

CO1: Differentiate the database concepts from conventional file storage system and describe DBMS architecture, relational, hierarchical and network database models

CO2: Be able to analyze application data using E-R modeling and describe the logical and physical database designs.

CO3: Learn relational algebra, calculus and apply structured query language (SQL) for database definition and manipulation.

CO4: Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.

CO5: Use transaction management systems and recover methods

Course Details:

Unit – I **(7 Hrs)**

Introduction to DBMS and ER Data Model

U1.1

Data Storage: File processing system, Disadvantages; DBMS: Need of DBMS, Terms: Data, Database, Metadata, Data Dictionary, Database System, Database Management System, Data Abstraction, Data Independence, System Architecture of DBMS, Data Model: Definition, ER and Relational Data Model, Object Oriented, Object Relational Models; ER Model: Entity, Entity Set, Attributes, Primary Key, Relationship, Types and Attributes of Relationship, Role, Cardinality Ratio, Participation Constraint, Weak Entity Set, EER Features.

U1.2

Self Study: Hierarchical and Network Data Models, Comparison of Different Data Models, Selection as 1. Entity Vs Attribute, 2. Entity Vs Relationship, 3. Binary Vs Ternary Relationship, Tools for Designing ER Model, Introduction of Popularly used Relational

Unit – II **(7 Hrs)**

Relational Data Model.

U2.1

Relational Data Model: Terms: Relation, Schema, Attributes, Tuples, Domains, Relation Degree (or Arity) and Cardinality, Relation Intention and Extension, Super Key, Candidate Key, Primary Key and Foreign Key, Relational Model Constraints, Schema Diagram, ER to Relation Mapping, Detailed storage architecture, Magnetic disk RAID Storage Access, File & Record Organization Indexing and order indices (B, B+ Tree).

U2.2

Self Study: Characteristics of Relation, Codd's Twelve Rules for Relational DBMS, Reverse Engineering: Relational Database into ER/ EER Model.

Unit – III **(8 Hrs)**

Relational Algebra and Relational Calculus

U3.1

Relational Algebra and its Operations: Set Theoretic Operators (Union, Intersection, Cartesian product, Division), Relational Algebra operators (Projection, Selection, Join, Rename

Relational Calculus: TRC, DRC

Database Language: SQL (DDL, DML, DCL), QBE

U3.2

Self study: Case study Using PL/SQL, DB functions (Date, Timestamp), Cursors

Unit – IV **(7Hours)**

Normalization

U4.1

Normalization: Anomalies of un-Normalized Relation, Need of Normalization, Pros and Cons of Normalization, Functional Dependency: Trivial, Full, Partial, Transitive, Multivalued, Join, Inclusion Dependency, Dependency Diagram, Inference Rules for Functional Dependencies, Closure of Functional Dependencies, Algorithms to find: 1. Candidate Key, 2. Closure of Attribute Set, 3. Minimal Cover of Functional Dependencies, Normal Forms: Checking of Lossless Join Decomposition and Dependency Preservation, Normal Forms: 1NF, 2NF, 3NF, BCNF, 4NF.

U4.2

Self study: Normal Forms: 5NF and DKNF, Normalization at Conceptual Level.

Unit – V **(7 Hrs)**

Transaction Management

U5.1

Complexity Theory: Transaction: Concept, ACID properties, Transaction States; Schedule: Definition, Types of Schedule, Serializability, Conflict and View Serializability, Precedence Graph, Recoverable Schedule, Cascade less Schedule, Deadlock, Concurrency Control Protocols: Lock Based, Timestamp Based Protocol, Recovery System: Log based Recovery, Checkpoint, Shadow paging.

U5.2

Self study: Tree and Multi version Protocol for Concurrency Control, ARIES Recovery Technique, Deadlock Handling.

Note: Five assignments to be given to the students on self study, comprising of one assignment from each unit.

Text Books

T1. "Database System Concepts", Silberschatz, Korth, Sudarshan, McGraw HillInternational Edition, ISBN- 0-07-228363-7, 4th Edition.

T2. "Fundamentals of Database Systems", Elmasri and Navathe, Pearson Education,ISBN 81-297-0228-2, 4th Edition.

Reference Books

R1. "Database Systems", Thomas Connolly and Carolyn Begg, Pearson Education,ISBN 81- 7808-861-4, 3rd Edition.

R2. "Database Management Systems", Ramakrishnan and Gehrke, McGraw-HillInternational Edition, ISBN 0-07-115110-9, 3rd Edition.

R3. An introduction to Database System – Bipin Desai, Galgotia Publications

Sub. Code	DATABASE MANAGEMENT SYSTEMS LAB	L	T	P	C
CS43362		0	0	1	1

Credits: 1 **Teaching Scheme: -** Practical 2 Hrs/Week

Prerequisites:

1. Computer Programming

2. Knowledge of Data Structures

Objectives: To implement queries by using Structured Query Language.

Upon completion of the course, graduates will be able to –

CO1: Apply the concept for database design, create database, and develop queries

CO2: Implement different database programs using procedures, function, and cursor.

CO3: Implement database features such as triggers, packages etc.

CO4: Implement ODBC/JDBC connectivity with programming languages and write programs to store and retrieve data by using queries.

CO5: Use transaction management systems and recovery methods.

Course Details:

List of Practical:

Experiment No.1:

Use of DDL commands.

Experiment No.2:

Use DML commands.

Experiment No.3:

Use of DQL commands.

Experiment No. 4:

Programs using Relational Operators such as JOIN, PROJECT etc

Experiment No.5. .

Programs using PL/SQL.

Experiment No.6:

Programs on Database Triggers.

Experiment No.7:

Programs on Packages.

Experiment No.8:.

Development of an example program using Check Point Technique

Experiment No.9:

Development of an example Concurrent Program and Serialization using Locking Protocol.

Experiment No.10:

Development of a JAVA program with JDBC.

Text-Books:

T1. “Oracle 8i-PL/SQL programming”, SCOTT Urman, TMH-2000

T2. “ORACLE 10g Lab Guide”, Rob, Coronel & Crockett, International Edition

T3. “The Programming Language Of Oracle”, IVAN BAYROSS, BPB Publication, Edition, Year of Publication.

Reference Books

R1. “Oracle 9i-the Complete Reference”, Loney, TMH-2000

Sub. Code	POWER ELECTRONICS	L	T	P	C
EE43107		3	0	0	3

Credits: 03 **Teaching Scheme: -** Theory 03Hrs/Week

Prerequisites: Basic knowledge of Electrical circuit theory, semiconductor devices

Course Objectives:

To introduce students the basic theory of power semiconductor devices and passive components, their practical application in power electronics. In this course students will also familiarize with the operational principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications. The course also provides the basis for further study of power electronics circuits, converters and systems.

Course Outcome:

At the end of the Course, the students will be able to

CO1: Understand basic operation of various power semiconductor devices, switching circuits and its protection.

CO2: Analyze and design an AC/DC rectifier circuit.

CO3: Analyze and design DC/DC converter circuits and understanding the operation of dual converter.

CO4: Understandand gain the ability to analyze DC/AC inverter circuits and its control.

CO5: Learn about AC/AC converter design and its control

Course Details:

Unit – I

Power semiconductor devices **8Hrs**

U1.1. Power semiconductor devices and their characteristics- Thyristor family: SCR,TRIAC, GTO, and Transistor Family: BJT, IGBT, and MOSFET. Protection of Devices: SCR, power BJT, IGBT and power MOSFET, Triggering Methods of SCR: UJT and R-C triggering scheme, cosine triggering scheme

U1.2. Power diodes, RCT, MCT. Isolation of gate and base drive, dv/dt& di/dt limitation of transistor

Unit – II

AC to DC converter **7 Hrs**

U2.1. Uncontrolled Diode rectifier : Single phase half wave and full wave rectifiers with R,R-L and R-L-E load, 3 phase bridge rectifier with R, R-L and R-L-E load. Controlled rectifiers : Principle of phase controlled converter operation, single phase full converter with R, R-L and R-L-E load, 3 phase full converter with R, R-L and R-L-E load, single phase semi converter and 3 phase semi converter with R, R-L and R-L-E load

U2.2. Single phase PWM rectifier, Three phase PWM rectifier.

