

**Course Name: WIRELESS COMMUNICATION**

**Course Code: EC – 701**

**Course Type: PC  
(Semester – VII)**

**Course Broad Category: (Major)**

**1. Course Prerequisite:**

Digital Communication  
Signal Processing  
Probability and Random Processes  
Electromagnetic and Antennas

**2. Course Learning Objectives:**

- i. Understand the fundamental principles of wireless communication.
- ii. Analyze the impact of multipath fading and interference on wireless signals.
- iii. Study various wireless network standards and technologies.
- iv. Explore modern wireless communication techniques such as MIMO and OFDM.
- v. Design and evaluate wireless systems for different applications.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I - (40 marks)
- B. Continuous Internal Assessment II - (40 marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name:** WIRELESS COMMUNICATION

**Course Code:** EC - 701

**Hours per Week:** 3L: 0T:0P

**Credits:** 3

Module	Topics	36L
1.	<b>Introduction to Wireless Communication:</b> • Evolution of wireless communication • Frequency spectrum, regulations, and standards • Wireless channel characteristics • Free space propagation and path loss models	5L
2.	<b>Mobile Radio Propagation:</b> • Multipath propagation, small-scale and large-scale fading • Doppler shift and coherence time • Statistical fading models (Rayleigh, Rician)	7L
3.	<b>Modulation and Coding for Wireless Systems:</b> • Digital modulation techniques (PSK, QAM, FSK, etc.) • Diversity techniques and error control coding • Equalization and channel estimation	7L
4.	<b>Multiple Access Techniques:</b> • FDMA, TDMA, CDMA, OFDMA • Resource allocation in cellular networks • Interference management and power control	6L
5.	<b>Wireless Network Standards and Technologies:</b> • Cellular concepts and frequency reuse • 2G, 3G, 4G LTE, and 5G wireless technologies • WLAN, Wi-Fi, Bluetooth, and IoT wireless protocols	6L

Module	Topics	36L
6.	<b>Advanced Topics in Wireless Communication:</b> •Multiple-input multiple-output (MIMO)•Orthogonal frequency division multiplexing (OFDM)•Millimeter-wave communication and massive MIMO•Cognitive radio and spectrum sensing	5L

**5. References:**

**Text Book:**

- "Wireless Communications: Principles and Practice" – Theodore S. Rappaport
- "Fundamentals of Wireless Communication" – David Tse and Pramod Viswanath

**Reference Books:**

- "Principles of Wireless Networks: A Unified Approach" – Kaveh Pahlavan and Prashant Krishnamurthy
- "Mobile Communications" – Jochen Schiller
- "Wireless Communication Systems" – Ke-Lin Du and M. N. S. Swamy

**6. Course Outcomes (CO):**

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC701.1	Describe the fundamental principles of wireless communication and mobile systems.	Describe	Understand
EC701.2	Analyze wireless channel characteristics and propagation models.	Analyze	Analyze
EC701.3	Apply modulation, coding, and diversity techniques to improve wireless communication performance.	Apply	Apply
EC701.4	Compare and contrast different multiple access techniques used in modern wireless systems.	Compare	Analyze
EC701.5	Evaluate existing wireless communication standards and emerging technologies	Evaluate	Evaluate
EC701.6	Design and simulate basic wireless communication systems using appropriate tools	Design	Create

**7. Mapping of Course Outcomes (CO) to module/course content:**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	3	3

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO):**

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

**9. Mapping to Program Specific Outcome(PSO):**

	PSO1	PSO2	PSO3
CO1	3	2	1
CO2	3	3	2
CO3	3	3	1
CO4	3	3	1
CO5	3	3	3
CO6	3	3	3

**\*\*\* End of the Syllabus\*\*\***

**Course Name: Microwave Theory and Techniques**

**Course Code: EC-702**

**Course Type: PE**

**(Semester VII)**

**Course Board Category: (Major)**

**1. Course Prerequisite:**

B. Tech. level knowledge of EM Theory  
Solid State Devices  
Circuit Theory

**2. Course Learning Objectives:**

- i. Understand the behavior of RF passive components and model active components
- ii. Perform transmission line analysis
- iii. Demonstrate use of Smith Chart for high frequency circuit design
- iv. Justify the choice/selection of components from the design aspects
- v. Contribute in the areas of RF circuit design

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case studies.

**Evaluation System –**

- A. Continuous Internal Assessment I - (40 marks)
- B. Continuous Internal Assessment II - (40 marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name:** Microwave Theory and Techniques

**Course Code:** EC - 702

**Hours per Week:** 3L: 0T:0P

**Credits:** 3

Module	Topics	34L
1.	<b>Introduction to Microwaves:</b> History of Microwaves, Microwave bands; Applications of Microwaves: Civil and Military, Medical, EMI/ EMC. Mathematical Model of Microwave Wave guide-Concept of Modes, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission. Analysis of RF and Microwave Transmission Lines- Coaxial line, Rectangular waveguide, Circular waveguide, Strip line, Micro strip line.	4L
2.	<b>Microwave Network Analysis:</b> Equivalent voltages and currents for non-TEMLines, Network parameters for microwave circuits, Scattering Parameters. Passive Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator. Microwave active components: Diodes, Transistors, Oscillators, Mixers.	5L

3.	<b>Microwave Semiconductor Devices:</b> Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes.	7L
4.	<b>Microwave Tubes:</b> Klystron, TWT, Magnetron and BWO.	7L
5.	<b>Microwave Measurements:</b> Power, Frequency and impedance measurement at microwave frequency, Network Analyzer and measurement of scattering parameters, Spectrum Analyzer and measurement of spectrum of a microwave signal, Noise at microwave frequency and measurement of noise figure. Measurement of Microwave antenna parameters.	7L
6.	<b>Microwave Systems:</b> Radar, Terrestrial and Satellite Communication, Radio Aids to Navigation, RFID, GPS. Modern Trends in Microwaves Engineering-Effect of Microwaves on human body, Medical and Civil applications of microwaves, Electromagnetic interference and Electromagnetic Compatibility (EMI & EMC), Monolithic Microwave ICs, RFMEMS for microwave components, Microwave Imaging.	4L

### 5. References:

#### Text Book:

- Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", Author House, 2009.
- D. M. Pozar, "Microwave engineering", Wiley, 4th edition, 2011.
- R. Ludwig and P. Bretchko, "R. F. Circuit Design", Pearson Education Inc, 2009.

#### Reference Books:

- G. D. Vendelin, A.M. Pavo, U. L. Rohde, "Microwave Circuit Design Using Linear And Non Linear Techniques", John Wiley 1990.
- S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987.
- Radmanesh, "RF and Microwave Electronics Illustrated", Pearson Education, 2004.

### 6. Course Outcomes:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC - 702.1	Develop a deep understanding of microwave principles, including electromagnetic wave propagation, wave guides and their behaviour at microwave frequencies.	Explain	Understand
EC - 702.2	Study the design and working principles of various microwave passive components such as microwave TEEs, couplers, mixers, different ferrite devices etc.	Identify, Implement Design	Apply, Create
EC - 702.3	Understand the characteristics and operation of microwave semiconductor devices such as diodes, transistors, Gunn diodes etc.	Explain	Understand
EC - 702.4	Understand the characteristics and operation of microwave tubes such as Microwave Klystron, Magnetron, TWT and	Identify, Select	Understand

	BWO.		
<b>EC - 702.5</b>	Understand and apply microwave measurement techniques such as power measurement, spectrum analysis, and vector network analysis.	Identify, Implement, Recognize	Apply, Understand
<b>EC - 702.6</b>	Apply the concepts learned to real-world microwave systems, including radar, satellite communications, wireless communication systems, and medical applications.	Explain, Identify, Select	Understand, Apply.

