Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

T.E (Electronics & Telecommunication Engineering)

(Course 2019)

(w.e.f. June 2021)

Savitribai Phule Pune University, Pune
T.E. (Electronics& Telecommunication Engineering) 2019 Course
(With effect from Academic Year 2021-22)

Semester-V

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
304181	Digital Communication	03	-	-	30	70	-	-	-	100	03	-	-	03
304182	Electromagnetic Field Theory	03	-	01	30	70	25	-	-	125	03	-	01	04
304183	Database Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304184	Microcontrollers	03	-	-	30	70	-	-	-	100	03	-	-	03
304185	Elective - I	03	-	-	30	70	-	-	-	100	03	-	-	03
304186	Digital Communication Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304187	Database Management Lab	-	02	-	-	-	-	-	25	25	-	01	-	01
304188	Microcontroller Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304189	Elective I Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304190	Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
304191A	Mandatory Audit Course 5 [&]	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**10**	**01**	**150**	**350**	**50**	**125**	**25**	**700**	**-**		-	-
										Total Credit	**15**	**05**	**01**	**21**

Elective -I

1) Digital Signal Processing
2) Electronic Measurements
3) Fundamentals of JAVA Programming
4) Computer Networks

Savitribai Phule Pune University, Pune
T.E. (Electronics& Telecommunication Engineering) 2019 Course
(With effect from Academic Year 2021-22)

Semester-VI

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
304192	Cellular Networks	03	-	-	30	70	-	-	-	100	03	-	-	03
304193	Project Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304194	Power Devices & Circuits	03	-	-	30	70	-	-	-	100	03	-	-	03
304195	Elective-II	03	-	-	30	70	-	-	-	100	03	-	-	03
304196	Cellular Networks Lab	-	02	-	-	-	-	-	50	50	-	01	-	01
304197	Power Devices & Circuits Lab	-	02	-	-	-	-	50	-	50		01		01
304198	Elective-II Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304199	Internship**	-	-	-	-	-	100	-	-	100	-	-	04	04
304200	Mini Project	-	04	-	-	-	25	-	50	75	-	02	-	02
304191 B	Mandatory Audit Course 6 &	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**12**	**10**	**00**	**120**	**280**	**125**	**75**	**100**	**700**				
										Total Credit	**12**	**05**	**04**	**21**

Abbreviations:
In-Sem: In semester End-Sem: End semester TH: Theory TW : Term Work
PR: Practical OR: Oral TUT: Tutorial

Note: Students of T.E. (Electronics & Telecommunications) have to opt any one of the audit course from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

Elective -II

1) Digital Image Processing
2) Sensors in Automation
3) Advanced JAVA Programming
4) Embedded Processors
5) Network Security

Savitribai Phule Pune University

Third Year of E & Tc Engineering (2019 Course)

304185 (C): Fundamentals of JAVA Programming (Elective - I)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Data Structures
2. Object Oriented Programming concept

Companion Course, if any: Fundamentals of JAVA Programming Lab

Course Objectives:

- Make the students familiar with basic concepts and techniques of object oriented programming in Java.
- Develop an ability to write various programs in Java for problem solving.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Understand the basic principles of Java programming language

CO2: Apply the concepts of classes and objects to write programs in Java

CO3: Demonstrate the concepts of methods & Inheritance

CO4: Use the concepts of interfaces & packages for program implementation

CO5: Understand multithreading and Exception handling in Java to develop robust programs

CO6: Use Graphics class, AWT packages and manage input and output files in Java

Course Contents

Unit I	**JAVA Fundamentals**	**(08 Hrs.)**

Review of Object oriented concepts, Evolution of Java, Comparison of Java with other programming languages, Java features, Java and World Wide Web, Java Run Time Environment. JVM architecture. Overview of Java Language, Simple Java Program, Java Program Structure. Installing and Configuring Java.

Java Tokens, Java Statements, Constants, variables, data types. Declaration of variables, Giving values to variables, Scope of variables, arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions, Operator precedence and associatively, Mathematical functions, Control statements- Decision making & looping.

Mapping of Course Outcomes for Unit I	**CO1: Understand the basic principles of Java programming language.**

Unit II	Classes and Objects	(06 Hrs.)
Class Fundamentals, Creating Objects, Accessing Class members, Assigning Object reference variables, Methods, Constructors, using objects as parameters, Argument passing, returning objects, Method Overloading, static members, Nesting of Methods , this keyword, Garbage collection, finalize methods, , final variables and methods, final class.		
Mapping of Course Outcomes for Unit II	**CO2: Apply the concepts of classes and objects to write programs in Java**	
Unit III	**Methods & Inheritance in JAVA**	**(06 Hrs.)**
Abstract Methods and classes, Strings ,One dimensional and two dimensional arrays , wrapper classes, enumerated types, Command line arguments **Inheritance:** Inheritance in Java, Creating Multilevel hierarchy, Constructors in derived class, Method overriding, Dynamic method dispatch.		
Mapping of Course Outcomes for Unit III	**CO3: Demonstrate the concepts of methods & Inheritance.**	
Unit IV	**Interfaces & Packages**	**(06 Hrs.)**
Interfaces: Define, implement and extend, Accessing Interface variables, Default interface methods, Using static method in interface **Packages:** Java API Packages, Using System Packages, Creating accessing and using a package, Importing packages, Adding a class to a Package, Hiding classes.		
Mapping of Course Outcomes for Unit IV	**CO4: Use the concept of interfaces & packages for program implementation.**	
Unit V	**Multithreading & Exception Handling**	**(06 Hrs.)**
Introduction to multithreading: Introduction, Creating thread and extending thread class. Concept of Exception handling: Introduction, Types of errors, Exception handling syntax, Multiple catch statements. I/O basics, Reading console inputs, Writing Console output. Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating a simple applet.		
Mapping of Course Outcomes for Unit V	**CO5: Understand multithreading and Exception handling in Java to develop robust programs**	

Unit VI	Graphics Programming and File Handling	(06 Hrs.)
Graphics class, Introduction to AWT packages, Handling events on AWT components, Introduction to Swing package, components and containers. **Managing input/output files**: Concept of streams, Stream Classes, Byte stream, Character stream, Using Stream, creation of files, reading or writing characters / bytes, Concatenating and buffering files, Random access files.		
Mapping of Course Outcomes for Unit VI	**CO6: Use Graphics class, AWT packages and manage input and output files in Java**	

Learning Resources

Text Books:

1. E Balagurusamy, "Programming with JAVA", Tata McGraw Hill, 6th Edition.
2. Herbert Schildt, "Java: The complete reference", Tata McGraw Hill, 7th Edition.

Reference Books:

1. T. Budd, "Understanding OOP with Java", Pearson Education, 2nd Updated Edition.
2. Y. Daniel Liang (2010), "Introduction to Java programming", Pearson Education, India, 7th Edition.
3. Cay Horstmann , "Core Java Volume 1", Kindle, 11th Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"Programming in Java"**

Link of the Course: https://nptel.ac.in/courses/106/105/106105191/

Savitribai Phule Pune University Third Year of E & Tc Engineering (2019 Course) 304189 (C): Fundamentals of JAVA Programming Lab (Elective - I)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical : 25 Marks**
Prerequisite Courses, if any: - Knowledge of Object Oriented Programming		
Companion Course, if any: Fundamentals of JAVA Programming		

List of Laboratory Experiments

Group A (All are Compulsory)

1.	Write some simple programs in Java such as: i) To find factorial of number. ii) To display first 50 prime numbers. iii) To find sum and average of N numbers
2.	Write a program in Java to implement a Calculator with simple arithmetic operations such as add, subtract, multiply, divide, factorial etc. using switch case and other simple java statements. The objective of this assignment is to learn Constants, Variables, and Data Types, Operators and Expressions, Decision making statements in Java.
3.	Write a program in Java with class Rectangle with the data fields width, length, area and colour. The length, width and area are of double type and colour is of string type. The methods are get_length(), get_width(), get_colour() and find_area(). Create two objects of Rectangle and compare their area and colour. If the area and colour both are the same for the objects then display " Matching Rectangles", otherwise display " Non-matching Rectangle"
4.	Write a program in JAVA to demonstrate the method and constructor overloading

Group B (Any Four)

5	Write Programs in Java to sort i) List of integers ii) List of names. The objective of this assignment is to learn Arrays and Strings in Java
6.	Write a Program in Java to add two matrices. The objective of this assignment is to learn Arrays in Java
7.	Write a program in Java to create a player class. Inherit the classes Cricket_player, Football_player and Hockey_player from player class. The objective of this assignment is to learn the concepts of inheritance in Java.
8.	Write a Java program which imports user defined package and uses members of the classes contained in the package.
9.	Write a Java program which implements interface.

10	Write a program to create multiple threads and demonstrate how two threads communicate with each other.
Group C (Any Three)	
11.	Write a java program which use try and catch for exception handling.
12.	Write a Java program to draw oval, rectangle, line , text using graphics class
13.	Write a java program in which data is read from one file and should be written in another file line by line.
14.	A Mini project in Java: A group of 4 students can develop a small application in Java

Virtual LAB Links:

Link of the Virtual Lab: https://java-iitd.vlabs.ac.in/

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University

Third Year of E & TC Engineering (2019 Course)

304195 (C): Advanced JAVA Programming (Elective - II)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Fundamentals of Java Programming

Companion Course, if any: Advanced JAVA Programming Lab

Course Objectives: Make the learner to:

- Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.
- Design and develop Web applications
- Designing Enterprise based applications by encapsulating an application's business logic.
- Designing applications using pre-built frameworks.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Design and develop GUI applications using Applets.

CO2: Apply relevant AWT/ swing components to handle the given event.

CO3: Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.

CO4: Learn to access database through Java programs, using Java Database Connectivity (JDBC)

CO5: Invoke the remote methods in an application using Remote Method Invocation (RMI)

CO6: Develop program for client /server communication using Java Networking classes.

Course Contents

Unit I	Applet	(06 Hrs.)

Applet Basics – Introduction, limitations of AWT, Applet architecture – HTML APPLET tag – Passing parameter to Appletget, DocumentBase() and getCodeBase() , Japplet: Icons and Labels Text Fields Buttons, Combo Boxes , Checkboxes, Tabbed Panes, Scroll Panes, Trees: Tables

Mapping of Course Outcomes for Unit I	CO1: Design and develop GUI applications using Applets.