Unit – III

DC to DC converter & Dual converter **7 Hrs**

U3.1. Classification of DC to DC converter: First quadrant, second quadrant, first and second quadrant, third and fourth quadrant, fourth quadrant converter, single phase Dual converter: circulating current and non-circulating current converter

U3.2. Introduction of switching mode regulators, Isolated converters

Unit – IV

DC to AC converter **7Hrs** Inverters: PWM inverters, Single phase Bridge Inverters, 3-Phase Inverters-180 deg. conduction, 120 deg. conduction. Voltage control of 3-Phase Inverters, Current Source Inverter.

U4.1. Space vector modulation techniques, Introduction of resonant converters

Unit – V

AC –AC converter **7 Hrs**

U5.1. AC voltage controller with R and R-L load, single phase cycloconverters: step up and step down type

U5.2. Ac-voltage controllers with PWM control, Application of AC-AC converters

Note: Five assignments to be given to the students, each comprises of one assignment from each unit (U1.1, U2.1, U3.1, U4.1, U5.1) and one from self study (U1.2, U2.2, U3.2, U4.2, U5.2)

TOTAL: 36 HOURS

Text-Books:

T1. "Power Electronics: Circuits, Devices and Applications", M.H. Rashid,Pearson Education, PHI Third edition, New Delhi 2004.

T2. "Elements of Power Electronics", Philip T.Krein,Oxford University Press, 2004 Edition.

T3. "Power Electronics", Cyril W.Lander, Third Edition McGraw hill-1993

Reference Books

R1. "Power Electronics", P.S.Bimbra,Khanna Publishers, Third Edition 2003

R2. "Power Electronics: Converters, Applications and Design", Ned Mohan, Tore.M.Undeland, William.P.Robbins,John Wiley and sons, third edition, 2003

R3. "Power Electronics for Technology", Ashfaq Ahmed, Pearson Education, Indian reprint, 2003.

R4. Open Source material: www.nptel.ac.in, www.ocw.mit.edu

Sub. Code	POWER ELECTRONICS LABORATORY	L	T	P	C
EE30305		0	0	2	1

Credits: 01 **Teaching Scheme: -** Laboratory 02Hrs/Week

Prerequisites: Basic knowledge of physics and mathematics at 10+2 level

Course Objectives:

This is a unique opportunity where the student willlearn to design and build power electronic circuits are the backbone of every modern convenience. It gives a whole idea of designing firing circuits for the power electronic devices which can be further useful for simulation based laboratory. In this course student will also familiarize with the operational principle of AC-DC, AC-AC, DC-AC converter circuits.

Course Outcome:

At the end of the Course, the students will be able to

CO1: Understand basic switchingcharacteristics of power semiconductor devices and its triggering methods.

CO2: Analyze and design single phaseuncontrolled and controlled AC/DC rectifier circuit.

CO3: Analyze and design three phase full controlled and semi controlled AC/DC rectifier circuit.

CO4: Understand and gain the ability to analyze DC/AC inverter circuits and its control.

CO5: Learn about AC/AC converter design and its control

Course Details:

Select any 10 experiments from the list of 15 experiments

List ofExperiment:

Experiment-1. Study of the V-I characteristics of SCR and TRIAC.

Experiment-2. Study of the V-I characteristics of MOSFET and UJT.

Experiment-3. Study of the synchronized UJT triggering circuit

Experiment-4. Study of the cosine controlled triggering method.

Experiment-5. Study of the RC triggering method and digital firing circuit

Experiment-6. Study of the single phase half wave & full wave uncontrolled rectifier circuit with R and R-L load.

Experiment-7. Study of the three phase half wave & full wave uncontrolled rectifier circuit with R and R-L load.

Experiment-8. Study of the single phase half wave controlled rectifier & semi controlled rectifier circuits with R and R-L load.

Experiment-9. Study of the single phase full wave controlled rectifier circuit with R and R-L load (midpoint & bridge type).

Experiment-10. Study of the three phase controlled rectifier circuit with R and R-L load (full & semi converter).

Experiment-11. Study the performance of single phase AC voltage controller with R and R-L load.

Experiment-12. Study the performance of single phase PWM voltage source inverter.

Experiment-13. Study the performance of three phase PWM voltage source inverter.

Experiment-14. Study the performance of single phase series inverter.

Experiment-15. Study of switched mode power converters.

Text-Books:

T1. "Power Electronics: Circuits, Devices and Applications", M.H. Rashid,Pearson Education, PHI Third edition, New Delhi 2004.

T2. "Elements of Power Electronics", Philip T.Krein,Oxford University Press, 2004 Edition.

T3. “Power Electronics”, Cyril W.Lander, Third Edition McGraw hill-1993

Reference Books

R1. “Power Electronics”, P.S.Bimbra,Khanna Publishers, Third Edition 2003

R2. “Power Electronics: Converters, Applications and Design”, Ned Mohan, Tore.M.Undeland, William.P.Robbins,John Wiley and sons, third edition, 2003

R3. “Power Electronics for Technology”, Ashfaq Ahmed, Pearson Education, Indian

EE30113

CONTROL SYSTEM ENGINEERING – II

Credits:3 **Teaching Scheme: -** Theory 03Hrs/Week

Prerequisites:Control Systems

Course Objectives:

The students will be able to understand the fundamentals of Discrete-Time Control Systems. The student will have the idea design State model of linear control systems. Further the student will be exposed to the concepts of Non-linearity

Course Details:

Unit1: Discrete Time Control Systems (8 Hrs)

U1.1. Introduction: Concepts of State, State Variables and State Model (of continuous time systems): State Model of Linear Systems, State Model for Single-Input-Single-Output Linear Systems, and Linearization of the State Equation. State Models for Linear Continuous – Time Systems: State-Space Representation Using Physical Variables, State – space Representation Using Phase Variables, Phase variable formulations for transfer function with poles and zeros, State – space Representation using Canonical Variables, Derivation of Transfer Function for State

U1.2. Eigen values and Eigenvectors

Unit2: Digital Control Devices & Algorithms (8 Hrs)

U2.1. Diagonalization: Eigen values and Eigenvectors Generalized Eigenvectors. Solution of State Equations: Properties of the State Transition Matrix, Computation of State Transition Matrix, Computation by Techniques Based on the Cayley-Hamilton Theorem, Sylvester's Expansion theorem. Concepts of Controllability and Observability: Pole Placement by State Feedback.

U2.2. Design of state observer.

Unit3: Control System Analysis using State Variable Methods (8 Hrs)

U3.1. Introduction: Discrete Time Control Systems and Continuous Time Control Systems, Sampling Process .Digital Control Systems: Sample and Hold, Analog to digital conversion, Digital to analog conversion. The Z-transform: Discrete-Time Signals, the Z-transform, Z-transform of Elementary functions, Important properties and Theorems of the Z-transform. The inverse Z transform-Transform method for solving Difference Equations. Z-Plane Analysis of Discrete Time Control Systems.

U3.2. Examples of Pulse Transfer function of open loop and closed loop systems

Unit4: State Variable Analysis of Digital Control Systems (8 Hrs)

U4.1. Z-Plane Analysis of Discrete Time Control Systems: Impulse sampling & Data Hold, Reconstruction of Original signals from sampled signals: Sampling theorem, folding, aliasing. Pulse Transfer function: Starred Laplace Transform of the signal involving Both ordinary and starred Laplace Transforms; General procedures for obtaining pulse Transfer functions, Pulse Transfer function of open loop and closed loop systems. Mapping between the s-plane and the z-plane, Stability analysis of closed loop systems in the z-plane: Stability analysis by use of the Bilinear Transformation and Routh stability criterion.

U4.2. Jury stability test.

