NRI INSTITUTE OF TECHNOLOGY

(An Autonomous Institution Permanently Affiliated to JNTUK, Kakinada)
(Accredited by NAAC with "A" Grade and ISO 9001:2015 Certified Institution)
POTHAVARAPPADU (V), (VIA) NUNNA, AGIRIPALLI (M), PIN – 521 212

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE FOR FINAL YEAR B.TECH PROGRAMME

IV YEAR I SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	**PC**	Microwave Engineering	3	1	-	4	40	60	100	4
2	**PC**	Optical Communication	3	-	-	3	40	60	100	3
3	**PC**	Digital Image Processing	3	1	-	4	40	60	100	4
4	**PE**	**Professional Elective III** **(i)**Satellite Communications & RADAR Engineering **(ii)** Data Base Management Systems **(iii)** Embedded System Design	3	-	-	3	40	60	100	3
5	**PE**	**Professional Elective IV** **(i)** Data Communications **(ii)** Operating Systems **(iii)** Analog IC Design	3	-	-	3	40	60	100	3
6	**MC**	***Indian Constitution (MC)***	2	-	-	2	40	60	100	0
7	**PC**	Microwave Engineering & OC Lab	-	-	2	2	40	60	100	1
8	**PR**	Mini Project	-	-	8	8	40	60	100	4
Total			**17**	**2**	**10**	**29**	**320**	**480**	**800**	**22**

IV YEAR II SEMESTER

Sl. No	Course Code	Title of the Course	Scheme of Instruction (Periods Per Week)				Scheme of Examination (Maximum Marks)			No. of Credits
			L	T	P	Total	CIA	SEA	Total	
1	**PE**	**Professional Elective V (MOOCS)** **(i)**Wireless Communications and Networks **(ii)** Soft Computing Techniques **(iii)** Digital IC Design	3	-	-	3	40	60	100	3
2	**PE**	**Professional Elective VI (MOOCS)** **(i)** Computer Networks **(ii)** Internet of Things and Applications **(iii)** Artificial Intelligence	3	-	-	3	40	60	100	3
3	**PR**	Main Project and Seminar	-	-	16	16	80	120	200	8
		Total	**6**	**-**	**16**	**22**	**160**	**240**	**400**	**14**

IV Year - I Semester **L T P C**
3 1 0 4

Microwave Engineering

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	4	**External Marks:**	60

Prerequisites: Transmission Lines, Electromagnetic Field Theory

Course Objectives:

- To understand the structure, and function of the various microwave tubes as oscillators and Amplifiers.
- To learn about Microwave solid State Devices as oscillators.
- To analyze fundamental characteristics of Micro strip lines through electromagnetic field concepts.
- To understand the basic properties of waveguide components, Ferrite materials and Microwave Bench Setup for measurement of Microwave parameters.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Describe the modes of operation of Klystron tube as microwave Oscillator and amplifier with calculation of efficiency.
CO2	Analyze the modes of operation of Magnetron and TWT as microwave tubes.
CO3	Explore different modes of propagation in waveguide structures using EM field concepts.
CO4	Understand fundamental characteristics of Micro strip lines through electromagnetic field analysis.
CO5	Estimate the S-matrix for various waveguide components and analyze the splitting of the microwave energy in a desired direction.
CO6	Understand the operation of microwave Solid state devices and Measure various microwave parameters using a Microwave test bench.

Course Content(Syllabus)

UNIT I

Part-A: (O type Microwave Tubes-1)

Introduction, Microwave Spectrum and Bands, Applications of Microwaves. Microwave tubes –

O type and M type classifications. O-type tubes : Two Cavity Klystron– Structure, Principle of working ,Velocity Modulation Process and Applegate Diagram, Expressions for o/p Power and Efficiency, Applications.

Part-B: (O type Microwave Tubes-2)

Reflex Klystron – Structure, Principle of working, Velocity Modulation Process and Applegate Diagram, Mathematical Theory of Bunching, Power Output, Efficiency, Oscillating Modes, Applications.

UNIT II

Part-A: (Microwave Tubes-M type)

M-type Tubes Introduction, Magnetrons – Different Types, 8-Cavity Cylindrical Magnetron, Hull Cut-off Condition, and PI-Mode Operation. Slow Wave Structures-types, Structure of TWT, working of TWT amplifier, Applications.

Part-B: (Microwave Solid State Devices)

Microwave Solid State Devices: Introduction, Classification, Applications. TEDs – Introduction, Gunn Diode – Principle, Characteristics, Basic Modes of Operation. Avalanche Transit Time Devices – Introduction, IMPATT and TRAPATT Diodes – Principle of Operation and Characteristics.