Unit II	Event Handling using AWT/Swing components	(08 Hrs.)

Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes. The AWT class hierarchy, user interface

components- labels, button, canvas, scrollbars, text components, checkbox, checkbox groups, choices, lists panels – scroll pane, dialogs, menu bar, graphics, layout manager – layout manager types – boarder, grid, flow, card and grib bag.		
Mapping of Course Outcomes for Unit II	**CO2: Apply relevant AWT/ swing components to handle the given event.**	
Unit III	**GUI Programming**	**(06 Hrs.)**
Designing Graphical User Interfaces in Java, Components and Containers, Basics of Components, Using Containers, Layout Managers, AWT Components, Adding a Menu to Window, Extending GUI Features Using Swing Components, Java Utilities (java.util Package) The Collection Framework: Collections of Objects, Collection Types, Sets, Sequence, Map, Understanding Hashing, and Use of Array List & Vector.		
Mapping of Course Outcomes for Unit III	**CO3: Design and develop GUI applications using Abstract Windowing Toolkit (AWT), Swing and Event Handling.**	
Unit IV	**Database Programming using JDBC**	**(06 Hrs.)**
The Concept of JDBC, JDBC Driver Types & Architecture, JDBC Packages, A Brief Overview of the JDBC process, Database Connection, Connecting to non-conventional Databases Java Data Based Client/server, Basic JDBC program Concept, Statement, Result Set, Prepared Statement, Callable Statement, Executing SQL commands, Executing queries		
Mapping of Course Outcomes for Unit IV	**CO4: Learn to access database through Java programs, using Java Database Connectivity (JDBC).**	
Unit V	**Remote Method Invocation (RMI)**	**(06 Hrs.)**
Remote Method Invocation: Architecture, RMI registry, the RMI Programming Model; Interfaces and Implementations; Writing distributed application with RMI, Naming services, Naming and Directory Services, Setting up Remote Method Invocation – RMI with Applets, Remote Object Activation; The Roles of Client and Server, Simple Client/Server Application using RMI.		
Mapping of Course Outcomes for Unit V	**CO5: Invoke the remote methods in an application using Remote Method Invocation (RMI)**	

Unit VI	**Networking**	**(08 Hrs.)**
The java.net package, Connection oriented transmission – Stream Socket Class, creating a Socket to a remote host on a port (creating TCP client and server), Simple Socket Program Example. InetAddress, Factory Methods, Instance Methods, Inet4Address and Inet6Address, TCP/IP Client Sockets. URL, URLConnection, HttpURLConnection, The URI Class, Cookies, TCP/IP Server Sockets, Datagrams, DatagramSocket, DatagramPacket, A Datagram Example.		

Connecting to a Server, Implementing Servers, Sending EMail, Servlet overview – the Java web server – The Life Cycle of a Servlet, your first servlet.	
Mapping of Course Outcomes for Unit VI	**CO6: Develop program for client /server communication using Java Networking classes.**

Learning Resources

Text Books:

1. Herbert Schildt, "Java: The complete reference", Tata McGraw Hill, 7th Edition
2. Jim Keogh, "Complete Reference J2EE" , Enterpr
3. E. Balaguruswamy, "Programming with JAVA: A Primer" McGraw Hill Education, India, 5th Edition.

Reference Books:

1. "Java 6 Programming", Black Book, Dreamtech
2. "Java Server Programming, Java EE6 (J2EE 1.6)", Black Book, Dreamtech
3. M.T. Savaliya,"Advanced Java Technology", Dreamtech

MOOC / NPTEL Courses:

1. NPTEL Course **"Programming in Java"**

Link of the Course: **https://nptel.ac.in/courses/106/105/106105191/**

2. Udemy course **"Advanced Java Programming"**

Link of the Course: **https://www.udemy.com/course/advanced-java-programming**

Savitribai Phule Pune University Third Year of E & TC Engineering (2019 Course) 304198 (C): Advanced JAVA Programming Lab (Elective – II)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 hrs. / week	**01**	**Practical: 25 Marks**

Prerequisite Courses, if any:
1.Fundamentals of Java Programming

Companion Course, if any: Advanced JAVA Programming

List of Laboratory Experiments

Group A (All are Compulsory)

1.	Write a program to demonstrate status of key on an Applet window such as KeyPressed, KeyReleased, KeyUp, KeyDown.
2.	Write a program to create a frame using AWT. Implement mouseClicked, mouseEntered() and mouseExited() events. Frame should become visible when the mouse enters it.
3.	Develop a GUI which accepts the information regarding the marks for all the subjects of a student in the examination. Display the result for a student in a separate window.
4.	Write a program to insert and retrieve the data from the database using JDBC.
5.	Develop an RMI application which accepts a string or a number and checks that string or number is palindrome or not.
6.	Write a program to demonstrate the use of InetAddress class and its factory methods.

Group B (Any Two)

7.	A. Write Servlet (procedure for client side) to display the username and password accepted from the client. B. Write Servlet (procedure for server side) to display the username and password accepted from the client.
8.	Write program with suitable example to develop your remote interface, implement your RMI server, implement application that create your server, also develop security policy file.
9.	Write a database application that uses any JDBC driver.

Group C (Any Two)

10.	Write a simple JSP page to display a simple message (It may be a simple html page).
11.	Create login form and perform state management using Cookies, HttpSession and URL Rewriting.
12.	Create a simple calculator application using servlet.
13.	Create a registration servlet in Java using JDBC. Accept the details such as Username, Password, Email, and Country from the user using HTML Form and store the registration details in the database.

Savitribai Phule Pune University

Faculty of Science &Technology

B.E. (Electronics & Telecommunication)
(2015 Pattern) Syllabus
(With effect from Academic Year 2018-19)

Savitribai PhulePune University
Final Year E&TC Engineering (2015 Course)
(With effect from Academic Year 2018-19)

Semester I												
Course Code	**Course**	**Teaching Scheme Hours / Week**			**Semester Examination Scheme of Marks**						**Credits**	
		Theory	**Tut**	**Pract**	**In-Sem**	**End-Sem**	**TW**	**PR**	**OR**	**Total**	**TH/TW**	**PR+OR**
404181	VLSI Design& Technology	3	--	--	30	70	--	--	--	100	3	--
404182	Computer Networks & Security	4	--	--	30	70	--	--	--	100	4	--
404183	Radiation & Microwave Techniques	3	--	--	30	70	--	--	--	100	3	--
404184	Elective I	3	--	--	30	70	--	--	--	100	3	--
404185	Elective II	3			30	70	--	--	--	100	3	--
404186	Lab Practice -I (CNS+ RMT)	--	--	4	--	--	50	--	50	100	--	2
404187	Lab Practice -II (VLSI + Elective I)	--	--	4	--	--	50	50		100	--	2
404188	Project Stage I	-	2	--	--	--	-	--	50	50	--	2
	Audit Course 5	--	--	--	--	--	--	--	--	--	----	
	Total	16	2	8	150	350	100	50	100	750	16	6
Total Credits											**22**	

Elective I	**Elective II**	**Audit Course 5**
1 Digital Image and Video Processing	1. Wavelets	1. Green Energy
2. Industrial Drives and Control	2. Electronics Product Design	2. Human Behaviour
3. Embedded Systems & RTOS	3. Optimization Techniques	
4. Internet of Things	4. Artificial Intelligence	
	5. Electronics in agriculture	

Final Year E&TC Engineering (2015 Course)

(With effect from Academic Year 2018-19)

Semester II

Course Code	Course	Teaching Scheme Hours / Week			Semester Examination Scheme of Marks						Credit	
		Theory	Tut	Pract	In-Sem	End-Sem	TW	PR	OR	Total	TH/TW	PR+OR
404189	Mobile Communication	3	--	--	30	70	--	--	--	100	3	--
404190	Broadband Communication Systems	4	--	--	30	70	--	--	--	100	4	--
404191	Elective III	3	--	--	30	70	--	--	--	100	3	--
404192	Elective IV	3	--	--	30	70	--	--	--	100	3	--
404193	Lab Practice –III (MC+BCS)	--	--	4	--	--	50	50	--	100	--	2
404194	Lab Practice –IV (Elective III)	--	--	2	--	--	--	--	50	50	--	1
404195	Project Stage II	--	6	-	--	--	150	--	50	200	--	6
	Audit Course 6	--	--	--	--	--	--	--	--	--		
Total		13	6	6	120	280	200	50	100	750	13	9
										Total Credits	**22**	

Elective III	**Elective-IV**	**Audit Course 6**
1. Machine Learning 2. PLC s and Automation 3. Audio and Speech Processing 4. Software Defined Radio 5. Audio Video Engineering	1. Robotics 2. Biomedical Electronics 3. Wireless Sensor Networks 4. Renewable Energy Systems 5. Open Elective*	1. Team Building, Leadership and Fitness 2. Environmental issues and Disaster Management

*Any one course from the list of Elective IV of computer/IT/Electrical/Instrumentation or Institute can offer elective IV based on any industry need with prior approval from BoS(Electronics & Telecommunication). Repetition of course or topics should be avoided.

404184 Digital Image and Video Processing (Elective-I)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Understand the fundamental concepts of Digital Image Processing with basic relationship of pixels and mathematical operations on 2-D data.
- Learn design and integrate image enhancement and image restoration techniques
- Understand object segmentation and image analysis techniques
- Learn the need for effective use of resources such as storage and bandwidth and ways to provide effective use of them by data compression techniques
- Learn basic concepts of video processing

Course Outcomes:

On completion of the course, student will be able to

1. Develop and implement basic mathematical operations on digital images.
2. Analyze and solve image enhancement and image restoration problems.
3. Identify and design image processing techniques for object segmentation and recognition.
4. Represent objects and region of the image with appropriate method.
5. Apply 2-D data compression techniques for digital images.
6. Explore video signal representation and different algorithm for video processing.