Unit5: Nonlinear Control Systems Analysis (8 Hrs)

U5.1. Introduction: Behavior of Non linear Systems(Jump Phenomenon, Frequency Entrainment etc), Freq. Investigation of nonlinear systems. Common Physical Non Linearities: Saturation, Friction, Backlash, Relay, Multivariable Nonlinearity. The Phase Plane Method: Basic Concepts, Singular Points: Nodal Point, Saddle Point, Focus Point, Centre or Vortex Point, Stability of Non Linear Systems: Limit Cycles, Construction of Phase Trajectories by Isoclines Method. Derivation of Describing Functions for Ideal Relay, Ideal Saturation. Second Method of Lypnove stability test for linear system.

U5.2. Liapnove stability test for non linear system.

Note: Five assignments to be given to the students, each comprises of one assignment from each unit (U1.1, U2.1, U3.1, U4.1, U5.1) and one from self study (U1.2, U2.2, U3.2, U4.2, U5.2)

Course Outcome:

At the end of the Course, the students will be able to

CO-1. Ability to analyse Discrete –Time control systems.

CO-2. Ability to learn Z-Transform.

CO-3. To gain a working knowledge of the basic linear system design techniques in control systems in order to enable students to deal with real-life applications.

CO-4. To gain a working knowledge of the basic nonlinearities in control systems in order to enable students to deal with real-life applications.

CO-5. Ability to identify and design a control system satisfying requirements..

TextBooks:

T4. "Digital Control and State Variable Methods", M. Gopal, McGraw Hill, 4th Edition (2012).

T5. "Discrete-Time Control System", K. Ogata, PHI, 2nd Edition (2009).

ReferenceBooks

R5. "Modern Control Systems", K. Ogata,PHI, 5Th Edition (2010).

R6. "Modern Control Systems", Richard C. Dorf. And Robert, H. Bishop,Pearson Publication, 11Th Edition (2008).

R7. "Control Systems Engineering", Norman S.Nise,Wiley India (P) Ltd, 4ThEdition (2008).

R8. Open Source material: www.nptel.ac.in, www.ocw.mit.edu

REF NO: To be filled by CD office

CS20105

DATA COMMUNICATION & COMPUTER NETWORKS

Credits: 03 **Teaching Scheme:** Theory 3 Hrs/Week

Prerequisites:

1. Computer Programming
2. Fundamentals of Computers

Objectives:

1. To understand the fundamental principles of Data communication and Computer Networking.
2. To get an exposure on standard OSI and TCP/IP layers and protocols.

Unit-1: Data Communication Fundamentals [8 Hrs]

U1.1 Overview of Data Communications, Fundamentals of Network, Network Topologies, Services, Standardization, Reference Models: OSI Model, TCP/IP Model.

Physical Layer: Analog and Digital Signals, Data Rate Limits, Transmission Impairment, More about signals.

Digital Transmission: Line coding, Sampling, Transmission modes.

U1.2 **Self Study:** Block Coding

Unit-2: Modulation and Switching Techniques [8 Hrs]

U2.1 Analog Transmission: Modulation of Digital Data, Modulation of Analog signals. Multiplexing: FDM, WDM, TDM, Transmission Media: Guided Media, Unguided Media, Circuit Switching and Packet Switching.

U2.2 **Self Study:** Telephone Network

Unit-3: Data Link Layer [8 Hrs]

U3.1 Error Detection and Correction: Types of Errors, Detection, Error Correction.

Data Link Control and Protocols: Flow and Error Control, Stop-and-wait ARQ, Go-Back-N ARQ, Selective Repeat ARQ, HDLC, PPP.

Multiple Accesses: Random Access, Controlled Access, Channelization.

Local area Network: Standard Ethernet, Wireless LANs: IEEE 802.11.

U3.2 **Self Study:** Bluetooth, Virtual circuits: Frame Relay and ATM.

Unit-4: Network and Transport Layer: [6 Hrs]

U4.1 Host to Host Delivery: Internetworking, Addressing and Routing, Network Layer Protocols: ARP, IPV4, ICMP, IPV6, Transport Layer: Process to Process Delivery: UDP, TCP, Congestion Control. Routing Protocols: AODV, DSDV, DSR

U4.2 **Self Study:** Quality of service.

Unit-5: Application Layer: [6 Hrs]

U5.1 Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP), File Transfer (FTP), POP, Remote Logging, HTTP and WWW.

U5.2 **Self Study:** Network Security, Authentication, Cryptography, Digital Signatures and Certificates, Firewalls.

Text Books:

T1. Data Communications and Networking: Behrouz A. Forouzan, Tata McGraw-Hill, 4th Edition.

T2. Computer Networks: A. S. Tannenbum, D. Wetherall, Prentice Hall, Imprint of Pearson 5th Edition.

Reference Books

R1. Data and Computer Communications: William Stallings, Prentice Hall, Imprint of Pearson, 9th Edition

R2. Data Communication and Computer Networks: Ajit Pal, PHI Learning Pvt. Ltd

R3. Data communication & Computer Networks: Gupta, Prentice Hall of India

R4. Network for Computer Scientists & Engineers: Zheng, Oxford University Press

R5. Data Communications and Networking: White, Cengage Learning

Outcome

Students will be able to:

1. Identify data communications system components, network topologies, and protocols.
2. Analyze different features of analog and digital transmission.
3. Analyze the working principles and protocols of data link layer.
4. Identify and differentiate working principles and protocols of network and transport layer.
5. Identify and implement different types of application in application layer.

REF NO: To be filled by CD office

CS20305

DATA COMMUNICATION & COMPUTER NETWORKS - LABORATORY

Credits: 01 **Teaching Scheme:** Laboratory 02Hrs/Week

Prerequisites:

1. Computer Programming
2. Fundamentals of Computers

Objectives:

1. To understand the fundamental principles of Data communication and Computer Networking.
2. To create different topology network
3. To simulate network structures using simulation software

List of Experiments:

Experiment No. 1

- To study the different types of cables such as CAT5 etc. and networking devices such as switches, and routers which are used for data communication.

Experiment No. 2 (NS2/NS3)

- Introduction to TCL and NS2: write the some programs in TCL; create the node, links, and different queues for network. To give the color, shape, connection, traffic to the network.
- To create a topology where two nodes are present (n0 and n1). Node n0 sends data to Node n1 in both TCP and UDP environment. Calculate the throughput with the simulation time, bandwidth and delay.

Experiment No. 3 (NS2/NS3/Toolkit)

- To create a topology where three nodes are present (n0, n1 and n2). Node n0 sends data to Node n2 in TCP environment whereas the node n1 send data in UDP environment. Calculate the throughput with the simulation time, bandwidth and delay for both the environment.
- **To Create a Topology :**

This network consists of 5 nodes (C1, R1, C2, R2 and S1). The duplex link between C1 and R1 has 2 Mbps of bandwidth and 50ms of delay. The duplex link between R1 and S1 has 100Kbps of bandwidth and 100 ms of delay. The duplex link between C2 and R2 has 100Kbps bandwidth and 50ms delay. The duplex link between R2 and S1 has 100Kbps bandwidth and 100ms of delay. Each link between nodes uses a Drop Tail queue. Find out the throughput, packet loss, PDR with simulation time, bandwidth and delay.

Experiment No. 4 (NS2/NS3/Toolkit)

- **To Create a Star Topology.**

That topology consists of 7 nodes (C1, C2, C3, Hub, S1, S2, and S3). The duplex link between C1, C2 and C3 to Hub has 2 Mbps of bandwidth and 50 ms of delay. The duplex link between Hub to S1, S2 and S3 has 2 Mbps of bandwidth and 50 ms of delay. Find out the throughput, packet loss, PDR with simulation time, bandwidth and delay.

- **To Create a Mesh topology (NS2/NS3/Toolkit)**

The topology consists of 5 nodes. To give the label, shape, color to the link and size of the queue. Find out the throughput, packet loss, PDR with simulation time, bandwidth and delay.

Experiment No. 5

- Simulation of Token Ring.
- Simulation of Token bus.

Experiment No. 6

- Simulation of Stop and Wait protocol.
- Simulation of Stop and Wait protocol with BER.
- Simulation of Sliding Window Go Back N protocol

- Simulation of Sliding Window Go Back N protocol with BER.
- Simulation of Sliding Window Selective Repeat protocol.
- Simulation of Sliding Window Selective Repeat protocol with BER.