**7. Mapping of course outcomes to module / course content:**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	2	1
2	1	3		-	1	3
3	-	-	3	-	2	3
4	1	1	-	3	1	1
5	1	2	1	1	3	2
6	2	2	2	2	2	3

**8. Mapping of the Course outcomes to Program Outcomes:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	3	1	2	1	-	-	-	1	1	1	2
<b>CO2</b>	3	3	2	2	1	-	-	-	1	1	1	2
<b>CO3</b>	3	3	2	2	2	-	-	-	1	1	1	2
<b>CO4</b>	3	3	2	2	2	-	-	-	1	1	1	2
<b>CO5</b>	3	3	2	2	2	-	-	-	1	1	1	2
<b>CO6</b>	3	3	2	2	2	-	-	-	1	1	1	2

**9. Mapping to PSO:**

	PSO1	PSO2	PSO3
<b>CO1</b>	3	3	1
<b>CO2</b>	3	3	1
<b>CO3</b>	3	3	1
<b>CO4</b>	3	3	1
<b>CO5</b>	3	3	1
<b>CO6</b>	3	3	1

\*\*\* End of Syllabus\*\*\*

**Course Name: Antennas and Radar Engineering**

**Course Type: PE**

**Course Code: EC-704**

**(Semester –VII)**

**Course Broad Category: (Major)**

**1. Course Prerequisite:** Basic Knowledge of Electromagnetic Theory and Microwave Engineering is required.

**2. Course Learning Objectives:**

- i. Explain the fundamental parameters for antennas and the radiation field from an antenna using potential functions and discuss about different antenna and array antenna design.
- ii. This course describes the understanding of the components of a radar system and their relationship to overall system performance.
- iii. To become familiar with design, operation, and applications of various types of radar systems.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I (40 Marks)
- B. Continuous Internal Assessment II (40 Marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name: Antennas and Radar Engineering**

**Course Code: EC - 704**

**Hours per Week: 3L: 0T:0P**

**Credits: 3**

Module	Topics	36L
1.	<b>Fundamental Concepts-</b> Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.	8L
2.	<b>Radiation from Wires and Loops-</b> Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.	6L
3.	<b>Types of antennas-</b> Horn antenna, Helical Antenna, Reflector antennas, parabolic reflector, Micro strip Antennas.	6L
4.	<b>Antenna Arrays-</b> Array of two sources, Pattern multiplication, linear arrays, Broadside array,End fire array,planar arrays.	5L
5.	<b>Basic radar-</b> Radar equation, radar block diagram and operation, radar frequencies, applications of radar. Prediction of range performance, minimum detectable signal, receiver noise, probability density functions, signal to noise ratio, Integration of radar pulses, radar cross section of targets, radar cross section fluctuations.	6L

Module	Topics	36L
6.	<b>CW And Frequency modulated Radar:</b> Doppler Effect, CW radar, frequency modulated CW radar, air borne Doppler navigation, MTI and Pulse Doppler Radar, The radar receiver, noise figure.	5L

#### 5. References:

##### Text Book:

- C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
- J.D. Kraus, Antennas, McGraw Hill, 1988.
- Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2nd Edition, 2007.

##### Reference Books:

- R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985
- Introduction to Radar Systems – Merrill I. Skolnik, 3rd Edition, Tata McGraw-Hill, 2001.
- Radar Principals, Technology, Applications – Byron Edde, Pearson Education, 2004.

#### 6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
<b>EC - 704.1</b>	Explain the concept of antenna and different important parameters of antenna.	Explain	Understand
<b>EC - 704.2</b>	Analyze different wire antenna and its characteristics	Identify	Analyze
<b>EC - 704.3</b>	Analyse and design different types of antennas.	Identify, Design	Apply
<b>EC - 704.4</b>	Understand the operation of array antennas and analyze the antenna characteristics.	Understand	Analyze
<b>EC - 704.5</b>	To become familiar with fundamentals of radar. And analyze the knowledge about the different types of radar and their operation	Implement	Understand
<b>EC - 704.6</b>	Students acquire knowledge on the different tracking radars and radar signal detection techniques.	Design	Analyze

#### 7. Mapping of Course Outcomes (CO) to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	2	-	-
2	-	3	-	2	-	-
3	-	-	3	2	-	-
4	-	-	-	2	3	-
5	-	-	-	2	-	3

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)**

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

**9. Mapping to Program Specific Outcome(PSO)**

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-
CO5	3	-	-
CO6	3	-	-

**\*\*\* End of Syllabus\*\*\***

**Course Name: ANALOG IC DESIGN**

**Course Code: EC -705**

**Course Type: PE  
(Semester – VII)**

**Course Broad Category: (Major)**

**1. Course Prerequisite:**

Basic Electrical Circuits  
Signals and Systems  
Analog Circuits

**2. Course Learning Objectives:**

- i. This course will introduce advanced concepts in analog circuit design specifically relevant to CMOS IC design.
- ii. It will cover circuit noise and mismatch, their analysis, and their impact on CMOS op-amp design.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I - (40 marks)
- B. Continuous Internal Assessment II - (40 marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name: ANALOG IC DESIGN**

**Course Code: EC-705**

**Hours per Week: 3L: 0T:0P**

**Credits: 3**

Module	Topics	36L
1.	<b>Introduction:</b> Negative Feedback Control Negative Feedback Amplifier Step Response, Sinusoidal Steady State Response, Loop Gain And Unity Loop Gain Frequency	11L
2.	<b>Op-amp:</b> Op-amp Realization Using Controlled Sources; Delay In The Loop, Negative Feedback Amplifier With Ideal Delay Small Delays, Negative Feedback Amplifier With Ideal Delay Large Delays Negative Feedback Amplifier With Parasitic Poles And Zeros, Negative Feedback Amplifier With Parasitic Poles And Zeros ; Nyquist Criterion, Single Stage Op Amp Realization, Two Stage Miller Compensated Op-amp, Two Stage Miller Compensated, Two And Three Stage Miller Compensated Op-amps; Feed forward Compensated Op-amp, Feed forward Compensated Op-amp, Typical Op-amp Data Sheet, Op-amp Offset And Cmrr; Tran impedance Amplifier Using An Op-amp	15L
3.	<b>MOS Transistor:</b> Basics, Mismatch, Mos Transistors mismatch, Speed, Noise In Resistors, Noise In Mos Transistors; Input And Output Referred Noise, Noise Scaling; Basic Amplifier Stages Common Source, Common Gate, Basic Amplifier Stages common Drain; Frequency Response Of Amplifiers, Common Source Amplifier Frequency Response;	5L

Module	Topics	36L
4.	<b>Differential Amplifier:</b> Differential And Common Mode Half Circuits; Differential Pair With Active Load, Single Stage Op-amp Characteristics, Op-amp With Single And Dual Supplies; Single Stage Op-amp Tradeoffs, Telescopic Cascode Op-amp, Folded Cascode Op-amp, Two Stage Op-amp, Three Stage And Triple Cascode Op-amps, Common Mode Rejection Ratio	5L

**5. References:**

**Text Book:**

- Willey M.C. Sansen, Analog Design Essentials, Springer, 2006.
- Grebene, Bipolar And Mos Analog Integrated Circuit Design, John Wiley & Sons, Inc., 2003. Phillip E.Allen, Douglas R .Holberg, Cmos Analog Circuit Design, Oxford University Press, 2nd Edition, 2002.

**Reference Book:**

- Jacob Baker CMOS: Circuit Design, Layout, and Simulation, Wiley IEEE Press, 3rd Edition, 2010.