Unit I : Fundamentals of Image Processing **5 Hrs**

Steps in Image processing, Human visual system, Sampling & quantization, Representing digital images, spatial and gray level resolution, Image file formats, Basic relationships between pixels, Distance Measures, Basic operations on images – image addition, subtraction, logical operations, scaling translation, rotation. Color fundamentals and models – RGB, HIS, YIQ

Unit II : Image Enhancement and Restoration **8 Hrs**

Point – Log transformation, Power law transformation, Piecewise linear transformation, Image histogram, histogram equalization, Mask processing of images, filtering operations- Image smoothing, image sharpening, frequency domains image enhancement: 2D DFT, smoothing and sharpening in frequency domein, Pseudo coloring. Image Restoration: Noise models, restoration using Inverse filtering and Wiener filtering

Unit III : Image Compression **6 Hrs**

Types of redundancy, Fidelity criteria, Compression models - Information theoretic perspective – Fundamental coding theorem, Lossless Compression: Huffman Coding- Arithmetic coding. Introduction to DCT, Lossy compression: DCT based compression, Wavelet based compression, Image compression standards JPEG and JPEG 2000.

Unit III : Image Segmentation **8 Hrs**

Pixel classification, Bi-level thresholding, Multi-level thresholding, Adaptive thresholding, Otsu's method, Edge detection – First order derivative Prewitt and Sobel, Second order derivative – LoG, DoG, Canny. Edge linking, Hough transform, Region growing and region merging. Morphological operators: Dilation, Erosion, Opening, Closing, Hit or Miss transform, Boundary detection, Thinning, Thicking, Skelton.

Unit V : Representation and Description 5 Hrs

Representation – Chain codes, Polygonal approximation, Signatures, Boundary descriptors, Shape numbers, Fourier descriptors, Stastical moments, Regional descriptors – Topological, texture, Principal components for description

Unit VI : Video Processing 6 Hrs

Fundamental Concepts in Video – Types of video signals, Analog video, Digital video, Color models in video, Motion Estimation; Video Filtering; Video Compression, Video coding standards MPEG.

Text Books:

1. Gonzalez and Woods, "Digital Image Processing", Pearson Education, 3rd edition
2. Iain E. G. Richardson, "H.264 and MPEG
3. Video Compression: Video Coding for Next Generation Multimedia", John Wiley and Son's Publication, 3rd Edition.

Reference Books:

1. A. K. Jain, Fundamentals of digital image processing, Prentice Hall of India, 1989.
2. Pratt William K. "Digital Image Processing", John Wiley & sons
3. A. Bovik, Handbook of Image & Video Processing, Academic Press, 2000

404184 Industrial Drives and Control (Elective-I)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 3Hours / Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Describe the structure of Electric Drive systems and their role in various applications such as flexible production systems, energy conservation, renewable energy, transportation etc., making Electric Drives an enabling technology
- Study and understand the operation of electric motor drives controlled from a power electronic converter and to introduce the design concepts of controllers for closed loop operation
- Study DC, AC, special machines like stepper motor, servo motor and brushless motor and their control.

Course Outcomes:

On completion of the course, student will be able to

1. Understand the basic principles of power electronics in drives and its control, types of drives and basic requirements placed by mechanical systems on electric drives for various applications
2. Understand the operation of 1ϕ & 3ϕ converter drives for separately excited & series DC motors, dual converter drives, 2 quadrant and 4 quadrant DC chopper drives, Open-loop & closed-loop control of DC drives with transfer function, Dynamic and regenerative braking. Protection circuits for DC drives.
3. Learn speed control of induction motor drives in an energy efficient manner using power electronics. To study and understand the operation of both classical and modern induction motor drives like FOC or Vector control.
4. Learn and understand working of various types of synchronous motors and their drive systems
5. Learn stepper motors & drives, BLDC and SRM motors and drives
6. Understand modern control techniques of Fuzzy logic and ANN in motor drive application

Unit I :Motor Drive as system **5 Hrs**

Electrical drive as system, Parts of Electrical drives AC / DC drives, Components, nature and classification of load torques. Four quadrant operation of a motor drive. Control of Electrical drives, steady state stability Closed loop control, Selection of motor power rating

Unit II : DC Motors and drives6Hrs

Basic characteristics of DC motors, Operating modes, Motor performance parameters, 1ϕ & 3ϕ converter drives for separately excited & series DC motors for continuous & discontinuous operations. Chopper fed DC drives, Comparison of converter fed drive & chopper fed drive. Open loop & closed loop control of dc drives with transfer function PLL control, Microprocessor based control of dc drives, Dynamic and regenerative braking of DC motors

Unit III :Induction Motors and Drives 8Hrs

Induction motor characteristics, Control strategies like stator voltage control, v/f control, rotor resistance control, Variable frequency Square wave VSI Drives, Variable frequency PWM VSI Drives, Variable frequency CSI Drives, Closed loop control of Induction motors, v/f control of three phase IM using PWM inverter, Vector Control (Field oriented Control): Basic principle of vector control, Direct vector control & indirect vector control, DQ Transformation, Braking of induction motor, soft acceleration and deceleration, various protections.

Unit IV :AC and DC synchronous Motors and drives6Hrs

Cylindrical rotor motor Drive, Salient pole motor Drive, Switched reluctance motor (SRM) drive, Synchronous Reluctance motor drive, self-controlled synchronous motor drives Permanent magnet Brushless DC motor drive, Permanent magnet AC synchronous motor drive, Variable reluctance & permanent magnet stepper motor and drive. Servo motor Drives.

Unit V :Power Electronics applications inRenewable Energy 6Hrs

Wind power system: System component, Turbine rating, Electrical load matching, fixed speed and variable speed operation, System design features, Maximum power operations and System control requirement WECS: Principle of WECS, role of power electronics in WECS, Drive selection criteria for fixed speed and variable speed WECS, Stand-alone PV systems, Grid connected PV systems. Power Electronics for Photovoltaic Power Systems Basics of Photovoltaic: The PV cell, Module and array, I-V and P-V curves, PV system component, Stand-alone PV systems, Grid connected PV systems.

Unit VI :Artificial Intelligence in Motor Drives5Hrs

Fuzzy logic principle and applications: Introduction, Fuzzy sets, Fuzzy system, Fuzzy control, Fuzzy logic based induction motor speed control. Neural network principle and applications: Introduction, Neural network in identification and control, AI Applications in electrical machines and drives, Neural network based PWM controller.

Text Books:

1. Fundamental of Electrical Drives, Gopal K. Dubey, Narosa Publishing House .
2. Power Electronics, circuits, devises and applications by Muhammad Rashid, Pearson
3. Modern Power Electronics and AC Drives, Bimal K. Bose, Pearson

Reference Books:

1. Wind & Solar Power system, Mukund Patel , CRC Press
2. Thyristor DC drives, P. C Sen, John Wiley.
3. Power Electronics, Converters, Applications and Design, N. Mohan, T. M. Undeland &W. P. Robbins, John Wiley and Sons, 3rd Edition

404184 Embedded Systems and RTOS(Elective-I)

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03Hr/Week				In-Sem : 30 Marks End-Sem: 70 Marks

Course Objectives:

- To understand and able to design an application specific systems.
- To develop implementation skill for application specific systems.
- To understand design and implementation of real time system using RTOS.
- To understand open source platform for embedded system

Course Outcomes:

On completion of the course, student will be able to

1. Understand design of embedded system
2. Use RTOS in embedded application
3. Use modern architecture for embedded system
4. Use Linux for embedded system development
5. Use open platform for embedded system development

Unit I : Embedded System Overview 6 Hrs

Embedded System Introduction, Hardware and software architectures of ES, Design metrics(technical and techno- economical), Prototyping models, Development tool chain insights(GNU), guidelines for Selection of hardware and memory architecture, embedded C programming, embedded system design challenges, standard programming practices in embedded system.

Unit II :Real time system and RTOS 7 Hrs

Real time system, types, design approaches and considerations, Usage ofSharedresourcesand related issues**,** Concept of RTOS, Types of RTOS, differences from GPOS (Multitasking, Inter-process communication, Timers, Device drivers, protection mechanism etc.), real time scheduling algorithms, commercial RTOS , survey of RTOS.

Unit III :µcos-II –RTOS8 Hrs

µcos-II features, kernel structure, data structure, µcos-II services as task management, time management, inter-process communication (mailbox, queue,events,pipesetc.), memory management.µcos-II porting on ARM7/Cortex (M3/M4) architecture.

Unit IV : Advanced embedded architectures (Cortex-M3/M4)8 Hrs

Introduction to ARM CORTEX series, Design Philosophy, processors series, versions, features and applications. CMSIS standard for ARM Cortex. Survey of CORTEX M3/M4 based controllers. ARM-CM3 Based Microcontroller LPC1768: Features, Architecture (Block Diagram &itsDescription), System Control, Clock & Power Control, GPIO, Pin Connect Block, interfacing with RGB LED, Seven Segment, TFT Display, MOTOR control using PWM.

Unit V : Embedded Linux 8 Hrs

Linux for embedded systems, embedded Linux development system, kernel architecture and configuration, file systems, porting Linux on ARM architecture, boot loaders, tool utilities such as Minicomp, Busybox, Redboot, Libc, Device drivers- concept, architecture, types, sample character device driver.

Unit VI :Open hardware /development systems and Case study7 Hrs

Arduino open platform (IDE), development using ATMega328p based Uno board, structure of Arduino programs, introduction to Arduino library, sample GPIO program.

Case study of implementation with control, compute and communication modules using Arduino platform.

Text Books:

1. Jean J.Labrosse, "MicroC OS II, The Real-Time Kernel", 2nd edition, CMP Books.
2. Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach "2nd edition, Prentice Hall.
3. Parag H Dave, Himanshu .H.Dave," Embedded systems" Concepts, design and programming, Pearson India

Reference Books:

1. Frank Vahid and Tony Givargis, " Embedded System Design – A Unified hardware/ Software introduction " 3rd edition, Wiley
2. David Simon, "Embedded system primer"
3. Raj Kamal, "Embedded Systems – Architecture, Programming and Design" 2nd edition,
4. http://www.ti.com/lit/an/slaa207/slaa207.pdf
5. MSP430x5xx: http://www.ti.com/product/msp430f5529
6. MSP430x4xx : http://www.ti.com/product/msp430f438
7. MSP430x2xx: http://www.ti.com/product/msp430g2302-ep

404184 Internet of Things (Elective-I)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To study fundamental concepts of IoT
- To understand roles of sensors in IoT
- To Learn different protocols used for IoT design
- To be familiar with data handling and analytics tools in IoT

Course Outcomes:

1. On completion of the course, student will be able to
2. Understand the various concepts, terminologies and architecture of IoT systems.
3. Use sensors and actuators for design of IoT.
4. Understand and apply various protocols for design of IoT systems
5. Use various techniques of data storage and analytics in IoT
6. Understand various applications of IoT

Unit I : Fundamentals of IoT **6Hrs**

Introduction, Definitions & Characteristics of IoT, IoT Architectures, Physical & Logical Design of IoT, Enabling Technologies in IoT, History of IoT, About Things in IoT, The Identifiers in IoT, About the Internet in IoT, IoT frameworks, IoT and M2M.