Experiment No. 7

- Simulation of ALOHA protocol.
- Simulation of Carrier Sense Multiple Access (CSMA) protocol
- Simulation of Carrier Sense Multiple Access / Collision Detection (CSMA/CD) protocol.
- Simulation of Carrier Sense Multiple Access / Collision Avoidance (CSMA/CA) protocol

Experiment No. 8

- Simulation of Distance Vector Routing Protocol.

Experiment No. 8

- Simulation of Link State Routing Protocol.

Experiment No. 10

- Some programming techniques in socket programming

Text Books:

T1. Introduction to Network Simulator NS2, Issariyakul, Teerawat, Hossain, Ekram , Springer, ISBN 978-1-4614-1406-3

T2. Benchmark Electronic System Manual

Reference Books:

R1. http://www.isi.edu/nsnam/ns/

Course Outcome:

After taking this course the graduate students will be able to:

1. Identify different guided and unguided media.
2. Analyze and implement different computer network topologies.
3. Design and implementation of network and transport layer protocols using simulation software.
4. Analyze and implement data communication using socket programming.

IT43104

Internet and Web Technology

Credits: 3 **Teaching Scheme: -** Theory 3 Hrs/Week

Prerequisites: Knowledge of any programming language, Knowledge of various control structures, Knowledge of functions, .Knowledge of basic I/O mechanisms, Ability to apply logic.

Co requisite:

Post requisite:

Objectives:

- To get a clear understanding of various web technologies.
- Be able to explain the difference between mark up and scripting language.
- Be able to separate presentation/style from structure of a web page
- Be able to build a working website using appropriate tools and design principles.
- Be able to apply client side validation.

Course Outcomes:

CO1: Distinguish between web architecture components, browser, server and protocols

CO2: Design and build web applications using HTML and Java script

CO3: Apply Style sheets for improved formatting of web screens

CO4: Use advanced web development concepts such as XML for data manipulation, PERL for presentation and CGI for web scripting

Course Details:

Unit 1

Introduction to Internet: (4 hours)

U1.1. Understanding the WWW and the Internet, intranet, Emergence of Web, Web architecture, Web Servers and its types, Web Browsers, Protocols: HTTP, Building Web Sites.

U1.2. Email, Chat, Protocols: SMTP, FTP

Unit 2

Introduction to HTML: (10 hours)

U2.1. HTML Introduction, The <!DOCTYPE> Declaration HTML Elements. HTML Attributes, HTML Headings, HTML Paragraphs tags HTML Quotation and Citation Elements, HTML Text, Formatting Elements, HTML Links, HTML Images, Image Maps, HTML Tables, HTML Lists, HTML Forms (The <form> Element, The <input> Element, The Action Attribute, The Method Attribute). HTML frames.

U2.2. HTML DOM, inner HTML

Unit 3

JAVASCRIPT (8 hours)

U3.1. Programming Fundamentals, Statements, Expressions, Operators, Popup Boxes, Control Statements, Try….Catch Statement, Throw Statement, Objects of JavaScript: Date object, array object, Boolean object, Math object.

U3.2. Window Object, Java script validation

Unit 4

CSS (8 hours)

U4.1. CSS: External Style Sheets, Internal Style Sheets, Inline Style, The class & id selector, The div & span selector, Font Properties, Box Property, Styles in HTML Table

U4.2. Pseudo-selectors, Text Properties

Unit 5

XML and CGI/PERL: (06 hours)

U5.1. XML: XML Basics, How It Works, XML Document Syntax, Well-Formed XML, Document Type Definition (DTD), Parsing of XML.

CGI/PERL: Introduction to CGI, Testing & Debugging PERL & CGI Script, Using Scalar variables and operators in PERL.

U5.2. XML Namespaces, Decision and loop controls in Perl

Text Books:

T6. "Web Warrior Guide to Web Design Technologies", Don Gosselin, Joel Sklar & others, Cengage Learning.

T7. Web Design in a Nutshell, A Desktop Quick Reference, 3rd Edition, Jennifer Niederst Robbins.

Reference Books:

R9. "Web Technologies", Uttam K Roy, Oxford

R10. "Web Programming: Building Internet Applications", Chris Bates, Wiley Dreamtech

R11. "Programming the World Wide Web", Robert W Sebesta, Pearson

R12. "Web Enabled Commercial Application Development Using HTML, JavaScript, DHTML and PHP", 4th Edition , Ivan Bayross, BPB Publication

DEPARTMENT OF AE & IE, C.V RAMAN COLLEGE OF ENGINEERING, BHUBANESWAR

Fourth Year B. Tech Structure with effect from Academic Year 2018-19

SEMESTER VIII

Sl. No.	Code	Subject	Type	Teaching Scheme			Credits
				L	P	T	
S1	EI40110	Fundamentals of Digital Image Processing	Theory – Core	3	-	1	4
S2	EI40111	Industrial Robotics	Theory – Core	3	-	-	3
S3			Elective – III(Programme)	3	-	-	3
S4			Elective – IV(open Elective)	3	-	1	4
P1	EI40308	Digital Image Processing	Lab – Core	-	2	-	1
P2			Lab of Elective-III	-	2	-	1
MP	EI47398	Major Project Stage-III	Project	-	8	-	5
			Total:	**12**	**12**	**2**	**21**

Elective – III (programme)-(with Lab)	**Elective – IV (Open Elective))**
1. Process Control Instrumentation (EI42182/EI42382 (LAB)) 2. Intelligent and Virtual Instrumentation. (EI42181/EI42381(LAB)) 3. JAVA (CS43107/CS43307).	Will be updated by Dean Academics

Sub. Code	FUNDAMENTALS OF DIGITAL IMAGE PROCESSING	L	T	P	C
EI40110		3	1	0	4

Credits: 03 **Teaching Scheme: -** Theory 03Hrs/Week

Prerequisites: Digital Signal Processing

Co-requisites: Nil

Post-requisites: Nil

Objective: It provides an introduction to image processing and focuses on the computation aspect of the Subject.

Course Outcomes:

CO1: To understand digital camera fundamentals, colour models and 2D transforms.

CO2: To apply the knowledge of histogram equalization, specification and filtering techniques for image enhancement.

CO3: To understand restoration, degradation and inverse filtering techniques for image restoration.

CO4: To apply the knowledge edge detection, linking, thresholding and region based segmentation techniques for classification.

CO5: To understand encoding and vector quantization techniques for image compression.

Course Details:

Unit I

DIGITAL IMAGE FUNDAMENTALS **9 Hrs**

U1.1 Elements of digital image processing systems, Digital Camera working principles, Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, Color image fundamentals, RGB, Image sampling, Quantization,Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT, KLT.

U1.2 HSI color models, dither, SVD.

Unit II

MAGE ENHANCEMENT **7 Hrs**

U2.1 Histogram equalization and specification techniques, Noise distributions, Spatial averaging,Directional Smoothing, Median, Geometric mean, Harmonic mean, Color image enhancement.

U2.2 Contra harmonic mean filters, Homomorphic filtering.

Unit III

IMAGE RESTORATION **7 Hrs**

U3.1 Image Restoration - degradation model, Unconstrained and Constrained restoration,InverseFiltering-removal of blur caused by uniform linear motion, Wiener filtering.

U3.2 Geometric transformations, spatial transformations.

Unit IV

IMAGE SEGMENTATION **7 Hrs**

U4.1 Edge detection, Edge linking via Hough transform, Thresholding, Region based segmentation,Region growing, Region splitting and merging.

U4.2 Segmentation by morphological watersheds, Basic concepts, Dam construction,Watershed segmentation algorithm.

Unit V

IMAGE COMPRESSION **6 Hrs**

U5.1 Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, Vector Quantization,

U5.2 Transform coding, JPEG standard, MPEG.

TOTAL: 36 PERIODS

TEXT BOOKS:

T1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Education,Inc., Second Edition, 2004.

T2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson Education, Inc., 2002.

REFERENCES:

R1. Kenneth R. Castleman, Digital Image Processing, Pearson, 2006.

R2. S. Sridhar, Digital Image Processing,Oxford University Press, 2011.