**6. Course Outcomes (CO):**

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-705.1	Design amplifiers to meet user specifications		Level 2 Understanding
EC-705.2	Analyse the frequency and noise performance of amplifiers		Level 2 Analyzing
EC-705.3	Design and analyse feedback amplifiers and one stage op amps		Level 5 Evaluating
EC-705.4	Analyse stability of op amp		Level 4 Analyzing

**7. Mapping of Course Outcomes (CO) to module / course content:**

Module	CO1	CO2	CO3	CO4
1	3	-	-	2
2	-	3	-	2
3	-	-	3	2
4	-	-	-	2
5	-	-	-	2

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)**

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

**9. Mapping to Program Specific Outcome(PSO)**

	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-

**Course Name: Adaptive Signal Processing**

**Course Code: EC - 706**

**Course Type: PE**

**(Semester –VII)**

**Course Broad Category: (Major)**

**1. Course Prerequisite:**

Subject knowledge of Linear Algebra

Signals and Systems

Digital Signal Processing

**2. Course Learning Objectives:**

- i. This course introduces the concepts about adaptive filter and their applications.
- ii. Students will also learn to design and analyze of impulse response and transfer function of unknown LTV System.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I - (40 marks)
- B. Continuous Internal Assessment II - (40 marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name:** Adaptive Signal Processing

**Course Code:** EC-706

**Hours per Week:** 3L: 0T: 0P

**Credits:** 3

Module	Topic	36L
1.	<b>Introduction to Adaptive Filters:</b> Definitions, Characteristics, Adaptive filter structures, Applications, Examples of adaptive systems. Adaptive linear combiner: General Description, Desired Response and Error, the performance function, gradient and minimum mean square error, and alternative expression of gradient.	5L
2.	<b>Wiener filter, Search methods and the LMS algorithm:</b> Wiener FIR filter (real case), Newton's type algorithm, steepest descent search and the LMS algorithm, Extension of optimal filtering to complex valued input, Complex LMS algorithm (FXLMS).	8L
3.	<b>Convergence and Stability Analyses:</b> Convergence analysis of the gradient search algorithms, learning curve and mean square error behavior, Weight error correlation matrix, Dynamics of the steady state mean square error (MSE), Mis-adjustment and stability of	5L

	excess MSE.	
4.	<b>Variants of the LMS algorithm:</b> The sign LMS family. Normalized LMS algorithm, block LMS and FFT based realization. Sparse Adaptive Filtering Technique: Proportionate Normalized LMS (PNLMS), Improved PNLMS (IPNLMS), Zero-Attracting NLMS (ZA-NLMS) and ZA-PNLMS algorithms, Block Sparse PNLMS (BS-PNLMS) algorithm, frequency domain adaptive filters, Sub-band adaptive filtering.	6L
5.	<b>Adaptive Recursive Filters and Structures:</b> Least square (LS) estimation, pseudo-inverse of a data matrix, optimality of LS estimation, adaptive recursive filters, RLS algorithm, and convergence analysis of RLS algorithm, Application of RLS algorithm, Lattice structures and adaptive lattice filters the adaptive Lattice Predictor.	6L
6.	<b>Application of Adaptive Filters:</b> Echo cancellation, Equalization of data communication channels, Linear predictive coding and Noise cancellation, Adaptive control systems: Adaptive Model control, Adaptive inverse Control. Introduction of adaptive array and adaptive beam forming, Recent advances in adaptive filtering.	6L

**5. References:**

**Text Books:**

- S. Haykin, Adaptive filter theory, Prentice Hall, 1986.
- C. Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.

**Reference Books:**

- Behrouz Farhang-Boroujeny Adaptive Filters: Theory and Applications'' Second Edition.

**6. Course Outcomes (CO):**

**After going through this course the Students will be able to:**

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-706-1	Understand adaptive systems, filter structures, performance functions, and optimization.	Concept	Understand
EC-706.2	Analyze Wiener filters, LMS algorithms, and complex optimal filtering.	Identify	Analyze
EC-706.3	Analyze gradient algorithms, learning curves, MSE dynamics, mis-adjustment, and stability.	Solve	Analyze
EC-706.4	Understand LMS variants, frequency-domain, block, and sub-band adaptive filtering.	Concept	Understand
EC-706.5	Understand LS estimation, RLS algorithm, adaptive lattice filters, and applications.	Concept	Understand
EC-706.6	Apply adaptive filtering in echo cancellation,	Implement	Apply

	communication, control, and beam forming.		
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**7. Mapping of Course Outcomes (CO) to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	1	1	-	-	-	-	-	2	-	1
<b>CO2</b>	3	2	2	2	2	2	-	-	-	2	-	1
<b>CO3</b>	3	2	2	2	2	2	-	-	-	2	-	1
<b>CO4</b>	3	2	1	1	-	-	-	-	-	2	-	1
<b>CO5</b>	3	1	1	1	-	-	-	-	-	2	-	1
<b>CO6</b>	2	1	1	1	2	2	-	-	-	2	-	1

**9. Mapping to Program Specific Outcome (PSO)**

	PSO1	PSO2	PSO3
<b>CO1</b>	3	2	1
<b>CO2</b>	3	2	-
<b>CO3</b>	3	2	-
<b>CO4</b>	3	2	-
<b>CO5</b>	3	2	-
<b>CO6</b>	3	2	-

**\*\*\* End of Syllabus\*\*\***

**Course Name: Embedded System**

**Course Code: EC-707**

**Course Type: PE  
(Semester – 7<sup>th</sup>)**

**Course Broad Category: (Major)**

**1. Course Prerequisite:**

Computer Organization and Architecture  
Digital Circuits and Logic Design

**2. Course Learning Objectives:**

- i. In this course, the students will learn about microprocessor and microcontroller architectures and their use to develop embedded systems.
- ii. Various case studies with popular development boards shall be discussed.
- iii. The course will be very helpful for students who want to apply the knowledge to develop real-life applications that involve embedded systems.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I (40 Marks)
- B. Continuous Internal Assessment II (40 Marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name:** Embedded System

**Course Code:** EC-707

**Hours per Week:** 3L:0T:0P

**Credits:** 3

Module	Topics	36L
1.	<b>Embedded Processing Systems:</b> Introduction, Components of Embedded Systems – Embedded Processor, Microcontrollers (PIC and ARM architectures), DSP and ASICs and SoC.	12L
2.	<b>Memory Devices:</b> ROM and RAM family, Interfacing Memory, Simple I/O programming, Interrupts and their servicing, Timing Devices and Interfacing, Analog I/O Techniques, Introduction to HDL, Design of Embedded Processors and Components, Design Case Studies.	10L
3.	<b>Embedded Communication:</b> Parallel Bus Standards, Serial Bus Standards, Networking Standards and Wireless Standards.	4L
4.	<b>Real Time Operating Systems (RTOS):</b> Introduction, Memory Management, I/O Management and Device Drivers, Scheduling, Introduction to Software Design: Embedded System Life Cycle, Multicore and Heterogeneous Embedded Systems.	10L

**5. References:**

**Text Books:**

- W. Wolf, Computers as Components: Principles of Embedded Computing System Design, 2<sup>nd</sup> Ed., Burlington, 2008.
- T Noergaard, Embedded Systems Architecture: A comprehensive Guide for Engineers and Prgrammers, Elsevier, Oxford, 2005.

**Reference Books:**

- Steve Heath, Embedded System Design, 2nd Edition, Newnes, Burlington, 2003.
- M. Sloss, D. Symes, and C. Wright, "ARM System Developers Guide: Designing and Optimizing System Software", (Online Resource).