Unit II :Sensors Networks **7Hrs**

Definition, Types of Sensors, Types of Actuators, Examples and Working, RFID Principles and components, Wireless Sensor Networks: History and Context, The node, Connecting nodes, Networking Nodes, WSN and IoT.

Unit III :Wireless Technologies for IoT **6 Hrs**

WPAN Technologies for IoT: IEEE 802.15.4, Zigbee, HART, NFC, Z-Wave, BLE, Bacnet, Modbus.

Unit IV :IP Based Protocols for IoT **6 Hrs**

IPv6, 6LowPAN, RPL, REST, AMPQ, CoAP, MQTT.

Unit V :Data Handling& Analytics6Hrs

Introduction, Bigdata, Types of data, Characteristics of Big data, Data handling Technologies, Flow of data, Data acquisition, Data Storage, Introduction to Hadoop. Introduction to data Analytics, Types of Data analytics, Statistical Models, Analysis of Variance, Data Dispersion, Contingence and Correlation, Regression Analysis, Precision and Error limits.

Unit VI :Applications of IoT **7Hrs**

Home Automation, Smart Cities, Energy, Retail Management, Logistics, Agriculture, Health and Lifestyle, Industrial IoT, IoT design Ethics, IoT in Environmental Protection.

Text Books:

1.Hakima Chaouchi, " The Internet of Things Connecting Objects to the Web" ISBN : 978-1-84821-140-7, Wiley Publications

2. Olivier Hersent, David Boswarthick, and Omar Elloumi, "The Internet of Things: Key Applications and Protocols", WileyPublications

3. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.

References

1. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications

2. by Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

3. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

4. https://onlinecourses.nptel.ac.in/noc17_cs22/course

404185 Wavelets (Elective-II)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Learn and understand basic linear algebra
- Understand the need of time frequency resolution
- Understand the basics of Discrete Wavelet transform and various wavelets available
- Learn the signal analysis using multi-resolution analysis
- Study the applications of Wavelets in compression, enhancement, noise removal etc.

Course Outcomes:

1. On completion of the course, student will be able to
2. Explore and learn the basics of linear algebra.
3. Identify the need of Wavelet transform and its properties.
4. Analyze the 1-D and 2-D signal using discrete wavelet transform.
5. Analyze the signal using Multi resolution analysis
6. Use wavelet transform in different applications like data compression, denoising, enhancement etc.

Unit I : Fundamentals of Linear Algebra6 Hrs

Vector spaces, Orthogonality, Ortho-normality, Projection, Functions and function spaces. Orthogonal basis functions. Fourier series orthogonality of complex exponential bases, mathematical preliminaries for continuous and discrete Fourier transformer. Limitations of Fourier domain signal processing, Towards wavelet signal processing, signal representation with continuous and discrete Short Time Fourier Transform.

Unit II : Introduction to Wavelet 6 Hrs

Concept of time-frequency resolution, Resolution problem associated with STFT, Heisenberg's uncertainty principle and time frequency tiling, why wavelet transform? The origin of wavelets, Properties of Wavelet Transform, Wavelet and other wavelet like transformer, different communities and family of wavelets, different families of wavelets within wavelet communities, Continuous and discrete wavelet transform

Unit III : Discrete Wavelet Transform 8 Hrs

Haar scaling function and function spaces, translation and scaling of $\varphi(t)$, function spaces V0 Finer Haar Scaling Functions, concept of nested vectopr spaces, Haar wavelet function, scaled and translated Haar wavelet functions, orthogonality of $\varphi(t)$ and $\gamma(t)$. Normalization of Haar bases at different scales, daubechies wavelets, plotting of Daubechies wavelets. 1-D and 2-D decomposition (analysis) of signals using Wavelet.

Unit IV : Multi-resolution Analysis 6 Hrs

Signal decomposition and its relation with filter banks, frequencies response, signal reconstruction course to fine scale, upsampling and filtering, QMF conditions, concepts of multi-Resolution analysis and multi-rate signal processing, Perfect matching filters, Vanishing moments of wavelet function and filter properties, introduction to wavelet lifting.

Unit V : Wavelet Transform in Data Compression 6 Hrs

Transform coding, image compression using DWT, Embedded tree image coding, comparison of JPEG and JPEG 2000, Audio masking, MPEG Coding for audio, Wavelet based audio coding, video coding using Multi-resolution technique (introduction).

Unit VI : Applications of Wavelet Transform 4 Hrs

Waveletdenoising, speckle removal, Edge detection and object isolation Image fusion, wavelet watermark, image enhancement. Communication application scaling functions as signaling pulses, Discrete Wavelet Multitone modulation.

Text Books:

1. K.P Soman, K I Ramchandran, N G Resmi, "Insights into Wavelets from theory to Practice", Third edition, PHI publication.
2. Raghuveer M Rao, Ajit S. Bopardikar, "Wavelet Transforms, Introduction to Theory and Applications", Seventh Indian Reprint 2005, Pearson Education.

Reference Books:

1. Jaideva C. Goswami, Andrew K. Chan, "Fundamentals of Wavelets", Wiley Student Edition
2. V. M. Gadre, A. S. Abhyankar, "Multiresolution and Multirate Signal Processing, Introduction, Principles and Applications", MGH Publication

404185 Electronic Product Design (Elective-II)

Teaching Scheme:		Examination Scheme:
Lectures: 3 Hrs./ Week		In Sem: 30 Marks End Sem: 70Marks

Course Objectives:

- To understand the stages of product (hardware/ software) design anddevelopment.
- To learn the different considerations of analog, digital and mixed circuitdesign.
- To be acquainted with methods of PCB design and different tools used for PCBDesign.
- To understand the importance of testing in product design cycle.`
- To understand the processes and importance ofdocumentation.

Course Outcomes:

After Successfully completing the course students will be able to

- Understand various stages of hardware, software and PCBdesign.
- Importance of product test &testspecifications.
- Special design considerations and importance ofdocumentation.

Unit I: Introduction to Electronic Product Design 6 Hrs

Man machine dialog and Industrial design, user-centered design, five element of successful design, cognition, ergonomics. Packaging and factors, design for manufacture, assembly and disassembly, wiring, temperature, vibration and shock. Safety, noise, energy coupling, grounding, filtering and shielding.

Unit II: Hardware Design & testing methods 6 Hrs

Design process. Identifying the requirements, formulating specifications, design specifications, Specifications verses requirements, System partitioning, Functional design, architectural design, Functional model verses architectural model. Prototyping. Performance and Efficiency measures. Formulating a test plan, writing specifications, Test procedure and test cases, Egoless design, design reviews. Module debug and test: black box test, white box test, grey box test.

Unit III: Software Design and Testing methods 6 Hrs

Types of Software. Waterfall model of software development. Models, metrics andsoftware limitations. Risk abatement and failure preventions. Software bugs and testing. Good programming practice. User interface .Embedded, Real time software.

Unit IV: PCB design 6 Hrs

Fundamental Definitions, Standards. Routing Topology Configurations, Layer Stack up assignment, Grounding Methodologies, Aspect Ratio, Image Planes, Functional Partitioning, Critical frequencies, Bypassing and decoupling. Design techniques for ESD Protection,Guard Band implementation.

Unit V: Product Debugging and Testing 6 Hrs

Steps of Debugging, Techniques for troubleshooting, characterization, Electromechanical components, passive components, active components, active devices, operational amplifier, Analog-Digital Conversion, Digital Components, Inspection and test of components, Simulation, Prototyping and testing, Integration, validation and verification. EMI & EMC issues.

Unit VI : Documentation 6 Hrs

Definition, need, and types of documentation. Records, Accountability, and Liability. Audience. Preparation, Presentation, and Preservation of documents. Methods of documentation, Visual techniques, Layout of documentation, Bill of material.

Text Books:

1. Kim Fowler," Electronic Instrument Design" Oxford universitypress.
2. Robert J. Herrick, "Printed Circuit board design Techniques for EMC Compliance", Second edition, IEEE press.

Reference Books:

1. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", Wiley publication
2. J C Whitakar," The Electronics Handbook", CRCpress.

404185 Artificial Intelligence (Elective II)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To learn various types of algorithms useful in Artificial Intelligence (AI).
- To convey the ideas in AI research and programming language related to emergingtechnology.
- To understand the concepts of machine learning, pattern recognition, and natural language processing.
- To understand the numerous applications and huge possibilities in the field of AI that gobeyond the normal human imagination.

Course Outcomes:

On completion of the course, student will be able to

1. Design and implement key components of intelligent agents and expert systems.
2. To apply knowledge representation techniques and problem solving strategies to common AI applications.
3. Applyand integrate various artificial intelligence techniques in intelligent system development as well as understand the importance of maintaining intelligent systems.
4. Build rule-based and other knowledge-intensive problem solvers.

Unit I :Foundation 6Hrs

Intelligent Agents, Agents and environments, Good behavior, The nature of environments, structure of agents, Problem Solving, problem solving agents, example problems, Searching for solutions, uniformed search strategies, avoiding repeated states, searching with partial information.

Unit II :Searching 6Hrs

Search and exploration, Informed search strategies, heuristic function, local search algorithms and optimistic problems, local search in continuous spaces, online search agents and unknown environments, Constraint satisfaction problems (CSP), Backtracking search and Local search for CSP, Structure of problems, Games: Optimal decisions in games, Alpha- Beta Pruning, imperfect real-time decision, games that include an element of chance.