Sub. Code	FUNDAMENTALS OF DIGITAL IMAGE PROCESSING	L	T	P	C
EI40210		0	1	0	1

Credits:01 **Teaching Scheme: -** Theory 01Hr/Week

Prerequisites: Digital Signal Processing

Co-requisites: Nil

Post-requisites: Nil

Objective: To understand the basic fundamentals of CMOS IC Fabrication and VLSI Design methods in digital backend aspects.

Course Outcomes:

CO1: Tounderstand image model and quantization techniques.

CO2: To understand transform techniques for processing of images.

CO3: To understand restoration, degradation and inverse filtering techniques for image restoration.

CO4: To understand Huffman coding for image compression.

CO5: To understand techniques for recognizing the isolated points and lines in an image for segmentation purpose.

Tutorial Details:

Tutorial-1: What is the result of s poor quantization effect? Explain.

Tutorial-2: Explain in detail the simple image model.

Tutorial-3: Apply DFT to the following matrices.

(a) $\begin{pmatrix} 2 & 2 \\ 0 & 1 \end{pmatrix}$ (b) $\begin{pmatrix} 7 & 0 \\ 3 & 1 \end{pmatrix}$

Tutorial-4: Apply DCT to the following sequences.

(a) $\{2 \quad 4 \quad 6 \quad 1\}$ (b) $\{1 \quad 2 \quad 8 \quad 9\}$

Tutorial-5: What is the difference between image enhancement and image restoration?

Tutorial-6: Consider the following image. Write a procedure for histogram equalization.

$$\begin{vmatrix} 4 & 4 & 4 & 4 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 4 & 4 & 4 & 4 \end{vmatrix}$$

Tutorial-7: What are the advantages and disadvantages of the Wiener filter?

Tutorial-8: Apply the following filters on the given image and show the intermediate result.

(a) Low-pass filter (b) High-pass filter (c) Median filter

$$\begin{pmatrix} 1 & 3 & 5 \\ 4 & 4 & 3 \\ 5 & 2 & 2 \end{pmatrix}$$

Tutorial-9: Does the Huffman scheme always give the same code? What is the meant by prefix property?

Tutorial-10: How are isolated points and lines recognized?

Text Books:

T1. S. Sridhar, Digital Image Processing, Oxford University Press, 2011.

Sub. Code	INDUSTRIAL ROBOTICS	L	T	P	C
EI40111		3	0	0	3

Credits: 03 **Teaching Scheme: -** Theory 03Hrs/Week

Prerequisites: Sensor, motors, control system

Co-requisites: Nil

Post-requisites: Nil

Objective: To get an insight of robotics and its application in automation.

Course Outcomes: At the end of the course, students will be able

CO1: To understand robot technology and its classification for work cell programming.

CO2: To understand the mathematical representation of robots for analysis of direct and indirect kinematics.

CO3: To learn the differential motion and statistics of robot for manipulator design.

CO4: To learn Joint space techniqueand parametric descriptions to analyse position and orientation of robots.

CO5: To understand Lagrangian mechanics, dynamic model for analysis of force control of robotic manipulator.

Course Details:

Unit-1

BASIC CONCEPTS **8Hrs**

U1.1 Brief history, Types of Robot, Technology, Robot classifications and specifications, Various manipulators, Sensors, work cell, Programming.

U1.2 Design and control issues.

Unit-II

DIRECT AND INVERSE KINEMATICS: **7Hrs**

U2.1 Mathematical representation of Robots, Position and orientation, Homogeneous Transformation, Various joints, Representation using the Denavit Hattenberg parameters, Degrees of freedom, Direct kinematics, Inverse kinematics.

U2.2 PUMA 560 & SCARA robots Solvability, Solution Methods, Closed form solution

Unit-II

MANIPULATOR DIFFERENTIAL MOTION AND STATICS: **7Hrs**

U3.1 Linear and angular velocity, Manipulator Jacobian, Prismatic and rotary joints, Inverse, Wrist and arm singularity

U3.2 Static analysis, Force and moment Balance

Unit IV

PATH PLANNING **7Hrs**

U4.1 Definition - Joint space technique, Use of p-degree polynomial, Cartesian spacetechnique, Parametric descriptions, Straight line and circular paths.

U4.2 Cubic polynomial, Position and orientation planning.

Unit V

DYNAMICS AND CONTROL **7Hrs**

U5.1 Lagrangian mechanics, 2 DOF Manipulator, Lagrange Euler formulation, Dynamicmodel, Manipulator control problem.

U5.2 Linear control scheme, PID control scheme, Force control of roboticmanipulator.

TOTAL: 36 PERIODS

TEXT BOOKS

T1. R. K. Mittal and I. J. Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005

T2. John J. Craig, Introduction to Robotics Mechanics and Control, Third edition,Pearson Education, 2009

REFERENCES

R1. Ashitava Ghoshal, Robotics - Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010

R2. K. K. Appu Kuttan, Robotics, I K International, 2007

R3. Edwin Wise, Applied Robotics, Cengage Learning, 2003

Sub. Code	DIGITAL IMAGE PROCESSING LABORATORY	L	T	P	C
EI40308		0	0	2	1

Credits: 01 **Teaching Scheme: -** Laboratory 02 Hrs/Week

Prerequisites: Introduction to MATLAB (Lab), Signals & System Lab, DSP Lab.

Co requisites: NI**L**

Post requisites: NIL

Objectives:

The aim of the lab is to help the student to analyze the images by applying various transformation techniques using MATLAB.

Course Outcome:

CO1: Ability to demonstrate different operations on images and manipulate them using MATLAB.

CO2: Analyze the images by applying various intensity transformation techniques using MATLAB.

CO3: Demonstrates the analysis of various coding techniques & edge detection operators using MATLAB.

CO4: Practice the experimental skill to solve the problems of Restoration, Compression & Segmentation on images.

Course Details:

List of Practical: (*Any 10)*

Experiment No. 1:

Display the gray scale image & perform Geometric transformations such as translation, rotation, and scaling using MATLAB.

Experiment No. 2:

Space domain operations such as histogram modification (scaling, offset, amplitude change) using MATLAB.

Experiment No. 3:

Perform Histogram equalization & specification using MATLAB.

Experiment No. 4:

The frequency domain processing of an image (Fourier transform, log compression) using MATLAB.

Experiment No. 5:

Filtering of an image corrupted by noise (mean and median) without using the inbuilt function in MATLAB.

Experiment No. 6:

Digital Image coding and compression (compression measures, losses compression, entropy, optimal coding) using MATLAB.

Experiment No. 7:

Perform the conversion between different color models using MATLAB.

Experiment No. 8:

Nonlinear image processing such as morphologic operators (opening, closing) and structuring element choice, dilation, erosion using MATLAB.

Experiment No. 9:

Perform the edge detection operation using the operators (Sobel, Prewitt, Roberts) in MATLAB.

Experiment No. 10:

Perform the canny edge detection without using MATLAB inbuilt function.

Experiment No. 11:

Perform the segmentation using watershed transform.

Experiment No. 12:

Filtering of an image corrupted by noise using wiener filter without using the inbuilt function in MATLAB.

Text Books:

T1. "Digital Image Processing Using MATLAB", R.C.Gonzalez,R.E.Woods,Steven L.Eddins, Mc Graw Hill Education, Second Edition

Sub. Code	INTELLIGENT & VIRTUAL INSTRUMENTATION	L	T	P	C
EI42181		3	0	0	3

Credits: 03 **Teaching Scheme: -** Theory 03Hrs/Week

Prerequisites: Transducers, sensors, data acquisition systems, Lab VIEW

Co-requisites: Nil

Post-requisites: Nil

Objective: To understand intelligent and virtual instrumentation systems.

Course Outcomes: At the end of the syllabus, students will be able

CO1: To understand the classical sensors and transducers, self-generating, variable parameter transducers and virtual sensors to design intelligent systems.

CO2: To understand the basics of LabVIEW.

CO3: To understand the Structures of LabVIEW.

CO4: To apply the knowledge of LabVIEW in interfacing with DAQ hardware.

CO5: To apply the knowledge of LabVIEW in acquiring the real world data.