**6. Course Outcomes (CO):**

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-707.1	Identify and explain the key components of embedded systems including microcontrollers (PIC and ARM), DSPs, ASICs, and SoCs.	Knowledge/Comprehension	Understand
EC-707.2	Analyze different memory types (ROM, RAM) and their interfacing techniques, and demonstrate basic I/O programming, interrupt handling, and analog I/O techniques.	Application/Analysis	Analyze
EC-707.3	Design and simulate simple embedded processors and components using Hardware Description Languages (HDLs).	Synthesis/Application	Evaluate
EC-707.4	Compare and evaluate various embedded communication standards including parallel, serial, networking, and wireless protocols.	Analysis/Evaluation	Apply
EC-707.5	Apply concepts of Real-Time Operating Systems (RTOS) for managing memory, I/O, device drivers, and task scheduling in embedded applications.	Application	Apply
EC-707.6	Develop embedded system applications by integrating software design principles with considerations for multicore and heterogeneous platforms, considering the complete embedded system life cycle.	Synthesis/Evaluation	Analyze

**7. Mapping of Course Outcomes (CO) to module / course content**

Module \ CO	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2				2
2	2	3	3			1
3				3		2
4					3	3

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)**

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

**9. Mapping to Program Specific Outcome(PSO)**

<b>CO \ PSO</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
CO1	3	3	
CO2	3	3	
CO3	3	3	
CO4	3	3	
CO5	3	3	
CO6	3	3	3

**\*\*\* End of Syllabus\*\*\***

**Course Name: Neural Network and Fuzzy Logic Control**

**Course Code: EC-708**

**Course Type: PE**

**(Semester – VII)**

**Course Broad Category: (MAJOR)**

**1. Course Prerequisite:**

Basic Mathematics  
Linear Algebra  
Probability  
Signals/Systems (recommended)

**2. Course Learning Objectives:**

- i. Introduce the foundational concepts of fuzzy sets, fuzzy relations, and approximate reasoning.
- ii. Develop the ability to design fuzzy logic systems, including rule base, database, fuzzification, and defuzzification procedures.
- iii. Provide an understanding of nonlinear and adaptive fuzzy control techniques for intelligent control applications.
- iv. Introduce biological and artificial neuron models and various neural network structures.
- v. Explain different learning strategies used in neural networks such as supervised, unsupervised, and reinforcement learning.
- vi. Expose students to real-world engineering applications of neural networks and fuzzy logic in prediction, classification, and control.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** –Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I - (40 marks)
- B. Continuous Internal Assessment II - (40 marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name: Computer Organization &Architecture**

**Course Code: EC - 708**

**Hours per Week: 3L: 0T:0P**

**Credits: 3**

Module	Topic	30L
1.	<b>Introduction to Fuzzy Logic:</b> Introduction to Fuzzy Sets – Crisp vs. Fuzzy sets, Membership Functions – Types (triangular, trapezoidal, Gaussian), Properties of fuzzy sets, Fuzzy Relations, Fuzzy relations – definition, representation, Operations on fuzzy relations, Composition of fuzzy relations, Fuzzy Reasoning & Rules, Approximate reasoning, Fuzzy if–then rules, Inference mechanisms (Mamdani, Sugeno basics)	9L
2.	<b>Fuzzy Control – Fundamentals:</b> Fuzzy control system architecture, Rule base design, Data base design, Fuzzification&Defuzzification, Fuzzification methods (crisp → fuzzy), Defuzzification procedures (centroid, MOM, SOM, weighted average), Choosing proper fuzzification and defuzzification strategies, Nonlinear & Adaptive Fuzzy Control, Nonlinear fuzzy controllers – design approach, Adaptive fuzzy systems (introduction), Model-based adaptive control.	9L

3.	<b>Introduction to Neural Networks:</b> Biological Neuron – structure & function Lecture 20: Artificial Neuron models (McCulloch–Pitts, Perceptron, Adaline), Neural activation functions, ANN Architectures, ANN structures – single layer & multilayer networks, Feedforward Networks & Backpropagation, Feedback/Recurrent Networks (overview), Learning Strategies, Learning paradigms – supervised, unsupervised, reinforcement, Learning rules – Hebbian, Delta rule, Gradient descent-based learning, Neural Network Applications, Applications in pattern recognition, Applications in control & prediction, Combined Neuro-Fuzzy Applications (ANFIS concept)	12L
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## 5. References:

### Text Books:

- S. Haykin, Neural Networks: A Comprehensive Foundation, Prentice Hall India, 2nd Ed., 1999.
- J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro-Fuzzy and Soft Computing, Pearson, 2nd Ed., 2005.

### Reference Books:

- J. A. Freeman & D. M. Skapura, Neural Networks: Algorithms, Applications, and Programming Techniques.
- S. N. Sivanandam & S. N. Deepa: Soft Computing: Fundamentals, Techniques and Applications.
- George J. Klir & Bo Yuan: Fuzzy Sets and Fuzzy Logic: Theory and Applications.

## 6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC - 708.1	Explain the concepts of fuzzy sets, fuzzy relations, and approximate reasoning.	Explain	K2 – Understanding
EC - 708.2	Design and analyze fuzzy rule-based systems including fuzzification and defuzzification methods.	Design, Analyze	K3 – Applying, K4 – Analyzing
EC - 708.3	Develop nonlinear and adaptive fuzzy controllers for intelligent control applications.	Develop	K4/K5 – Analyzing/Evaluating
EC - 708.4	Describe biological and artificial neuron models and evaluate different ANN architectures.	Describe, Evaluate	K2 – Understanding, K5 – Evaluating
EC - 708.5	Apply appropriate learning strategies to train neural networks for various tasks.	Apply	K3 – Applying
EC - 708.6	Implement fuzzy logic and neural network-based solutions for real-world engineering problems.	Implement	K4/K5 – Analyzing/Evaluating

**7. Mapping of Course Outcomes (CO) to module / course content**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	3	0	0	1
2	2	3	3	0	0	1
3	0	0	3	3	3	3

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)**

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	0	0	1	0	1	0	2
CO2	3	3	3	2	3	0	0	1	1	1	1	2
CO3	3	3	3	3	3	0	0	1	1	1	1	2
CO4	3	2	1	1	1	0	0	1	0	1	0	2
CO5	3	3	3	3	3	0	0	1	1	2	1	3
CO6	3	3	3	3	3	1	1	1	2	3	3	3

**9. Mapping to Program Specific Outcome(PSO)**

CO / PSO	PSO1	PSO2	PSO3
CO1	3	1	2
CO2	3	3	3
CO3	3	3	3
CO4	3	1	2
CO5	3	2	3
CO6	3	3	3

**\*\*\* End of Syllabus\*\*\***

**Course Name: VLSI Physical Design**

**Course Code: EC-709**

**Course Type: PE**

**(Semester – 7<sup>th</sup>)**

**Course Broad Category: (Major)**

**1. Course Prerequisite:**

Basic Electrical Engg, Basic Electronics Engg,  
Digital Electronics, Digital System Design,  
CMOS Digital VLSI Design.

**2. Course Learning Objectives:**

On completion of the course, the students will learn:

- i. Efficient floor planning & efficient placement techniques of design blocks.
- ii. Efficient clock tree & efficient routing techniques among design blocks.
- iii. To Perform timing closure & physical verification to ensure functional correctness.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** –Lectures,Presentations, Board Work, Interactive Discussions, Quiz, Assignment.

**Evaluation System –**

- A. Continuous Internal Assessment I(40 Marks)
- B. Continuous Internal Assessment II(40 Marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name:** VLSI Physical Design

**Course Code:** EC-709

**Hours per Week:** 3L: 0T:0P

**Credits:** 3

Module	Topics	36L
1.	<b>Introduction to VLSI Physical Design:</b> Front-end vs. Back-end design, Overview of Physical Design (PD) flow, Layout design rules , Standard cell layout, Cell libraries (LEF/DEF), Netlist to Layout:HDL synthesis, Technology libraries, timing libraries, Netlist formats, Design Constraints (SDC files)	6L
2.	<b>Floor Planning:</b> Die size estimation, Core vs. I/O, Macro placement, Power planning (rings/straps/grid), Placement blockages and utilization	6L
3.	<b>Placement:</b> Standard cell placement, Timing-drivenplacement, Congestion-driven placement, Legalization, Placement optimization	6L
4.	<b>Power Planning &amp; Clock Tree Synthesis:</b> Power grid design, Power Integrity: IR drop, Electro migration, Clock tree fundamentals, Skew and latency, Clock gating	6L
5.	<b>Routing:</b> Global routing, Detailed routing, Metal layers and design rules, Crosstalk and shielding, Via insertion, DRC during routing	6L

Module	Topics	36L
6.	<p><b>Timing Analysis &amp; Timing Closure:</b> STA Basics: Setup time, Hold time, Critical paths, Clock domains and constraints, Timing ECOs.</p> <p><b>Physical Verification &amp; Sign-Off:</b> DRC (Design Rule Check), LVS (Layout vs Schematic), Antenna effect, Parasitic Extraction (RC extraction), Redundant vias, dummy fill, GDSII generation, Tape-out checklist</p>	6L

#### 5. References:

##### Text Book:

- Sneh Saurabh - Introduction to VLSI Design Flow– Cambridge.
- S.M.Sait & H. Yousuf - VLSI Physical Design Automation: Theory & Practice– Cambridge.
- Sung Kyu Lim - Practical Problems in VLSI Physical Design Automation – Springer.
- Naveed Sherwani– Algorithms for VLSI Physical Design Automation- Springer.
- Sabih Gerez - Algorithms for VLSI Design Automation–Wiley.