Unit III :Knowledge Representation 6Hrs

First order logic, representation revisited, Syntax and semantics for first order logic, Using first order logic, Knowledge engineering in first order logic, Inference in First order logic, prepositional versus first order logic, unification and lifting, forward chaining, backward chaining, Resolution, Knowledge representation, Uncertainty and methods,Bayesian Probability and Belief network, probabilistic Reasoning,Bayesian networks, inferences in Bayesian networks,Temporalmodels,Hidden Markov models.

Unit IV :Learning 6Hrs

Learning from observations: forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning, Logical formulation of learning, Explanation based learning, Learning using relevant information, Inductive logic programming, Statistical learning methods, Learning with complete data, Learning with hidden variable, EM algorithm, Instance based learning, Neural networks - Reinforcement learning, Passive reinforcement learning, Active reinforcement learning, Generalization in reinforcement learning.

Unit V :Pattern Recognition and Expert System6 Hrs

Basic steps of pattern recognition system, Feature Extraction- Principal Component Analysis,Linear Discriminant Analysis, Classification, Object Recognition- Template Matching theory, Prototype Matching Theory, Speech Recognition, Pattern Mining- Apriori Algorithm,

Unit VI :Natural Language Understanding6Hrs

Why NL, Formal grammar for a fragment of English, Syntactic analysis, Augmented grammars, Semantic interpretation, Ambiguity and disambiguation, Discourse understanding, Grammar induction, Probabilistic language processing, Probabilistic language models

Text Books:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence”, A Modern Approach, Pearson Education/Prentice Hall of India.
2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, Tata McGraw-Hill.

Reference Books

404185 Optimization Techniques (Elective II)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand the need and origin of the optimization methods.
- To get a broad picture of thevarious applications of optimization methods used in engineering
- To define an optimizationproblem and its various components.

Course Outcomes:

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

1. Describe clearly a problem, identify its parts and analyze the individual functions.
2. Perform mathematical translation of the verbal formulation of an optimizationproblem.
3. Design algorithms, the repetitive use of which will lead reliably to finding an approximate solution
4. Discover, study and solve optimization problems.
5. Investigate, study, develop, organize and promote innovative solutions for various applications.

Unit I : Introduction to Optimization **6Hrs**

Introduction: Historical Development, Engineering Applications of Optimization, Statement of an Optimization Problem, Classification of Optimization Problems, Optimization Techniques, Engineering Optimization Literature, Mathematical Background.

Unit II :Classical Optimization Techniques **7Hrs**

Single-Variable Optimization, Multivariable Optimization with No Constraints, Multivariable Optimization with Equality Constraints, Multivariable Optimization with Inequality Constraints, Convex Programming Problem.

Unit III : Linear Programming **6 Hrs**

Introduction, Applications of Linear Programming, Standard Form of a Linear Programming Problem, Geometry of Linear Programming Problems, Definitions and Theorems, Solution of a System of Linear Simultaneous Equations, Pivotal Reduction of a General System of Equations, Motivation of the Simplex Method, Simplex Method,Revised Simplex Method, Duality in Linear Programming, Decomposition Principle, Sensitivity or Post optimality Analysis,Transportation Problem.

Unit IV : Nonlinear Programming -I **7Hrs**

Unimodal Function, Elimination Methods:Unrestricted Search, Unrestricted Search, Dichotomous Search, Interval Halving Method, Fibonacci Method

Interpolation Methods:Quadratic Interpolation Method, Cubic Interpolation Method, Direct Root Methods, Practical Considerations,

Unit V :Nonlinear Programming-II7Hrs

Introduction to Unconstrained Optimization techniques, Direct Search Methods: Random Search Methods,Grid Search Method, Univariate Method, Pattern Directions, Powell's Method, Simplex Method. Indirect Search Methods: Gradient of a Function, Steepest Descent (Cauchy) Method, Conjugate Gradient (Fletcher–Reeves) Method, Newton's Method, Davidon–Fletcher–Powell Method, Test Functions.

Unit VI : Modern Methods of Optimization6 Hrs

Genetic algorithms, Simulated annealing, Particle Swarm Optimization, Ant Colony Optimization, Optimization of Fuzzy systems, Neural Network based optimization

Text Books:

1.Singiresu S Rao, "Engineering optimization Theory and Practice", New Age International, 2009
2.Kalynamoy Deb, "Optimization for Engineering Design, Algorithms and Examples",PHI

Reference Books:

1. Hadley, G. "Linear programming", Narosa Publishing House, New Delhi.
2.Ashok D Belegundu, Tirupathi R Chandrupatla, "Optimization concepts and Application inEngineering", Pearson Education.
3. KantiSwarup, P.K.Gupta and Man Mohan, Operations Research, Sultan Chand and Sons.
4. J. S. Arora, Introduction to Optimum Design, McGraw-Hill Book Company.
5. David Lay, Steven L Lay, "Linear Algebra and its Applications", Pearson Education.
6. Papalambros& Wilde, Principles of Optimal Design, Cambridge University Press, 2008

404185 Electronics in Agriculture (Elective II)

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03 Hr/Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To inculcate the ability to recognize environmental problems and to provide solutions to agricultural sector.
- An over view of technology of advanced topics like DAS, SCADA and Virtual Instrumentation.
- The ability to select the essential elements and practices needed to develop and implement the Engineering Automation for Agricultural sector.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand Role of computers & virtual instrumentation.
2. Provide communication solution for interpreting environmental parameters with Electronics systems.
3. Describe Instrument technology used in agriculture.
4. Apply knowledge of Electronics in Agriculture.
5. Understand Greenhouse Technology & Role of Electronics Governance.

Unit I: Review of computers & Virtual instrumentation **6 Hrs**

Data loggers, Data acquisitions systems (DAS), Supervisory control and data acquisition (SCADA), Basics of PLC, Functional block diagram of computer control system, alarms, interrupts.Virtual Instrumentation: Historical Perspective, advantages, Block diagram and architecture of virtual instrument, data flow techniques, graphical programming in data flow, comparison with conventional programming.

Unit II:Communication Systems **6Hrs**

Use of field buses, functions, international standards, field bus advantages and disadvantages, Instrumentation network: sensor networks, Open networks-advantages and limitations, HART Network, Foundation field bus network.Profibus PA: Basics, architecture, model, network design.Foundation field bus segments: General consideration, network design.

Unit III:Instrument technology for agriculture **6Hrs**

Instrument for measurement of pH, Electrical conductivity, gas analysis, humidity, leaf area, chlorophyll content, and soil moisture & temperature.

Unit IV:Precision Farming **6Hrs**

An introduction to precision farming. GIS/GPS positioning system for precision farming, Yield monitoring and mapping, soil sampling and analysis. Computers and Geographic information systems. Precision farming- Issues and conditions. Role of electronics in farm machinery for precision farming.

Unit V:Electronics in Agriculture **6 Hrs**

Instrument for crop monitoring – moisture measurement – capacitive, infrared reflectance and resistance. Monitoring soil and weather – measurement of soil properties and meteorological parameters – irrigation control systems. Instruments for crop establishment monitoring. Crop spraying – selective crop spraying – flow control. Yield monitoring. Technology for precision farming. Instruments for protected cultivation – green house environment control – transducers and control system. Instruments and systems for crop handling processing and storage. ,

Unit VI:Applications & Electronics Governance **6Hrs**

Greenhouse: History of modeling and control of Greenhouse, Identification of control and manipulation variables for Greenhouse. Crop Preservation : Importance of Preservation of various commodities and parts of plants, Drying process for preservation, Variable identification for drying process, Electronic control system for grape drying process.Agriculture& Electronics Governance: Governance products & services in agriculture sector, Role of Electronics Governance in Agricultural sector.

Text Books:

1. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education
2.Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication

Reference Books:

1. De Mess M. N. Fundamental of Geographic Information System. John Willy & sons, NewYork, Datta S.K.1987.
2. K. Krishna Swamy, "Process Control"; New Age International Publishers
3. Kuhar, John. E. 1977. The precision farming guide for agriculturalist.
4. Lori J. Dhabalt, USManual of Soil & Water conservation Engineering. Oxford & IBH Co. Sigma &Jagmohan, 1976.

UNIT I: Light wave System Components **8Hrs**

Key Elements of optical fiber system, Optical fibers as a communication channel: Optical fiber modes and configurations, Mode theory for Circular waveguides, Single mode fibers, Graded index fiber structure, Signal degradation in optical fibers. Optical sources: Basic concepts and characteristics of LEDs and LASERs. Photo detectors: Basic concepts, Common photo detectors.

UNIT II: Light wave Systems **6 Hrs**

System architectures, Point to point links: System considerations, Design guidelines: Optical power budget, Rise time budget, Long - Haul systems.

UNIT III: Multichannel Systems **6 Hrs**

Overview of WDM, WDM Components: 2 x 2 Fiber coupler, Optical isolators and circulators, Multiplexers and De-multiplexers, Fiber Bragg Grating, FBG applications for multiplexing and de-multiplexing function, Diffraction gratings, Overview of optical amplifiers: SOA, EDFA and RFA in brief.

UNIT IV: Orbital Mechanics and Launchers **8 Hrs**

History of Satellite communication, Orbital mechanics, Look angle determination, Orbital perturbations, Orbital determination, Launchers and launch vehicles, Orbital effects in communication system performance.

UNIT V: Satellite sub systems **6 Hrs**

Satellite Subsystems, Attitude and Control Systems (AOCS), Telemetry, Tracking, Command and monitoring, Power systems, Communication subsystems, Satellite antennas, Equipment reliability and space qualification.

UNIT VI: Satellite communication link design **8Hrs**

Introduction, Basic transmission theory, System noise temperature and G/T Ratio, Design of downlinks, SatelHrsite systems using small earth stations, Uplink design, Design of specified C/N: Combining C/N and C/I values in satellite links system design examples.

Text Books:

1. Gerd Keiser, “Optical fiber Communications”, Tata McGraw Hill, 4th edition.
2. Timothy Pratt, Charles Bostian, Jeremy Allnutt, “Satellite Communications”, John Wiley & Sons.

Reference Books:

1. Govind P. Agrawal, “Fiber -Optic Communication Systems”, Wiley, 3rd edition.
2. Dennis Roody, “Satellite Communications”, McGraw Hill

404191 Machine Learning (Elective III)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 Hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Explore supervised and unsupervised learning paradigms of machine learning used forregression and classification.
- To design and analyze various machine learning algorithms using neural networks
- To explore Deep learning technique and various feature extraction strategies.