Course Details:

Unit: I

Basic Concepts for Intelligent Instrumentation **10 Hrs**

U1.1 Background of Instrumentation: Introduction, Classification of Classical Sensors and Transducers, Self-Generating Transducers, Variable ParameterTransducers, Radioactive Transducer, Biosensors.Intelligent Sensors:Introduction, Classification, Smart Sensors, Cogent Sensors, Soft orVirtual Sensors, Self-Adaptive Sensors, Self-Validating Sensors.

U1.2 Semiconductor Sensors, Array-Based Sensors, VLSI Sensors, Temperature compensating Intelligent Sensors.

Unit II

Virtual Instrumentation **6 Hrs**

U2.1 Introduction to Virtual Instrumentation: Computers in instrumentation, what is Virtual instrumentation (VI), History of VI, LabVIEW and VI, Conventional and graphical programming, Distributed systems.Basics of LabVIEW: Components of LabVIEW, Owned and free labels, Tools and otherpalettes, arranging objects, Creating sub-Vis.

U2.2 pop-up menus, Colour coding, Code debugging, Context sensitive help.

Unit III

Structures in LabVIEW **8 Hrs**

U3.1 **FOR and WHILE Loops:** The FOR loop, The WHILE loop, Additional loop problem, Loop behaviour and interlope communication, Local variables, Global variables, Shift registers, Feedback, Auto indexing, Loop timing, Timed loop.

Arrays and Clusters: Arrays, Clusters, inter-conversion of arrays and clusters.

Graphs and Charts: Waveform chart, Resetting plots, Waveform graph, Use of cursors, X-Y graph. File Input/Output: File formats, File I/O functions, Path functions, Sample VIs to demonstrate file WRITE and READ, Generating file names automatically.

U3.2 Sequence structures, Case structures, Formula node, Event structure, LabVIEW string formats, Examples, Some more functions, Parsing of strings.

Unit IV

Interfacing in Virtual Instrumentation **5 Hrs**

U 4.1 Analog interfacing, Connecting the signal to the board, Bridge signal sources.Interfacing with Assistants: DAQ assistant, Analysis assistant.

U4.2 Guidelines, Practical versus ideal interfacing, Instrument assistant.

Unit V

Data Acquisition **7 Hrs**

U5.1: Basics of Data Acquisition: Classification of signals, Data Acquisition withLabVIEW DAQmx and DAQ Vis: Measurement and automation explorer,working in DAQmx, Working in NI- DAQ (Legacy DAQ).

U5.2 Read-world signals, Use of simple VIs, Intermediate VIs.

TOTAL: 36 HOURS

Text-books:

T1. M. Bhuyan, Intelligent Instrumentation Principles and Applications, CRC Press2011,ISBN-13: 978-1-4200-8954-7

T2. Sanjay Gupta and Joseph John, **Virtual Instrumentation Using LabVIEW**, 2nd Edn.,Tata McGraw-Hill, 2010, **ISBN-10:** 0-07-07002**8-1**, **ISBN-13:** 978-0- 07-070028-4.

T3. Jerome Jovitha, **Virtual Instrumentation Using LabVIEW**, PHI Learning, 2010, **ISBN-10:**8120340302, **ISBN-13:** 9788120340305, 978-8120340305.

Reference Books:

R1. J.S.R. Jang, C.T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing, PHI.

R2. Ham & I. Kostanic, Principles of Neuro Computing for Science & Engineering, TMH.

R3. V.keeman, Learning and Soft Computing, Pearson Education, New Delhi.

Sub. Code	JAVA	L	T	P	C
CS43107		3	0	0	3

Credits: 3 **Teaching Scheme: -** Theory 3 Hrs/Week

Prerequisites:

1. Computer programming.

2. Object Oriented Programming and C++.

Objectives:

1. To get a clear understanding of Object Oriented Programming constructs.

2. To be able to get necessary skills to write Java Programs.

3. To familiarize with the concepts of multithreaded applications.

4. To get a clear understanding of GUI programming using Applets and Swing.

5. To get a clear understanding collection framework and Database connectivity.

Course Details:

Unit 1

Introduction: (04Hrs)

U1.1.

Introduction to Object Oriented Programming, Introduction to Java and Java programming environments, Java Virtual Machine,

Fundamental Programming Structure: Data Types, variable, Typecasting, Operators and their precedence, Introduction to Arrays

Control Flow: Java's Selection statements (if, switch), Jump Statements (break, continue, return), Java Loop Control Structures (while, do-while, for, Nested loops).

Classes and Object: Concept of Objects and Classes, Using Exiting Classes building your own classes, constructors in Java (Default, parameterized), Constructor overloading, static, final, this keyword.

U1.2. Self Study: Java Virtual Machine, JDK and Java Environment, Control structures

Unit 2

Methods and Inheritance (06Hrs)

U2.1

Methods: Introduction to methods, Methods taking parameters (primitive values, objects), Methods returning values (primitive value, object), static methods, final methods, recursion, Overloading Methods.

Introduction to Garbage Collection, its advantages and disadvantages.

Inheritance: Super class, Super class constructors, Method overriding, Polymorphism, Dynamic method Dispatch, Abstract Classes, Using final with inheritance

U2.2. Self Study: Programs of constructors, Inheritances, The Object Class.

Unit 3

Packages & Interface, Exception Handling (06Hrs)

U3.1

Packages & Interfaces: Introduction to packages, Need of using packages and methods for importing packages, Access Protection, Interface, Implementing Interfaces, variables in Interfaces, mechanism of extending interfaces.

Exception Handling: What is an Exception and its fundamentals, Exception vs error, Types of Exception: Checked and Unchecked exceptions, Exception handling mechanisms: try, catch, throw, throws and finally, Handling of Multiple catch, throw , throws, finally, Java's Built in exceptions, user defined exception.

String Handling: String constructors, String length, Character Extraction, String Comparison, Modifying a string

U3.2. Self Study: Programs on exception handling, programs regarding interfaces, chained exception, Java Input/output stream classes

Unit 4 :

Multithreading, I/O and JDBC **(10Hrs)**

U4.1.

Multi Threading: Difference between Process and threads, Overview of Threads, Java Thread Model, Thread Priorities, Synchronization, Creating a thread, Creating Multiple threads, Implementation of Runnable interface and Extending thread class, Using isAlive ( ) and join ( ), wait () & notify ( ).

Java I/O: Classes & Interfaces, Stream classes, Byte streams, Character streams, Serialization.

JDBC: Fundamentals, Type I, Type II, Type III, Type IV drivers, Client/Server Model (2-tier and 3-tier), Basic Steps of JDBC, Creating and Executing SQL Statements, The Result Set Objects.

U4.2. Self Study: Programs on multithreading, String handling Programs, Programs on JDBC connectivity.

Unit 5

Collection, Swing and Applets **(06 Hrs)**

U5.1

Collection Framework: Collection Interface (List, set, queue), Collection class (Linked Hashset, Stack, Linked List, Array list)

Swing: Overview, Swing controls, Event Classes, Event Listener Interfaces, Adapter classes.

Applets: Basics, Architecture, Skeleton, The HTML APPLET Tag, Passing Parameters to Applets.

Event Handing: Delegation Event model, Event Classes, Event Listener Interfaces, Adapter classes.

Exploring Java-lang: Simple type wrappers, Runtime memory management, object (using clone and the cloneable Interface).

U5.2. Self Study: Programs applets, Applet context and show documents. Event Handling Applications and RMI.

TOTAL: 32 HOURS

Text Books:

T1. Java The Complete Reference, Herbert Schildt, TMH, 5th Edition.

T2. Introduction to Java Programming: Liang, Pearson Education, 7th Edition.

Reference Books:

R1. Balguruswamy, Programming with JAVA, TMH.

R2. Programming with Java: Bhave &. Patekar, Pearson Education.

R3. Big Java: Horstman, Willey India, 2nd Edition.

R4. Java Programming Advanced Topics: Wigglesworth, Cengage Learning.