#### 6. Course Outcomes (CO):

*On completion of the course, the students will be able to:*

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-709.1	Understand physical design flow, standard cell libraries, netlist, technology files and design rules.	Understand	Understanding
EC-709.2	Apply practical techniques for floorplanning considering chip performance, power distribution and signal integrity.	Apply	Applying
EC-709.3	Apply practical techniques for optimal placement of standard cells and macros to minimize wirelength and congestion.	Apply	Applying
EC-709.4	Apply optimize clock trees using CTS algorithms to meet skew and latency constraints.	Apply	Applying
EC-709.5	Apply different routing strategies to ensure design rule compliance and minimize timing violations.	Apply	Applying
EC-709.6	Apply physical verification techniques such as DRC, LVS, and timing analysis to ensure layout correctness.	Apply	Applying

#### 7. Mapping of Course Outcomes (CO) to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	-	-	-
3	-	-	3	-	-	-
4	-	-	-	3	-	-
5	-	-	-	-	3	-
6	-	-	-	-	-	3

#### 8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

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

### 9. Mapping to Program Specific Outcome(PSO)

COs	PSO1	PSO2	PSO3
CO1	3	1	-
CO2	3	1	-
CO3	3	1	-
CO4	3	1	-
CO5	3	1	-
CO6	3	1	-

**\*\*\* End of Syllabus\*\*\***

**Course Name: Web Technology**  
**Course Code: EC - 710**  
**Course Type: OE**  
**(Semester –7<sup>th</sup>)**  
**Course Broad Category: (Multi Disciplinary)**

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**1. Course Prerequisite:**

Basic computer literacy and an interest in problem-solving

**2. Course Learning Objectives:**

- i. Introduction to Java.
- ii. Classes, Inheritance.
- iii. Interface, Package
- iv. Exception Handling.
- v. String Handling
- vi. Java I/O Stream.
- vii. Java Utility package.
- viii. Event Handling and AWT.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I (40 Marks)
- B. Continuous Internal Assessment II(40 Marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name:** Web Technology

**Course Code:** EC-710

**Hours per Week:** 3L: 0T:0P

**Credits:** 3

Module	Topics	43L
1.	Java and Java applications, Java Virtual Machine(JVM), Java Runtime Environment(JRE)Java Development Kit(JDK,) Byte code, Java characteristics, Object oriented Programming, Simple java programs, Data types, Operators, Expressions, control statements, Selection statements, Iteration statements, Jump statements.	8L
2.	Classes in java, Declaring a class, Creating instances of class, Constructors, Argument Passing, use of static keyword, Inner class. Method overloading, Inheritance, use of super keyword, Method overriding, Abstract class, Dynamic method dispatch, use of final keyword.	6L
3.	Package, Access control mechanism, Interface, Dynamic Method look up.	3L
4.	Java Exception Handling Mechanism, try, catch, throw, throws and finally, Exception types, Built in Exceptions: checked and unchecked exceptions, User defined Exceptions.	6L

Module	Topics	43L
5.	String and String Buffer, Constructors, String operations: character extractions, String comparisons, searching, strings, modifying a string. To String () and value Of() methods, String Buffer operations.	4L
6.	I/O basics, Byte stream, Character stream, Reading console input, Writing console output, Reading and writing files	3L
7.	Collection overview, Collection interfaces, Collection classes: Array List, Linked List, Accessing a collection using, it erator and for-Each statement	3L
8.	Applet class, Applet architecture, Applet Skeleton, Life cycle methods, set Fore ground() and set Bach ground()methods, Using the status window, HTML Applet tag, Passing parameters to an applet, Get Codebase() and Get Document base() methods.	6L
9.	Delegation Event Model, Event classes, Sources of Events, Event Listener interfaces, Event handling using adapter class, Inner and anonymous class, AWT classes: Label, Button, Text Field etc.	4L

## 5. References:

### Text Book:

- Java-The Complete Reference, Herbert Schildt, 9th Edition, McGraw Hill Education 2014

### Reference Book:

- HTML- Complete Reference, Powell, 3rd Edition, TMH 2007
- Core Java-An Integrated Approach, Dr. R.Nageswara Rao, Dreamtech 2015

## 6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC - 710.1	Design good web pages using different tags, tables, forms, frames and style sheets supported by HTML.	Understand	Apply
EC - 710.2	Implement, compile, test and run Java programs, comprising more than one class, to address a particular software problem..	Identify	Analyze
EC - 710.3	Demonstrate the ability to employ various types of selection statements and iteration statements in a Java program..	Analyze	Analyzing
EC - 710.4	Be able to leverage the object-oriented features of Java language using abstract class and interface.	Analyze	Analyzing
EC - 710.5	Be able to handle errors in the program using exception handling techniques of Java.	Identify	Understanding
EC - 710.6	Design applets as per the requirements with event handling facility.	Explain	Understanding

**7. Mapping of Course Outcomes (CO) to module / course content:**

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	1	–	–	–	–
2	1	3	1	–	–	–
3	–	1	3	1	–	–
4	–	–	1	3	1	–
5	–	–	–	1	3	1

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO):**

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

**9. Mapping to Program Specific Outcome (PSO):**

COs	PSO1	PSO2	PSO3
CO1	2	1	–
CO2	3	2	–
CO3	3	2	1
CO4	3	2	2
CO5	3	3	2
CO6	3	3	3

**\*\*\* End of Syllabus\*\*\***

**Course Name: Optimization Technique**

**Course Code: EC - 711**

**Course Type: OE  
(Semester – 7<sup>th</sup>)**

**Course Broad Category: (Multi Disciplinary)**

**1. Course Prerequisite:**

Engineering Mathematics  
Basic Probability & Statistics  
Fundamentals of Algorithms / Computational Methods, Basic Programming Knowledge

**2. Course Learning Objectives:**

- i. Understand the basic concepts, need, and scope of optimization in engineering applications.
- ii. Learn and interpret various classical optimization methods, including linear and nonlinear programming techniques.
- iii. Formulate real-life engineering problems into mathematical optimization models.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I (40 Marks)
- B. Continuous Internal Assessment II (40 Marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name: Optimization Technique**

**Course Code: EC - 711**

**Hours per Week: 3L: 0T:0P**

**Credits: 3**

Module	Topics	37L
1.	<b>Introduction:</b> Optimal problem formulation, Design variables constraints, Objective function, Variable bounds, Engineering optimization problems, Optimization algorithms.	7L
2.	<b>Single-variable Optimization Algorithm:</b> Optimality Criteria, Bracketing methods: Exhaustive search methods, Region-Elimination methods; Interval halving method, Fibonacci search method, Point estimation method; Successive quadratic estimation method..	8L
3.	<b>Gradient-based Methods:</b> Newton-Raphson method, Bisection method, Secant method, Computer programmers.	6L
4.	<b>Multivariable Optimization Algorithm:</b> Optimality criteria, unidirectional search, Direct search methods: Evolutionary optimization method, Simplex search method, Hooke-Jeeves pattern search method, Cauchy's (Steepest descent) method, Newton's method, multi-objective optimization, Pareto optimization.	6L
5.	<b>Constrained Optimization Algorithm: Characteristics of a constrained problem. Direct methods:</b> The complex method, Cuttingplane method, Indirect method: Transformation Technique, Basic approach in the penalty function method, Interior penalty function method, Convex method.	5L

Module	Topics	37L
6.	<b>Advanced Optimization Algorithms:</b> Genetic Algorithm (GA), working principles, GAoperators, selection methods, advanced GAs, computer programmes, simulated annealing. Particle swarm optimization (PSO), differential evolution (DE) algorithm, bacterial foraging algorithm, ant colony optimization algorithm.	5L

## 5. References:

### Text Book:

- Optimization for Engineering Design-Algorithms & Examples – K. Deb, PHI, 2nd Ed., 2012.
- . Multi-objective Optimization Using EvolutionaryAlgorithms-K. Deb, John Wiley & Sons, 1st Ed., 2001

### Reference Book:

- Optimization: Theory and Applications - S.S. Rao, Wiley Eastern Ltd, 2nd Ed., 1979.