Course Outcomes:

On completion of the course, student will be able to

1. To compare and contrast pros and cons of various machine learning techniques and to get an in sight of when to apply a particular machine learning approach.
2. To mathematically analyze various machine learning approaches and paradigms.
3. To implement convolution neural networks in recognition applications.

Unit I :Introduction to Machine Learning **4Hrs**

Why Machine learning. Types of machine learning, basic concepts in machine learning like parametric and non-parametricmodeling, linear and nonlinear regression, overfitting and dimensionality reduction. Decision trees, Feature reduction.

Unit II : Models for Regression and Classification **8Hrs**

Linear Models for Regression :Least SquaresandNearestNeighbors ,Linear Basis Function Models,The Bias-Variance Decomposition,Bayesian Linear Regression,Bayesian Model ComparisonLinear Models for Classification : Discriminant Functions .Probabilistic Discriminative Models Multivariate Data,ParameterEstimation,MultivariateClassification,Multivariate RegressionKernal Methods : Support Vector machines and Relevance Vector Machines

Unit III :Clustering **6Hrs**

Dimensionality Reduction : Principal Components Analysis,Factor Analysis,Multidimensional Scaling,Linear Discriminant Analysis Clustering : k-Means Clustering,Mixtures of Gaussians.

Unit IV : Artificial Neural Networks I 6Hrs

Biological neuron, Artificial neuron model, concept of bias and threshold, Activation functions, McCulloch-Pits Neuron Model, learning paradigms,concept of error energy, gradient descent algorithm and application of linear neuron for linear regression,: Learning mechanisms: Hebbian, Delta Rule, Perceptron and its limitations.

Unit V : Artificial Neural Networks II **6 Hrs**

Multilayer perceptron (MLP) and back propagation algorithm, Application of MLP for classification, Self-Organizing Feature Maps,Learning vector quantization Radial Basis Function networks.

Unit VI : Deep Learning and Convolution Neural Networks **6Hrs**

Improvement of the Deep Neural Network:Vanishing Gradient, Overfitting, Computational Load,ReLU Function, Dropout Architecture of ConvNet, Convolution Layer, Pooling Layer, Applications of CNN's.

Text Books:

1. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
2. LaureneFausett ," Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education, Inc, 2008.

Reference Books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elementsof Statistical Learning", Springer 2009.
3. Phil Kim, "MATLAB Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence",a Press 2017.
4. EthemAlpaydın "Introduction to Machine Learning" Second Edition The MIT Press 2010.

5. SimonHaykin," Neural Networks : A comprehensive foundation, Prentice Hall International Inc. 1999.

404191 PLC & Automation (Elective III)

Credits: 03

Teaching Scheme:			Examination Scheme:	
Lecture : 03hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- Student will get the ability to recognize industrial control problems suitable for PLC control
- The learners will get an over view of technology of advanced topics such as SCADA, DCS Systems, DigitalController, CNC Machines.
- Student will gain the ability to select the essential elements and practices needed to develop and implement the Engineering Automation using PLC approach.

Course Outcomes:

On successful completion of the course, students able to:

1. Understand PLC architecture
2. Develop PLC ladder programs for simple industrial applications
3. Design Automation systems for industrial applications
4. Implement the Engineering Automation using PLC approach.

Unit I: Process Control & Automation **6Hrs**

Process control principles, Servomechanisms, Control System Evaluation, Analog control, Digital control, Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Effects of modern developments in automation on global competitiveness.

Unit II: Transmitters and Signal Conditioning **6Hrs**

Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire & 3-Wire transmitters, Analog and Digital signal conditioning for RTD, Thermocouple, DPT etc , Smart and Intelligent transmitters.

Unit III: Controllers and Actuators **6Hrs**

PID Controller, Cascade PID control, Microprocessor Based control, PAC (Programmable automation controller), Mechanical switches, Solid state switches,Electrical actuators: Solenoids, Relays and Contactors, AC Motor, VFD, energy conservation schemes through VFD, DC Motor, BLDC Motor, Stepper Motor, Servo Motor, Pneumatic and hydraulic actuators.

Unit – IV Introduction to PLC **6Hrs**

PLC: Characteristics, Operation, function, Types of PLC, Architecture Of PLC, Applications of PLC, PC v/s PLC, PLC programming, Ladder diagram: of logic gates, multiplexer, Ladder diagram for different logical conditions or logical equations or truth table. Timers: types of timer, Characteristics, Function of timer in PLC, Classification of a PLC timer, Ladder diagram using timer, PLC counter, Ladder diagram using counter.

Unit – V Industrial Automation **6 Hrs**

Basic Concept, History and Hierarchy of DCS, Functions of each level, Advantages and Disadvantages, Architecture of SCADA , MTU- functions of MTU, RTU- Functions of RTU, Working of SCADA, Comparison, suitability of PLC, DCS and SCADA, Applications: Thermal power plant, Irrigation and Cement factory.

Unit VI: Automation and CNC (Computer Numeric Control) Machines **7 Hrs**

Introduction of CNC Machines: Basics and need of CNC machines, NC, CNC and DNC (Direct NC) systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines. Industrial Communication:Devicenet, Interbus , Device network: Foundation Fieldbus -H 1, HART, CAN, PROFIBUS-PA, Control network: ControlNet, FF-HSE, PROFIBUS-DP, Ethernet, TCP/IP. Panel Engineering for Automation

Text Books:

1. Curtis Johnson, "Process Control Instrumentation Technology"; 8th Edition, Pearson Education.
2. MadhuchhandaMitra, SamarjitSen Gupta, "Programmable Logic controllers and Industrial Automation"; Penram International Publishing India Pvt. Ltd.

Reference Books:

1. Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication.
2. John W. Webb, Ronold A Reis, "Programmable Logic Controllers, Principles and Applications"; 5th Edition, Prentice Hall of India Pvt. Ltd.
3. Kilian, "Modern control technology: components & systems, Delmar 2nd edition.
4. Bela G Liptak, Process software and digital networks, 3rd edition, 2002.
5. Pollack. Herman, W & Robinson., T. "Computer Numerical Control", Prentice Hall. NJ. Pabla, B.S. &Adithan, M. "CNC Machines", New Age Publishers, New Delhi

404191Audio and Speech Processing (Elective III)

Credits: 03

Teaching Scheme			**Examination Scheme**	
Lecture : 03 hr/week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand basics of speech production and perception mechanism.
- To understand classification of speech sounds based on acoustic and articulatory phonetics.
- To understand the motivation of short-term analysis of speech and audio.
- To understand various audio and speech coding techniques.
- To perform the analysis of speech signal using LPC.
- To extract the information of the speech or audio signals in terms of cepstral features.
- To provide a foundation for developing applications in the field of speech and audio processing.

Course Outcomes:

On completion of the course, student will be able to

1. Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
2. Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).
3. Analyze speech signal for extracting LPC and MFCC Parameters of speech signal.
4. Apply the knowledge of speech and audio signal analysis to build speech processing applications like speech coding, speech recognition, speech enhancement and speaker recognition/verification.

Unit I : Fundamentals of speech production 6 Hrs

Anatomy and physiology of speech production, Human speech production mechanism, LTI model for speech production, Nature of speech signal, linear time varying model, articulators, articulatory phonetics, manner of articulation, place of articulation, acoustic phonetics, spectrogram, classification of speech sounds: vowels, semivowels, nasal diphthongs, stops, affricates, fricative, vowel triangle.

Unit II : Human auditory system and speech perception 6 Hrs

Anatomy and physiology of the ear, outer ear, middle ear and inner ear. Human auditory system, simplified model of cochlea. Sound perception, Auditory psychophysics, thresholds, just noticeable differences (JNDs), Sound pressure level and loudness. Sound intensity and Decibel sound levels. Pitch perception, masking, Concept of critical band and introduction to auditory system as a filter bank, Uniform, non-uniform filter bank, mel scale and bark scale. Speech perception: vowel perception. Coarticulation effects. Consonant perception, perception of manner of articulation feature. Perception of place of articulation.

Unit III: Time and frequency domain methods for speech and audio signal analysis. 6Hrs

Time-dependent speech processing. Short-time energy, short time average magnitude, Short time average zero crossing rate. Speech Vs. silence discrimination using energy and zero crossing rate. Short-time autocorrelation function, short-time average magnitude difference function. Pitch period estimation using autocorrelation method. Audio feature extraction, Spectral centroid, spectral spread, spectral entropy, spectral flux, spectral roll-off. Spectrogram: narrow band and wide band spectrogram.

Unit IV : Linear prediction and cepstral analysis 6Hrs

Basic principles of linear predictive analysis. Autocorrelation method, covariance method. Solution of LPC equations: Durbin's recursive solution, lattice formulations and solutions. Frequency domain interpretation of LP analysis. Applications of LPC parameters as pitch detection and formant analysis

Homomorphic processing of speech signal, application of cepstral analysis for vocal tract vocal cord parameter estimation (formants and pitch). Computation of MFCC.

Unit V : Speech and Audio coding 6Hrs

Time domain waveform coding: linear PCM, companded PCM, DPCM, DM, ADM.

Spectral coders: Filter bank analysis, sub-band coders, Adaptive transform coders (ATC), Harmonic coding. Linear predictive coders (LPC), Non-LP source voice coders: phase vocoders, channel vocoders, excitation for vocoders, Homomorphic (Cepstral) vocoders. Speech coding standards and applications.

Unit VI : Digital speech processing for man-machine communication 6Hrs

Automatic speech recognition (isolated word recognition, automatic telephone number dialing system etc. using statistical signal modeling e.g. GMM, GMM-HMM), Linear and dynamic time warping, text to speech synthesis, speaker recognition and verification, speech enhancement, Introduction to Musical instrument classification, Musical Information retrieval.

Text Books:

1. L. R. Rabiner and S.W. Schafer, "Digital processing of speech signals" Pearson Publication.
2. Douglas O'Shaughnessy, "Speech Communications: Human and Machine:, 2nd Edition Universities Press.