R5. Java How to Program: H.M. Deitel & Paul J. Deitel, PHI, 8th Edition

Course Outcomes:

Upon completion of the course, graduates will be able to-

1. Identify classes, methods, and libraries of object-oriented programming using Java.
2. Design and implement a class based on attributes and behaviour of objects.
3. Design exception handling, package and interface for problem solving using Java.
4. Design and implement concepts of Multithreading and JDBC connectivity**.**
5. Analyze and design Java programs using advanced features such as collection framework, Applet, Swing.

Sub. Code	JAVA LAB	L	T	P	C
CS43307		0	0	2	1

Credits: 01 **Teaching Scheme: -** Laboratory 02 Hrs/Week

Prerequisites:

1. Computer programming.
2. Object Oriented Programming and C++.

Objectives:

1. To get a clear understanding of Object Oriented Programming constructs.
2. To be able to get necessary skills to write Java Programs.
3. To familiarize with the concepts of multithreaded applications.
4. To get a clear understanding of GUI programming using Applets and Swing.
5. To get a clear understanding collection framework and Database connectivity.

Course Details:

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc. loop control structures: do, while, for etc.
3. Classes and objects.
4. data abstraction & data hiding, inheritance.
5. Interfaces and inner classes.
6. Exception handlings.
7. Threads.
8. Applet, Swing and event handling.
9. Wrapper classes, String, I/O programs.
10. Collection framework and JDBC.

List of Practicals:

Experiment No. 1:

Basic java programs

a) developing
b) compiling
c) executing

Experiment No. 2:

Programs to Understand Different Loop and method Concept.

a) Method overloading
b) Implementation of different loops
c) Implementation of Function with default arguments

Experiment No. 3:

Program to understand class and object.

a) Program to differentiate between class and object.
b) Program to implement array of objects.
c) Implementation of static data members and member methods.

Experiment No. 4:

Programs to understand data abstraction & data hiding, inheritance.

a) Single Inheritance
b) Multiple Inheritance
c) Super keyword

Experiment No. 5:

Program to implement interfaces and inner classes

a) Nested and inner class
b) Implementing interfaces
c) Dynamic method dispatch

Experiment No. 6:

Programs to implement exception handlings

a) try, catch and throw
b) throw vs throws
c) finally
d) user defined exceptions

Experiment No. 7:

Programs to implement Threads

a) ways of creating threads
b) creating multiple threads
c) join(), isAlive(),wait(),notify().
d) Synchronizing threads

Experiment No. 8:

Program to implement Applet, Swing, Event handling programs

a) ways of running applet programs
b) Creation of Form and Panel

Experiment No. 9:

Program to implement wrapper classes, String, I/O programs

a) Use of wrapper classes
b) Use of different string methods
c) I/O programs

Experiment No. 10:

Programs to implement collection framework and JDBC.

a) Programs on list and set.
b) Program on JDBC.

Text Books:

T1. Java The Complete Reference, Herbert Schildt, TMH, 5th Edition.

T2. Introduction to Java Programming: Liang, Pearson Education, 7th Edition.

Reference Books:

R1. Balguruswamy, Programming with JAVA, TMH.

R2. Programming with Java: Bhave &. Patekar, Pearson Education.

R3. Big Java: Horstman, Willey India, 2nd Edition.

R4. Java Programming Advanced Topics: Wigglesworth, Cengage Learning.

R5. Java How to Program: H.M. Deitel & Paul J. Deitel, PHI, 8th Edition

Course Outcomes:

Upon completion of the course, graduates will be able to-

1. Identify classes, methods, and libraries of object-oriented programming using Java.
2. Design and implement a class based on attributes and behaviour of objects.
3. Design exception handling, package and interface for problem solving using Java.
4. Design and implement concepts of Multithreading and JDBC connectivity**.**
5. Analyze and design Java programs using advanced features such as collection framework, Applet, Swing.

Sub. Code	PROCESS CONTROL INSTRUMENTATION	L	T	P	C
EI42182		3	0	0	3

Credits:03 **Teaching Scheme: -** Theory 03Hrs/Week

Prerequisites: Control System, Instrumentation Devices and Systems

Co-requisites: Nil

Post-requisites: Nil

Objective Ability to understand and analyse process control engineering problems.

Course Outcomes: At the end of the syllabus, students will be able to

CO1: Tounderstandbasics of process control instrumentation.

CO2: To apply analog and digital signal conditioning technique in process control instrumentation systems.

CO3: To apply the sensors for designing process control instrumentation systems.

CO4: To apply final control elements in process control.

CO5: To understand the controllers for controlling various processes in industry.

Course Details:

Unit I

Introduction to Process Control Instrumentation: (6 hours)

U1.1 Process-Control Principles, Process-Control Block Diagram,Control System Evaluation, Process-Control Drawings, Sensor Time Response, First-Order Response, Second-order response, Significance and Statistics.

U1.2 Human-Aided control, Servomechanisms.

Unit II

Analog and Digital Signal Conditioning: (6 hours)

U2.1 **Analog Signal Conditioning:** Introduction, Principles of Analog Signal Conditioning, Signal-Level Changes, Linearization, Conversions, Zero adjustment, Span adjustment, Level changing, Protection Voltage-to–Current Converter, Current-to-Voltage Converter.

Digital Signal Conditioning: Introduction, Digital Information, Sample and Hold, Multiplexer and De-multiplexer, decoder and encoder, Pulse modulations, Digital recorder.

U2.2 Filtering and Impedance Matching. Voltage Follower, Active Filters, Integrator.

Unit III

Sensors for Process Control Instrumentation: (9 hours)

U3.1 **Thermal Sensors:** Introduction, Definition of Temperature, Metal Resistance versus Temperature Device, Thermocouple Sensors, Gas Thermometer, Liquid Expansion Thermometer.

Mechanical Sensors: Strain Sensors, Motion Sensors, Pressure Sensors, Flow Sensors.
Optical Sensors: Photodetectors, Pyrometry, LASER Principles, Applications.

U3.2 Bimetal Strips, Vapour-Pressure Thermometer, Displacement, Position Sensors.

Unit IV

Final Control: (7hours)

U4.1 Final Control Operation, Signal Conversions, Switching and Control Devices, Actuators, control Elements.Discrete-State Process Control: Characteristics of the System, Relay Controllers and Ladder diagrams.

U4.2 PLCs.

Unit V
Controllers for Process Control: (8hours)

U5.1 Controller Principles, Process Characteristics, Control System Parameters, Continuous Controller Modes, Composite Control Modes. Analog Controllers: Pneumatic controllers, design consideration. Cascade, Feed forward, and Ratio Control, Cascade Control, Feed forward Control, Feed forward-feedback Control Configuration, Ratio Control. Selective and Adaptive Control Systems: Selective Control, Adaptive Control, Adaptive Control Configuration.

U5.2 Discontinuous Controller Modes, Electronic controllers.

TOTAL: 36 PERIODS

TEXT BOOK:

T 1 PROCESS CONTROL INSTRUMENTATION TECHNOLOGY BY-Curtis D.Johnson.PHI Publication.
T2 PROCESS CONTROL PRINCIPLES AND APPLICATIONS BY- SurekhaBhanot. Oxford Publication.

REFERENCE BOOK:

R1. Process control Systems and Instrumentation By-Terry Bartelt , Cengage Learning Publication.

Sub. Code	PROCESS CONTROL INSTRUMENTATION LAB	L	T	P	C
EI42382		0	0	2	1

Credits: 1 **Teaching Scheme: -** Theory 2 Hrs/Week

Course Outcomes:

Upon completion of the course, graduates will be able to-

1. Understand the behavior of first and second order process characteristics.
2. Apply the knowledge of LabVIEW for designing and tuning the PID controller.
3. Design instrumentation amplifier, state variable and biquad filter, DAC and A to D converter.
4. Design and implement on off controller for temperature process control
5. Understand pH control

List of experiments

1. Understanding the behavior of first order and second order process using some level control system kit.
2. Implementation of PID controller using LabVIEW and to check its operation by taking various plant model and with a given set point.
3. Implementation of controller tuning methods for various plant models in LabVIEW.
4. Implementation of ladder logic programming for controlling various sequential process using a PLC simulator.
5. Design, simulation and implementation of instrumentation amplifier.
6. Design, implement and simulate state variable and Biquad filter.
7. Design and implementation of DAC based A/D converter.
8. Design of ON/OFF controller for temperature process.
9. Study of pH control test Rig.
10. Auto tuning of PID controller.