## 6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC - 711.1	Explain the basic concepts, importance, and scope of optimization in engineering	Explain	Understanding
EC - 711.2	Formulate real-world engineering problems into mathematical optimization models	Formulate	Applying
EC - 711.3	Apply linear programming techniques such as simplex, transportation, and assignment methods to solve optimization problems.	Apply	Applying
EC - 711.4	Analyze unconstrained and constrained nonlinear optimization methods to determine optimal solutions	Analyze	Analyzing
EC - 711.5	Evaluate and select suitable optimization methods (LP, NLP, dynamic programming, integer programming) for engineering applications	Evaluate	Evaluating
EC - 711.6	Develop optimal solutions using dynamic programming and advanced optimization tools for multi-stage decision processes	Develop	Creating

## 7. Mapping of Course Outcomes (CO) to module / course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	1	–	–	–
2	1	3	3	2	2	–
3	–	2	3	1	2	1
4	–	1	1	3	2	–
5	1	-	2	2	3	–
6	–	2	3	3	2	–

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO):**

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

**9. Mapping to Program Specific Outcome (PSO):**

COs	PSO1	PSO2	PSO3
CO1	2	1	1
CO2	3	2	1
CO3	3	3	1
CO4	2	3	2
CO5	2	3	2
CO6	2	2	3

**\*\*\* End of Syllabus\*\*\***

**Course Name: Entrepreneurship**  
**Course Code: EC - 712**  
**Course Type: OE**  
**(Semester –7<sup>th</sup>)**  
**Course Broad Category: (Multi Disciplinary)**

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**1. Course Prerequisite:**

Knowledge of English professional skill these courses are typically open to undergraduate students, often recommended for those in fourth year.

**2. Course Learning Objectives:**

- i. This course introduces the concepts about solid-state electronic components and their applications.
- ii. Students will also learn the construction, operation, and characteristics of various electronic devices, such as diodes, transistors (BJTs and MOSFETs), and other Optoelectronics devices.
- iii. This course introduces the concept of different fabrication processes for Integrated Circuits.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I (40 Marks)
- B. Continuous Internal Assessment II (40 Marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name:** Entrepreneurship

**Course Code:** EC-712

**Hours per Week:** 3L: 0T:0P

**Credits:** 3

Module	Topics	36L
1.	New Industrial Policy of 1991, Meaning and Definition of Entrepreneurship, Incentives and benefits available to SSI Units and New Entrepreneurs. Dearth of entrepreneurial talent in India, Growth of SSI in India. Procedures to start SSIs.	10L
2.	Market survey and research pricing and techniques, Distribution Channel, Sales promotion activities. Raising Finance and enterprise launching.	10L
3.	Financial Management, Working Capital Management, Costing, Book Keeping, Break-Even Analysis. Taxation: Income Tax, Excise duty, Sales tax and VAT.	10L
4.	Decision making – Types, Forecasting-Qualitative and Quantitative methods, Personal Management, Motivation and theories of motivation. Preliminary Project Report (PPR), Detailed Project Report (DPR) writing.	6L

**5. References:**

**Text Book:**

- Entrepreneurial Development S.S.Khanka. S.Chand, 2007

**Reference Book:**

- Industrial Organisation and Engg.Economics. Sharma &Banga.Khanna Publication, 2003.
- Entrepreneurship New Venture Creation. David H.Holt.Prentice Hall .PHI, 2013.

**6. Course Outcomes (CO):**

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-712.1	Know the contribution of an entrepreneur and role of SSI units in growth and development of socioeconomic condition of our country.	Understand	Apply
EC-712.2	Learn market survey, sales promotions and management of working capital through costing and book keeping..	Identify	Analyze
EC-712.3	Know different decision making technique and benefit of personal management system as well as motivational methods of an enterprise.	Analyze	Analyzing
EC-712.4	Learn how to prepare a project report and knowledge about different tax system of an enterprise.	Analyze	Analyzing

**7. Mapping of Course Outcomes (CO) to module / course content:**

Module	CO1	CO2	CO3	CO4
1	3	2	-	-
2	2	1	3	-
3	1	2	-	3
4	1	1	-	-

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO):**

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

**9. Mapping to Program Specific Outcome (PSO):**

COs	PSO1	PSO2	PSO3
CO1	3	-	-
CO2	3	-	-
CO3	3	-	-
CO4	3	-	-

\*\*\* End of Syllabus\*\*\*



**Course Name: Cyber Physical System**

**Course Code: EC-713**

**Course Type: OE**

**(Semester – VII)**

**Course Broad Category: (Multi Disciplinary)**

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**1. Course Prerequisite:**

Control systems  
Feedback principles  
Dynamical system modeling  
Basic stability analysis  
Sound understanding of signals and systems  
Continuous- and discrete-time system behavior and transforms  
Familiarity with real-time and embedded systems  
Concepts such as task scheduling  
Concurrency  
Timing constraints  
Exposure to probability and random processes  
Useful for topics related to estimation and attack detection  
Working knowledge of linear algebra and optimization techniques  
Especially quadratic programming  
Aid in controller design  
Basic familiarity with machine learning concepts  
Neural networks  
Co-requisite to support the study of AI-enabled CPS controllers

**2. Course Learning Objectives:**

- i. To understand the fundamental principles of Cyber-Physical Systems (CPS) and their distinction from conventional embedded systems through the study of interactions between physical dynamics and computational control.
- ii. To develop the ability to model, design, and analyze CPS by integrating concepts from real-time systems, control theory, and computational methods.
- iii. To expose students to real-world applications and challenges in safety-critical domains, with emphasis on system design, validation, and assurance of safety and stability.
- iv. To introduce advanced approaches, including Artificial Intelligence and neural network-based decision-making, while addressing issues of reliability, predictability, and constraint-based safety guarantees.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies, Assignments, Term paper and mini project.

**Evaluation System –**

- A. Continuous Internal Assessment I - (40 marks)
- B. Continuous Internal Assessment II - (40 marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name: Cyber Physical System**