Reference Books:

1. Thomas F. Quateri , "Discrete-Time Speech Signal Processing: Principles and Practice" Pearson Publication.
2. ShailaApte, "Speech and audio processing", Wiley India Publication
3. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", Wiley India.
4. L. R. Rabiner , B. H. Juang and B. Yegnanarayana "Fundamentals of speech recognition". PearsonPublication

404191 Software Defined Radio (Elective III)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03Hr/Week				**In-Sem: 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand "Modern Radio Communication System " that can be reconfigured
- To understand GNU Radio
- To understand how SDR platform provides easy access to wireless network system
- To understand how unlike simulation in Communication Projects, SDR allows easy
- access to both PHY and MAC layer
- To understand the concept of Cognitive Radio and Spectrum sharing

Course Outcomes:

On completion of the course, student will be able to

1. Compare SDR with traditional Hardware Radio HDR.
2. Implement modern wireless system based on OFDM, MIMO & Smart Antenna.
3. Build experiment with real wireless waveform and applications, accessing both PHY and MAC, Compare SDR versus MATLAB and Hardware Radio
4. Work on open projects and explore their capability to build their own communication System.

Unit I : Introduction to SDR and RF Implementation **6Hrs**

Introduction to SDR, Need of SDR, Principles of SDR , Basic Principle and difference in Analog radio and SDR , SDR characteristics, required hardware specifications, Software/Hardware platform, GNU radio -What is GNU radio, GNU Radio Architecture, Hardware Block of GNU,GNU software , MATLAB in SDR , Radio Frequency Implementation issues, Purpose of RF front End, Dynamic Range ,RF receiver Front End topologies, Flexibility of RF chain with software radio, Duplexer ,Diplexer ,RF filter ,LNA ,Image reject filters , IF filters , RF Mixers Local Oscillator , AGC, Transmitter Architecture and their issues, Sampling theorem in ADC, Noise and distortion in RF chain, Pre-distortion

Unit II :SDR Architecture **7Hrs**

Architecture of SDR-Open Architecture, Software Communication Architecture, Transmitter Receiver Homodyne/heterodyne architecture, RF front End, ADC, DAC, DAC/ADC Noise Budget, ADC and DAC Distortion, Role of FPGA/CPU/GPU in SDR, Applications of FPGA in SDR, Design Principles using FPGA, Trade –offs in using DSP, FPGA and ASIC, Power Management Issues in DSP, ASIC, FPGA

Unit III : Multi Rate Signal Processing **6Hrs**

Sample timing algorithms, Frequency offset estimation and correction, Channel Estimation, Basics of Multi Rate, Multi Rate DSP, Multi Rate Algorithm, DSP techniques in SDR, OFDM in SDR

Unit IV : Smart/MIMO Antennas using Software Radio **6Hrs**

Smart Antenna Architecture, Vector Channel Modeling , Benefits of Smart Antenna Phased Antenna Array Theory, Adaptive Arrays, DOA Arrays, Applying Software Radio Principles to Antenna Systems, Beam forming for systems-Multiple Fixed Beam Antenna Array, Fully Adaptive Array , Relative Benefits and Trade-offs OF Switched Beam and Adaptive Array, Smart Antenna Algorithms , Hardware Implementation of Smart Antennas, MIMO -frequency, time, sample Synchronization, Space time block coding-Space Time Filtering, Space Time Trellis Coding .

Case Study : Principles of MIMO-OFDM

Unit : Cognitive Radio **6Hrs**

Cognitive Radio Architecture, Dynamic Access Spectrum, Spectrum Efficiency, Spectrum Efficiency gain in SDR and CR ,Spectrum Usage, SDR as a platform for CR, OFDM as PHY layer ,OFDM Modulator, OFDM Demodulator, OFDM Bandwidth, Benefits of OFDM in CR, Spectrum Sensing in CR, CR Network

Unit VI : Applications of SDR **7Hrs**

Applicationof SDR in Advance Communication System-Case Study, Challenges and Issues, Implementation, Parameter Estimation –Environment, Location, other factors, Vertical Handoff, Network Interoperability.

Case Study : 1)CR for Public Safety –PSCR , Modes of PSCR, Architecture of PSCR
2)Beagle board based SDR 3)Embedded PCSR using GNU radio

Text Books:

1. Jeffrey. H. Reed ,Software Radio : A Modern Approach to Radio Engineering, Pearson LPE
2. Markus Dillinge, KambizMadani, Nancy Alonistioti, Software Defined Radio :Architectures , Systems and Functions ,Wiley

Reference Books:

1. Tony .J. Rouphael, RF and DSP for SDR, Elsevier Newness Press ,2008
2. Dr.TajStruman,Evaluation of SDR –Main Document
3. SDR –Handbook, 8th Edition , PENTEK
4. Bruce a. Fette, Cognitive Radio Technology, Newness, Elsevier

404191 Audio Video Engineering (Elective III)

Credits: 03

Teaching Scheme:		**Examination Scheme:**	
Lecture : 03Hr/Week			**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- After learning AVE course, students will get benefit to learn and understand the working of real life video system and the different elements of video system plus the encoding/decoding techniques.
- The learners will be groomed up to understand different channel allocations, difference between various systems present in this world, their transmission and reception techniques.
- Students will get insight on functioning of individual blocks, different standards of compression techniques and they will be acquainted with different types of analog, digital TV and HDTV systems.
- The students will get overview of fundamentals of Audio systems and basics of Acoustics

Course Outcomes:

On successful completion of the course, students able to:

1. Apply the fundamentals of Analog Television and Colour Television standards.
2. Explainthe fundamentals of Digital Television, DTV standards and parameters.
3. Study and understand various HDTV standards and Digital TV broadcasting systems and acquainted with different types of analog, digital TV and HDTV systems.
4. Understandacoustic fundamentals and various acoustic systems.

Unit I: Fundamentals of Colour Television **8Hrs**

The basic Television system and scanning principles, Composite video signal and television standards, Color TV systems, fundamentals, mixing of colours, colour perception, chromaticity diagram. NTSC, PAL, SECAM systems, colour TV transmitter, (high level, low level), colour TV receivers.

Unit II: Digital TV and Display Devices **6Hrs**

Introduction to Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, advanced MAC signal transmission, Digital TV receivers, Basic principles of Digital Video compression techniques, MPEG Standards. Digital TV recording techniques, Display devices: OLED, LCD, TFT, Plasma, Camcoder, Digicam.

Unit III: HDTV **6Hrs**

HDTV standards and systems, HDTV transmitter and receiver/encoder, Digital TV satellite Systems, video on demand, CCTV, CATV, direct to home TV, set top box with recording facility, conditional access system (CAS), 3D TV systems, HD video cameras, Digital broadcasting, case study (Cricket match, Marathon, Football match).

Unit IV: Advanced TV Systems **6Hrs**

IP Audio and Video, IPTV systems, Mobile TV, Video transmission in 3G/4G mobile System, Digital Video Recorders, Wi-Fi Audio / Video Transmitter and Receivers.

Unit V: Fundamentals of Audio-Video Recording **8Hrs**

Methods of sound recording & reproduction, optical recording, CD recording, audio standards. Digital Sound Recording, CD/ DVD player, MP3 player, Blue Ray DVD Players, MP3 Player.

Unit VI: Fundamentals of Acoustics 6Hrs

Studio acoustics & reverberation, P.A. system for auditorium, acoustic chambers, Cordless microphone system, special types of speakers & microphones, Digital Radio Receiver Satellite radio reception.

Text Books

1. Television and video Engineering, A. M. Dhake, TMH Publication.
2. R. R. Gulati, "Monochrome and colour television"

Reference Books

1. Television Engineering -Audio and Video Systems, D. S. Bormane, P.B. Mane& R RItkarkar, Wiley publication.
2. S. P. Bali, "Color TV Theory and Practice".
3. Bernard Grobb, Charles E, "Basic TV and Video Systems".
4. Video Demisified, Kelth jack, Penram International Publication.
5. Audio Video Systems, R.G. Gupta, TMH Publication

404192 ROBOTICS (Elective-IV)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03Hr/Week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To understand the history, concept development and key components of robotics technologies.
- To understand basic mathematics manipulations of spatial coordinate representation and transformation.
- Able to solve basic robot forward and inverse kinematic problems
- To understand and able to solve basic robotic dynamics, path planning and control problems

Course Outcomes:

On completion of the course, student will be able to

1. Familiar with the history, concept development and key components of robotics technologies.
2. Implement basic mathematics manipulations of spatial coordinate representation and transformation.
3. Solve basic robot forward and inverse kinematic problems
4. Understand and able to solve basic robotic dynamics, path planning and control problems

Unit I :Basic concepts in robotics 6Hrs

Definition ; anatomyof robot, basic structure of robot, Specifications and Classification of robot, Safety Measures in robotics ,Industrial Applications of Robots.

Unit II :Robot drivers,Sensors and Vision 6Hrs

Drives for robots: Electric, hydraulic and pneumatic.

Sensors: Internal-External,Contact-noncontact, position, velocity,force, torque, proximity and range.

Vision: Introduction to techniques, Image acquisition and processing

Unit III : End Effectors and Actuators **6Hrs**

Different types of grippers- Mechanical,Magnetics,vacuum,Adhesive, Gripper force Analysis&Gripper Design , overview of actuators, Power and torque, Acceleration and velocitySpecifications and characteristics of Stepper motors, AC motors, DC motors and servomotors.