Sub. Code	EMBEDDED SYSTEMS	L	T	P	C
EI40110		3	0	0	3

Credits: 03 **Teaching Scheme: -** Theory 03Hrs/Week

Prerequisites: Microprocessor and Microcontroller

Co-requisites: Operating systems

Post-requisites: Real time embedded systems

Objective: To enhance the knowledge in embedded systems design for industrial application and facilitate a broad area for research and development activities.

Course Outcomes:

CO1: Outline the structure and behavior of embedded processor and software simulators.

CO2: Demonstrate the different protocols used in embedded systems for networking.

CO3: Describe the device drivers and interrupts used in embedded designs.

CO4: Outline the introduction of real time operating systems and embedded design developments.

UNIT- I **8 Hrs**

INTRODUCTION TO EMBEDDED SYSTEMS:

U 1.1 Build process for embedded systems – Structural units in Embedded processor , selection of processor & memory devices – DMA – memory mapping – Timer and Counting devices, Watchdog Timer, Real Time Clock – Software Embedded in a system – IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator,

U 1.2 Target Hardware Debugging, Boundary Scan.

UNIT- II **7 Hrs**

Embedded Networking:

U 2.1 Introduction, I/O Device Ports – Serial Bus communication protocols- RS232 standard – RS485 – CAN Bus – RS485 – Serial Peripheral Interface (SPI) – InterIntegrated Circuits (I2C) – PC Parallel port communication Protocols – network using ISA.

U2.2 PCI- Wireless and Mobile System Protocols

UNIT- III **7 Hrs**

DEVICE DRIVERS AND INTERRUPTS SERVICE MECHANISM:

U 3.1 PROGRAMMED – I/O busy-wait approach without interrupt service mechanism – ISR concept-interrupt sources – multiple interrupts – context and periods for context switching, interrupt latency and deadline – Device Driver .

U 3.2 Introduction to Basic Concept of Parallel port & Serial port Device Drivers.

UNIT- IV **7 Hrs**

RTOS BASED EMBEDDED SYSTEM DESIGN:

U4.1 Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-shared memory, message passing – Interprocess Communication– synchronization between processes – semaphores, Mailbox, pipes, priority inversion, priority inheritance,

U 4.2 Comparison of Real time Operating systems: VxWorks, Чc/OS-II, RT Linux

UNIT- V **7 Hrs**

EMBEDDED SYSTEM APPLICATION WITH DEVELOPMENT:

U 5.1 Case Study of Washing Machine- Automotive Application – RFID – System, Application, Tag, Reader – Embedded Product Development Life Cycle, Objective, Need, different Phases & Modelling of the EDLC

U 5.2 Product Enclosure Design & Development: Product Enclosure Design Tools,

ProductEnclosure Development Techniques.

TOTAL: 36 HOURS

TEXT BOOKS:

T1. Rajkamal, ‘Embedded system-Architecture, Programming, Design’, TataMcgraw Hill,2011.

T2. Peckol,”Embedded System Design”, John Wiley,2010.

REFERENCES:

R1. Shibu.k.v, “Introduction to Embedded Systems”, TataMcgraw Hill, 2009

R2. Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007

R3. Han-Way Huang, ”Embedded system Design using C8051”, Cengage Learning, 2009

Sub. Code	RENEWABLE ENERGY SYSTEMS	L	T	P	C
EE41106		3	0	0	3

Credits: 3 **Teaching Scheme: -** Theory 03Hrs/Week

Prerequisites: Knowledge of Electrical machines and sources of energy

Course Objectives:

The course provides an introduction to energy systemsand renewable energy resources.It also explores the use of solar (thermal and photovoltaic), hydro-electric, wind, as well as energy from biomass.At the end of the course, the student expected to do understand and analyze the pattern of renewable energy resources, suggest methodologies / technologies for its utilization and economics of the utilization and environmental merits.The potential of using renewable energy technologies and the possibility of combining renewable and non-renewable energy technologies in hybrid systems are analysed.

Course Outcome:

At the end of the Course, the students will be able to

CO1: Understanding the primary renewable energy resources, technologies and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.

CO2: Apply knowledge of Solar Photovoltaic systems, their operating principle and solar thermal system in real life applications.

CO3: Understand and analyze wind energy conversion systems, constant voltage and constant frequency generation with power electronic control, Characteristics of wind power plant to work in industries

CO4: Gain an understanding of waste energy management using biomass resources, power generation using biomass and its applications.

CO5: Learn about practical scenario of hybrid energy systems, its real life application and future trends of renewable energy generation.

Course Details:

Unit1: Introduction to sources of Energy (6Hrs)

U1.3. Fossil fuel based systems Impact of fossil fuel based systems, Non conventional energy – seasonal variations and availability, Renewable energy - sources and features, Hybrid energy systems, Distributed energy systems and dispersed generation (DG)

U1.4. Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells

Unit2: Solar Energy (9Hrs)

U2.3. Solar Photovoltaic systems: Operating principle, Photovoltaic cell concepts, Cell, module, array, series and parallel connections, characteristics of PV module, maximum power point tracking, measurement of solar radiations, solar collectors. types and performance characteristics. solar thermal power plants, thermal energy storage for solar heating and cooling, limitations. Applications

U2.4. Battery charging, solar pumping, solar cooking, solar lighting, Greenhouses, Solar power plants. Peltier cooling, solar processes and spectral composition of solar radiation; Radiation flux at the Earth's surface.

Unit3: Wind Energy (9Hrs)

U3.3. Origin and properties of wind, Introduction Wind energy conversion system, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Eefficiency limit, aerodynamics of wind rotors, power ~ speed and torque ~ speed characteristics of wind turbines, wind turbine control systems; selection of electrical generator: induction and synchronous generators, grid connected and self excited induction generator operation, constant voltage and constant frequency generation with power electronic control, single and double output systems

U3.4. Reactive power compensation in WECS, Characteristics of wind power plant, Wind energy farms, Economic issues, Recent developments, Applications of wind energy

Unit4: Biomass Power **(6Hrs)**

U4.3. Operating principle of biomass, Combustion and fermentation, anaerobic digester. Wood gasifiers, Pyrolysis, Applications, Bio gas, Wood stoves, Bio diesel, Combustion engine.

U4.4. Energy recovery from urban waste, Power generation from liquid waste, bio gas plant technology, Biomass resource development in India.

Unit5: Hybrid Systems **(6Hrs)**

U5.3. Need for Hybrid Systems, Range and type of Hybrid systems, Case studies of Diesel-PV, Wind-PV, Microhydel-PV, Biomass-Diesel systems, Electric and hybrid electric vehicles

U5.4. Hybrid electric vehicle advancements, working of plug in hybrid electric vehicle

Note: Five assignments to be given to the students, each comprises of one assignment from each unit (U1.1, U2.1, U3.1, U4.1, U5.1) and one from self study (U1.2, U2.2, U3.2, U4.2, U5.2)

TOTAL: 36 HOURS

Text Books:

T1. "Renewable Energy Sources and Emerging Technologies", D. P. Kothari, K. C. Singal, R. Ranjan, Prentice Hall of India, New Delhi, 2008.

T2. "Non-Conventional Energy Resources", B.H. Khan, Tata McGrawHill, 2009.

T3. "Wind Electrical Systems", S. N. Bhadra, D. Kastha, S. Banerjee, Oxford Univ. Press, New Delhi, 2005.

Reference Books:

R1. "Renewable Energy Sources and Their Environmental Impact", S. A. Abbasi, N. Abbasi, Prentice Hall of India, New Delhi, 2006.

R2. "Renewable energy sources and conversion technology", Bansal Keemann, Meliss, Tata McGrawHill, 1990.

R3. "Non conventional Energy", Ashok V. Desai, New Age International Publishers Ltd, 1997.

R4. Open Source material: www.nptel.ac.in, www.ocw.mit.edu