**Course Code: EC-713**

**Hours per Week: 3L: 0T:0P**

**Credits: 3**

Module	Topics	35L
1.	<b>Introduction to CPS:</b> Definition, Scope, and Motivational Examples, CPS vs. Embedded Systems – Key Differences. Application Domains (Automotive, Healthcare, Energy, etc.). CPS Compute Platforms – Hardware Architectures and Trade-offs. Overview of CPS Design Challenges and Course Roadmap.	5L
2.	<b>Real-Time Sensing:</b> Sensors, Actuators, and Interfaces. Real-Time Communication Protocols (CAN, Flex Ray, Wireless CPS). Timing Models and Synchronization in CPS. Basics of Real-Time Scheduling – Periodic and aperiodic Tasks. Scheduling Algorithms (Rate Monotonic, EDF). Case Studies on Real-Time Task Scheduling.	6L
3.	<b>Dynamical System Modelling:</b> State-Space Representations. Stability Analysis – Continuous and Discrete Systems. Controller Design – PID and State Feedback Approaches. Delay-Aware Design – Impact of Communication and Computation Delays. Platform Effects on Stability and Performance. Case Study: Delay-Aware Control in Networked Systems.	6L
4.	<b>Hybrid Automata:</b> Modelling CPS with Continuous and Discrete States. Formal Models of Hybrid Systems. Reachability Analysis – Concepts and Techniques. Lyapunov Stability Theory – Basics and Applications. Barrier Functions – Ensuring Safety in CPS. Case Studies: Verification of Hybrid CPS Model.	6L
5.	<b>Optimization in Control:</b> Problem Formulation. Quadratic Programming Basics for Control. Applications. Safe Controller Design via Quadratic Programs. Neural Network (NN) Based Controllers – Introduction and Motivation. Safety and Stability Challenges in NN-Based Controllers. Techniques for Safe Integration of NN Controllers in CPS.	6L
6.	<b>State Estimation in CPS:</b> Motivation and Challenges. Kalman Filters – Fundamentals and Applications. Extensions of Kalman Filters (EKF, UKF) in Nonlinear CPS. Cyber security in CPS – Threat Models and Attack Surfaces. Attack Detection Techniques in CPS. Mitigation Strategies and Case Studies (Smart Grid, Automotive CPS).	6L

## 1. References:

### Text Books:

- “Principles of Cyber-Physical Systems” - Rajeev Alur.
- "Introduction to Embedded Systems — A Cyber— Physical Systems Approach" - E. A. Lee, Sanjit Seshia".

### Reference Books:

- Suh, Sang C., U. John Tanik, John N. Carbone, and Abdullah Eroglu, eds. Applied cyber-physical systems. Springer New York, 2014.
- Alur, Rajeev. Principles of cyber-physical systems. MIT Press, 2015.
- Colombo, Armando W., Thomas Bangemann, StatmatisKarnouskos, Jerker Delsing, Petr Stluka, Robert Harrison, Francois Jammes, and Jose L. Lastra. "Industrial cloud-based cyber-physical systems." The Imc-aesop Approach 22 (2014): 4-5.
- Andrew M Sloss, Dominic Symes, Chris Wright, “ARM System Developers Guide: Designing optimizing System Software” (Online resource)

## 6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC-713.1	Explain the fundamental concepts of CPS and	Explain	Remember,

	differentiate them from embedded systems.		Understand Apply
<b>EC-713.2</b>	Identify and analyze the role of sensing, communication, and scheduling in real-time CPS.	Identify	Understand, Analyze, Apply
<b>EC-713.3</b>	Identify system models and design controllers considering stability and platform constraints.	Identify, Design	Apply, Analyze, Evaluate
<b>EC-713.4</b>	Design and analyze hybrid CPS models to ensure safety and stability.	Design	Apply, Analyze, Evaluate
<b>EC-713.5</b>	Implement optimization and AI-based controllers while ensuring safety in CPS.	Implement	Understand, Apply, Analyze
<b>EC-713.6</b>	Design secure and resilient CPS by applying estimation and attack mitigation techniques.	Design	Analyze, Evaluate, Create

### 7. Mapping of Course Outcomes (CO) to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	1	1	0	0	0
2	1	3	1	0	0	0
3	0	1	3	2	1	0
4	0	0	2	3	1	0
5	0	0	1	1	3	1
6	0	0	0	1	1	3

### 8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	3	2	1	0	1	0	0	0	0	1	0	2
<b>CO2</b>	2	3	2	1	2	0	0	0	1	1	0	2
<b>CO3</b>	2	3	3	2	2	0	0	0	1	1	0	2
<b>CO4</b>	2	3	3	3	2	1	1	0	1	1	0	2
<b>CO5</b>	2	2	3	3	3	1	0	0	1	1	1	2
<b>CO6</b>	2	3	3	3	3	2	1	1	2	1	1	3

### 9. Mapping to Program Specific Outcome(PSO)

COs	PSO1	PSO2	PSO3
<b>CO1</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>CO2</b>	<b>3</b>	<b>3</b>	<b>1</b>
<b>CO3</b>	<b>3</b>	<b>2</b>	<b>1</b>
<b>CO4</b>	<b>3</b>	<b>2</b>	<b>2</b>
<b>CO5</b>	<b>2</b>	<b>3</b>	<b>2</b>
<b>CO6</b>	<b>2</b>	<b>3</b>	<b>3</b>

\*\*\* End of Syllabus\*\*\*

**Course Name: Principles of Management**

**Course Code: EC - 715**

**Course Type: HM**

**(Semester – 7<sup>Th</sup>)**

**Course Broad Category: (Value added)**

**1. Course Prerequisite:**

General awareness of how businesses and organizations work,  
Along with an interest in management practices

**2. Course Learning Objectives:**

- i. **Understand foundational management concepts** — including what “management” means, its nature (art, science, and profession), evolution of management thought, and the roles and skills of managers.
- ii. **Comprehend major management functions** such as planning, organizing, staffing, leading/directing, and controlling.
- iii. **Analyze organizational structure and design** — understanding formal vs informal organizations, departmentation, delegation, centralization/decentralization, lines of authority, etc

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology** – Lectures and Presentations, Interactive Discussions and Case Studies.

**Evaluation System –**

- A. Continuous Internal Assessment I (40 Marks)
- B. Continuous Internal Assessment II (40 Marks)
- C. End-Semester Exam (60 Marks)

**4. Course Content:**

**Course Name:** PRINCIPLES OF MANAGEMENT

**Course Code:** EC-715

**Hours per Week:** 3L: 0T:0P

**Credits:** 3

Module	Topics	35L
1.	<b>Basic concepts of management:</b> Definition - Essence, Functions, Roles, Level. Functions of Management: Planning - Concept, Nature, Types, Analysis, Management by objectives; Organisation Structure -Concept, Structure, Principles, Centralization, Decentralization, Span of Management; Organisational Effectiveness.	10L
2.	<b>Management and Society:</b> - Concept, External Environment, CSR, Corporate Governance, Ethical Standards. People Management - Overview, Job design, Recruitment & Selection, Training & Development, Stress Management. Managerial Competencies - Communication, Motivation, Team Effectiveness, Conflict Management, Creativity, Entrepreneurship.	9L
3.	<b>Leadership:</b> Concept, Nature, Styles. Decision making: Concept, Nature, Process, Tools & techniques. Economic, Financial & Quantitative Analysis - Production, Markets, National Income Accounting, Financial Function & Goals, Financial Statement & Ratio Analysis, Quantitative Methods - Statistical Interference, Forecasting, Regression Analysis, Statistical Quality Control.	10L

Module	Topics	35L
4.	<b>Customer Management:</b> - Market Planning & Research, Marketing Mix, Advertising & Brand Management. Operations & Technology Management - Production & Operations Management, Logistics & Supply Chain Management, TQM, Kaizen & Six Sigma, MIS.	6L

## 5. References:

### Text Book:

- Management: Principles, Processes & Practices - Bhat, A & Kumar, A (OUP).
- Essentials for Management - Koontz, Revised edition, Tata McGraw Hill (TMH).