Unit IV : Robot Kinematics and Dynamics **8Hrs**

Direct and inverse kinematics for industrial robots for position and orientation, Redundancy, Manipulator, direct and inverse velocity. Lagrangian formulation , Link inertia tensor and manipulator inertia tensor, Newton –Eller formulation for RP and RP manipulators, Trajectory planning, interpolation, static force and moment transformation, solvability, stiffness

Unit V:Programming methods **6Hrs**

Robot language classification, Robot language structure, elements and its functions. Simple programs on Sensing distance and direction., Line Following Algorithms, Feedback Systems Other topics on advance robotic techniques

Unit VI : Developing and building a robot **6Hrs**

Models of flexible links and joints, Robotic arm – Components and structure, Types of joints and workspace, Design models for mechanic arms and lifting systems

Case Study: 1. Robots in material handling and assembly.
2. Human Robot Interaction

Text Books:

1. Introduction to Robotics By S.K.Saha , Tata McGraw Hill
2. Robotics Control ,Sensing ,Vision and Intelligence by K.S. Fu, R.C .Gonzalez, C.S.G.Lee , Tata McGraw Hill

Reference Books:

1. J. Hirchhorn: Kinematics and Dynamics of Machinery, McGraw Hill book co.
2. Robert J. Schilling , Fundamentals of Robotics- Analysis and Control, Prentics Hall india.
3. Robotics Technology and Flexible Automation by S.R.Deb, S. Deb, Tata McGraw Hill
4. Robot Motion and Control (Recent Developments) by M.Thoma& M. Morari

404194 Biomedical Electronics (Elective-IV)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 hr/week				**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To study Human Physiological Systems from Engineering Perspectives
- To understand the basic signals in the field of biomedical.
- To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, PCG, Pulse.
- To understand Sources and characteristics of noise and artifacts in bio signals.
- To understand use of bio signals in diagnosis, patient monitoring and physiological investigation

Course Outcomes:

After successfully completing the course students will be able to:

1. Model a biomedical system.
2. Understand various methods of acquiring bio signals.Understand various sources of bio

3. signal distortions and its remedial techniques.
4. Get an Overview of major Devices currently used in Medical field
5. The students will have an understanding of analyzing bio-signal and classifying them

Unit I: Introduction to Biomedical System **6Hrs**

Biomedical Instrumentation System, Cell structure, Bio-Cell potential , Concept of Bio-electrodes, Types of Bio-electrodes to measure Bio-signal, Transducers and Sensors to measure Bio signal EEG,ECG,EMG, Respiration, Body temperature, SPO2, and Pulse. Artifacts in Bio signal Acquisition: Noise, Power line, Baseline, Skin Impedance and Motion Artifacts, Techniques to reduce the artifacts.

Unit II: Cardiovascular System 6Hrs

Introduction to Heart**,** Physiology and anatomy of Heart, Lead Configurations to acquire ECG, ECG preamplifiers, ECG recorder, Heart Sounds and Murmurs, Phonocardiography

Unit III:Nervous System 6Hrs

Nerve Cell and nerve potential, Neural Communication, Brain structure, 10-20 electrode placement for EEG , Types of Montage configuration, Types of EEG signals and its significance, EEG machine, EEG applications for Epilepsy and Sleep apnea**.**

Unit IV: Medical Instrumentation **8Hrs**

Design of Instrumentation system for ECG acquisition, Isolation Amplifier, Right Leg drive Mechanism, Noise removal techniques using Active Filters, Wiener Filters, Adaptive Filters: Basic Concept, Principle noise cancellation model, removal of periodic events, using adaptive cancellation, adaptive cancellation of maternal ECG from fetal ECG of Interest. Grounding and shielding Concepts

Unit: Analysis of Electrical Activity of Heart **6Hrs**

ECG Signal Processing: Removal of Base line and Power line Interference, Muscle noise Filtering, Highlight ECG feature points, QRS detection, ECG classification for normal and abnormal state using Multilayer Perceptron. Use of Multiscale analysis for ECG parameter estimation.

Unit VI:Medical Devices **4Hrs**

Introduction To Blood Pressure Measurement (noninvasive), Life saving Devices Pacemakers and Defibrillators, Bedside Monitors, Central Monitoring system, Stress Test System, X Ray, CT scan , Dental instruments

Text Books:

1. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", 4th Edition, Prentice Hall, 2000.
2. R. Rangayan, "Biomedical Signal Analysis", Wiley 2002.
3. R.S.Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003, Edition-II.

Reference Books:

1. John L Semmlow, "Bio-signal and Biomedical Image Processing", Marcel Dekker
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", 4thEdition, Prentice Hall, 2000.

404194 Wireless Sensor Networks (Elective-IV)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03 hr/week				**In-Sem : 30 Marks** **End-Sem: 70 Marks**

Course Objectives:

- To learn basic concepts of Wireless sensor networks
- To be familiar with architecture and protocols used in Wireless sensor networks
- To provide knowledge of deployment and security issued of Wireless sensor networks

Course Outcomes:

On completion of the course, student will be able to

1. Explain various concepts and terminologies used in WSN
2. Describe importance and use of radio communication and link management in WSN
3. Explain various wireless standards and protocols associated with WSN
4. Recognize importance of localization and routing techniques used in WSN
5. Understand techniques of data aggregation and importance of security in WSN
6. Examine the issues involved in design and deployment of WSN

Unit1 : Introduction **6 Hrs**

What are Wireless Sensor Networks, Wireless Sensor Node, Anatomy of a Sensor Node, architecture of WSN , Performance metrics in WSNs, types of WSN

Unit 2: Radio Communication And Link Management **7 Hrs**

Radio Waves and Modulation/Demodulation, Properties of Wireless Communications, Medium Access Protocols, Wireless Links Introduction, Properties of Wireless Links, Error Control, Naming and Addressing, Topology Control

Unit 3: Wireless Standards And Protocol Stack **7 Hrs**

WSN Standards- IEEE802.15.4 Low rate WPAN, Zigbee, WirelessHART, ISA 100.11a, 6LoWPAN,IEEE802.15.3, Wibree,BLE, Zwave, ANT, Insteon, Wavenis, Protocol stack of WSNs, Cross Layer Protocol Stack

Unit 4: Localization And Routing **7 Hrs**

Localization : Localization Challenges and Properties, Deployment Schemes, Proximity Schemes. Ranging Schemes, Range-Based Localization, Range-Free Localization,
Routing Basics, Routing Metrics, Routing Protocols, Full-Network Broadcast, Location-Based Routing, Directed Diffusion, Collection Tree Protocol, Zigbee, Multi-Hop Communications

Unit 5: Data Aggregation And Security **7 Hrs**

Clustering Techniques, In-Network Processing and Data Aggregation, Compressive Sampling, Security Issues in Wireless Sensor Networks, Attacks, Defensive Measures, Securityrequirements and threat model,

Unit 6: Designing And Deploying WSN Applications **6 Hrs**

Designing and Deploying WSN Applications,Early WSN Deployments, General Problems, General Testing and Validation, Requirements Analysis, The Top-Down Design Process, Bottom-Up Implementation Process.

Text Books

1.Kazem Sohraby, Daniel Minoli and TaiebZnati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007.

2.Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.

Reference Books

1. HossamFahmy, "Wireless Senor Networks: Concepts, Application, experimentation and analysis", Springer Publication

2. Anna Forster, "Introduction to Wireless Sensor Networks", IEEE Press, Wiley Publication

3.Anna Hac, "Wireless Sensor Network Designs", John Wiley & Sons Ltd,

404194 Renewable Energy Systems (Elective-IV)

Credits: 03

Teaching Scheme:			**Examination Scheme:**	
Lecture : 03hr/week				**In-Sem : 30 Marks** **End-Sem : 70 Marks**

Course Objectives:

- To study energy generation, different energy sources and their utilization and impact on environment
- To gain knowledge of solar radiation and its applications
- To understand the wind energy and its nature
- To analyze the performance of solar collectors and wind turbines
- To learn fuel cell and its efficiency

Course Outcomes:

On successful completion of the course, students able to:

1. Interpret energy reserves of India and potential of different energy sources.
2. Measure the solar radiation parameters and performance of different solar collectors.
3. Calculate different parameters of wind turbine rotor.
4. Implicit the importance and applications of geothermal and ocean energy.
5. Demonstrate knowledge in field of fuel cell and potential for power generation.

Unit I : Energy Resources and Utilization: 6Hrs

Conservation and forms of energy, energy reserves in India, nuclear power, hydroelectric power potential, India's power scene, impact on environment, renewable energy sources, energy parameters, cogeneration, rational energy use of energy, energy efficiency and conservation, new technologies, distributed energy systems and dispersed generation.

Unit II :Solar Energy 8Hrs

Solar constant, spectral distribution of extraterrestrial radiation, terrestrial solar radiation, solar radiation geometry, computation of COSθ, sunrise, sunset, day length, LAT, Empirical equation, solar radiation measurement, Solar Thermal energy collectors, design parameters,laws of thermal radiation, radiation heat transfer between real bodies, radiation optics, transmitivity, heat losses and coefficient, Solar Thermal energy storage.

Unit III : Solar photovoltaic systems& Solar Applications 8Hrs

Solar photovoltaic systems: Photovoltaics, Different types of PV Cells, Mono-poly crystalline and amorphous Silicon solar cells. Design of PV array. Efficiency and cost of PV systems

Solar Applications: Solar water heating, solar distillation, solar ponds, solar pumping system, solar cooker, solar green house.

Unit IV : Wind energy 8Hrs

Classification, types of rotors, terminology, operation of wind turbines, wind energy extraction, wind characteristics, wind speed, energy estimation, power density duration curve, density function, field data analysis, direction and wind speed, variation of wind speed, wind scale, energy pattern factor in wind power studies, land for wind energy, design of wind turbine rotor, regulating system, wind power generation curve, horizontal axis wind turbine generator, modes of wind power generation, advantages and disadvantages, wind energy farms.

Unit V: Ocean and Geothermal Energy **6Hrs**

Ocean Energy: Tidal Energy, Tidal characteristics, Tidal Energy estimation, Development of a tidal power scheme,Wave energy- characteristics-energy and power from the waves.

Geothermal energy: Structure of earth's interior, sites, field, gradient, resources, power generation, geothermal resources in India, utilization, global status of electricity generation from geothermal resources, advantages of geothermal energy

Unit VI : Fuel Cells **6Hrs**

Principle of operation of an acidic Fuel Cell, Technical parameter, Fuel Processor, methanol fuel cell, fuel cell types, Advantages of fuel cell power plants, comparison between acidic and alkaline hydrogen-oxygen fuel cells, state of art fuel cells, energy output of a fuel cell, efficiency and EMF of a fuel cell, Gibbs-Helmholtz equation, operating characteristics of fuel cells.

Text Books:

1. D.P. Kothari, K.C. Singal and RakeshRanjan, "Renewable Energy Sources and Emerging Technologies", Prentice Hall of India, New Delhi, 2009.
2. S.P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", TMH, New Delhi, 2008

Reference Books:

1. Chetan Singh Solanki, "Renewable Energy Technologies", Prentice Hall of India, New Delhi, 2009
2. G. D. Rai, "Non- conventional Energy Sources", Khanna publishers, New Delhi, 2011.
3. MaltiGoel, "Energy Souces and Global Warming", allied publishers Pvt Ltd. New Delhi, 2005.