### Reference Book:

- Management - Stoner, James A. F. (Pearson)
- Management - Ghuman, Tata McGraw Hill(TMH)

## 6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC - 715.1	Describe the fundamental concepts, functions, and evolution of management.	Describe	Understanding
EC - 715.2	Explain the planning process, decision-making techniques, and apply basic managerial tools in simple scenarios	Explain	Applying
EC - 715.3	Analyze different types of organizational structures, authority relationships, and departmentation to determine their suitability for various organizations.	Analyze	Analyzing
EC - 715.4	Evaluate leadership styles, motivation theories, and communication methods to solve managerial/people-related issues.	Evaluate	Explain
EC - 715.5	<b>Apply</b> controlling techniques and <b>assess</b> quality management practices (TQM, Kaizen, Benchmarking) for improving organizational performance.	Apply	Evaluating
EC - 715.6	<b>Discuss</b> the role of management in adapting to organizational change, innovation, and the external business environment	Discuss	Understanding

## 7. Mapping of Course Outcomes (CO) to module / course content:

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	1
2	1	3	1	-	-	-
3	-	1	3	1	-	1
4	-	-	-	3	1	1
5	2	-	-	-	-	3

**8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO):**

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
<b>CO1</b>	1	1	1	1	-	-	-	-	1	1	-	1
<b>CO2</b>	1	2	2	2	1	-	-	-	1	2	1	2
<b>CO3</b>	2	2	2	-	-	-	1	2	2	-	1	2
<b>CO4</b>	2	2	2	-	2	1	2	3	3	-	2	2
<b>CO5</b>	1	2	3	2	1	1	-	1	2	2	2	2
<b>CO6</b>	1	1	2	1	-	2	2	2	2	3	1	3

**9. Mapping to Program Specific Outcome (PSO):**

COs	PSO1	PSO2	PSO3
<b>CO1</b>	1	-	2
<b>CO2</b>	2	2	1
<b>CO3</b>	1	2	2
<b>CO4</b>	-	2	3
<b>CO5</b>	2	3	2
<b>CO6</b>	1	2	3

**\*\*\* End of Syllabus\*\*\***

**Course Name: Wireless Communication Laboratory**

**Course Code: EC – 791**

**Course Type: pc**

**(Semester – VII)**

**Course Broad Category: (Major)**

**1. Course Prerequisite:**

Signals and Systems: Understanding of basic signal processing techniques.

Electromagnetic Theory: Basic knowledge of electromagnetic waves and propagation.

Digital Communications: Fundamental knowledge of modulation techniques, noise analysis, and basic communication systems.

Mathematics: Proficiency in probability theory, linear algebra, and calculus.

Analog and Digital Electronics: Understanding analog and digital electronics principles for hardware implementations.

**2. Course Learning Objectives:**

- i. Demonstrate practical knowledge of wireless communication systems, including hardware and software tools.
- ii. Implement and evaluate various modulation and demodulation schemes.
- iii. Analyze and simulate the effects of wireless channels, including fading, noise, and interference.
- iv. Develop practical skills using simulation tools like MATLAB/Simulink for wireless communication systems.
- v. Gain a hands-on understanding of error detection and correction techniques.
- vi. Analyze and implement multiple access techniques in wireless communication systems.

**3. Teaching methodology and evaluation system for the course:**

**Teaching methodology: Instruction:** This method recognizes that students have different learning styles, abilities, and backgrounds, and aims to create a learning environment that accommodates these differences.

**Evaluation System –**

A. **Internal Assessment (60 Marks)**- Formative Continuous Assessment [Continuous Assessment; Note Book (30 Marks), Viva Voce (20 Marks), Attendance (10 Marks)]

B. **End-Semester Exam (40 Marks)**- Summative Assessment.

**4. Course Content:**

**Course Name:** WIRELESS COMMUNICATION LAB

**Course Code:** EC - 791

**Hours per Week:** 0L: 0T: 2P

**Credits:** 1

Module	Topics	16L
1.	<b>Digital Modulation Techniques:</b> Objective: Analyze and compare digital modulation schemes. Steps: Implement BPSK, QPSK, and 16-QAM modulation in MATLAB. Add AWGN noise to the modulated signals. Visualize the constellation diagrams. Calculate and plot the Bit Error Rate (BER) vs. Signal-to-Noise Ratio (SNR). MATLAB Functions: pskmod, qammod, awgn, scatterplot, berawgn.	2L

Module	Topics	16L
2.	<b>Simulation of Rayleigh and Rician Fading Channels:</b> Objective: Simulate fading channel effects on wireless signals. Steps: Generate a baseband signal (e.g., BPSK or QPSK). Pass the signal through Rayleigh and Rician fading channels. Analyze the received signal for different Doppler shifts and fading parameters. MATLAB Functions: rayleighchan, ricianchan, and filter.	2L
3.	<b>Performance of OFDM Systems:</b> Objective: Study the impact of multipath fading on OFDM signals. Steps: Generate an OFDM signal using multiple subcarriers. Pass the signal through a multipath fading channel. Add AWGN and visualize the received spectrum. Calculate BER for varying channel conditions. MATLAB Functions: ifft, fft, awgn, rayleighchan, comm. OF DM Modulator.	2L
4.	<b>Channel Capacity and Shannon's Theorem:</b> Objective: Verify channel capacity using Shannon's formula. Steps: Simulate a communication system with varying bandwidth and SNR. Calculate channel capacity. Plot capacity vs. SNR for different bandwidth values. MATLAB Implementation: Direct scripting using mathematical operations.	2L
5.	<b>Error Control Coding:</b> Objective: Implement and analyze convolution coding and decoding. Steps: Encode data using a convolutional code. Simulate transmission over an AWGN channel. Decode using the Viterbi algorithm. Compare BER with and without coding. MATLAB Functions: convenc, vitdec, berplot.	2L
6.	<b>Spectrum Sensing for Cognitive Radio:</b> Objective: Detect the presence of a primary user in a frequency band. Steps: Generate a primary user signal (e.g., a sinusoidal waveform). Add noise and simulate spectrum sensing using energy detection. Plot the power spectral density (PSD). MATLAB Functions: pwelch, fft, plot.	2L
7.	<b>MIMO Systems:</b> Objective: Simulate a MIMO system and analyze its capacity. Steps: Create a 2x2 MIMO channel matrix. Simulate data transmission with spatial multiplexing. Calculate the channel capacity using the SVD (Singular Value Decomposition) method. MATLAB Functions: svd, randn, log2.	2L
8.	<b>BER Performance in Fading Channels:</b> Objective: Analyze BER performance of a wireless system under fading conditions. Steps: Transmit BPSK or QPSK signals over AWGN, Rayleigh, and Rician channels. Compare the BER for different SNR values under each channel. MATLAB Functions: bertool, rayleighchan, ricianchan, qammod.	2L

## 5. References:

### Textbooks:

- T.S. Rappaport, *Wireless Communications: Principles and Practice*, Pearson Education.
- Andrea Goldsmith, *Wireless Communications*, Cambridge University Press.

### Reference Books:

- David Tse and Pramod Viswanath, *Fundamentals of Wireless Communication*, Cambridge University Press.
- Simon Haykin and Michael Moher, *Modern Wireless Communications*, Pearson Education.
- William Stallings, *Wireless Communications & Networks*, Pearson Education.

## 6. Course Outcomes (CO):

After going through this course the Students will be able to:

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
EC - 791.1	Demonstrate an understanding of fundamental wireless communication concepts through practical experiments.	Demonstrate	Understand
EC - 791.2	Implement and analyze different modulation and demodulation schemes in a wireless system.	Implement, analyze	Analyze
EC - 791.3	Evaluate wireless channel characteristics and their impact on system performance.	Evaluate	Evaluate
EC - 791.4	Apply coding and error detection techniques to enhance the reliability of wireless communication.	Apply	Apply
EC - 791.5	Explain the fundamentals of cognitive radio technology and the need for spectrum sensing in wireless communication.	Explain	Understand
EC - 791.6	Understand the fundamentals of MIMO technology and its role in modern wireless communication systems.	Understand	Understand

## 7. Mapping of Course Outcomes (CO) to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	2	3	-	-	-	-
2	2	-	3	-	-	-
3	2	-	3	-	-	-
4	2	-	3	-	-	-
5	2	-	-	3	-	-
6	2				3	
7	2					3
8	2		3			

## 8. Mapping of the Course Outcomes (CO) to Program Outcomes (PO)

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

**9. Mapping to Program Specific Outcome (PSO)**

	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>
<b>CO1</b>	2	3	-
<b>CO2</b>	2	3	-
<b>CO3</b>	2	3	-
<b>CO4</b>	2	3	-
<b>CO5</b>	2	3	-
<b>CO6</b>	2	3	-

**\*\*\* End of the Syllabus\*\*\***