UNIT III

Part-A: (Wave Guides)
Rectangular Waveguides – TE/TM modes, Expressions for Fields, Cut-off Frequencies, Filter Characteristics, Mode Characteristics. Circular Waveguides- Introduction, TE/TM modes, Expressions for Fields, Impossibility of TEM Waves in Hollow Waveguides.

Part-B: (Micro strip Lines)
Introduction to Strip Lines, Basic Structure of Micro strip lines, Z_o Relations, Effective Dielectric Constant, advantages of micro strip lines, losses and applications of micro strip lines.

UNIT IV

Part-A: (Wave Guide Components)
Scattering Matrix– Significance, Formulation and Properties. S-Matrix Calculations for - E-plane and H-plane Tees, Magic Tee, Directional Couplers – 2Hole, Ferrite Components–Faraday Rotation, S-Matrix Calculations for Isolator, Circulator, Related Problems.

Part-B: (Microwave Measurements)
Description of Microwave Bench – Different Blocks and their Features, Precautions; Microwave Power Measurement – Bolometer Method, Measurement of Attenuation, Frequency, Guide Wavelength, VSWR.

TEXT BOOKS:

1. Microwave Devices and Circuits – Samuel Y. Liao, PHI, 3rd Edition,1994

2.Microwave Principles – Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, CBS Publishers and Distributors, New Delhi,

REFERENCES:

1. Foundations for Microwave Engineering – R.E. Collin, IEEE Press, John Wiley, 2nd Edition, 2002.
2. Microwave Engineering - David M. Pozar,Wiley publications,4th Edition
3. Microwave Engineering- Annapurna Das and Sisir K.Das, Mc Graw Hill Education, 3rd Edition.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	3
CO2	2	2	-	2	-	3	-	-	-	-	-	-	2	-
CO3	3	3	-	-	3	-	-	-	3	-	2	-	-	-
CO4	3	3	-	2	-	-	-	-	-	-	-	-	-	3
CO5	2	2	-		-	-	2	-	-	-	-	2	-	--
CO6	-	2	-	2	-	-	-	-	-	2	-	-	-	3

IV Year - I Semester **L T P C**
3 0 0 3

OPTICAL COMMUNICATION

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Engineering physics, Analog Communications, Digital Communication.

Course Objectives:

- Analyze and design optical communication and fiber optic sensor systems.
- Understand the properties of optical fiber that affect the performance of a communication link and types of fiber materials with their properties and the losses occur in fibers.
- Analyze the principles of single and multi-mode optical fibers and their characteristics.
- Working of semiconductor lasers, differentiate between direct modulation and external electro-optic modulation. Analyze the operation of LEDs, laser diodes, PIN, photo detectors (spectral properties, bandwidth, and circuits) and apply in optical systems.
- Design the functionality of each of the components that comprise a fiber optic communication system, the models of analog and digital receivers.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the overview of optical fiber communication and classify the types of optical fibers, analyze cylindrical fibers using mathematical equations.
CO2	Design the optical fibers using various materials and to illustrate various attenuation losses.
CO3	Illustrate various dispersion models Apply splicing techniques on fibers and choose low loss connectors to minimize joint losses.
CO4	Analyze different types of optical sources and photo detectors, External quantum efficiency, and analyze signal transmission, receiver operation and error sources of optical fiber.
CO5	Evaluate the power coupled in to optical fibres and Measurement of Attenuation and Dispersion, Eye pattern.
CO6	Design optical system with budget analysis and to classify principles and types of WDM.

Course Content(Syllabus)

UNIT I

PART A: Overview of optical fiber communication – Historical development, The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Total Internal Reflection, Acceptance angle, Numerical Aperture, Skew rays, Cylindrical fibers- Modes, V-number, Mode coupling, Step Index fibers, Graded Index fibers, Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index, Related problems.

PART B: Fiber materials– Glass, Halide, Active glass, Chalgenide glass, Plastic optical fibers. **Fiber losses**-Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses

UNIT II

PART A: Signal distortion in optical fibers - Information capacity determination, Group delay, Types of Dispersion-Material dispersion, Wave-guide dispersion, Polarization-Mode dispersion, Intermodal dispersion, related problems.

PART B: Optical fiber Connectors-Connector types, Single mode fiber connectors, Connector return loss, **Fiber Splicing**- Splicing techniques, Splicing single mode fibers, **Fiber alignment and joint loss**- Multimode fiber joints, single mode fiber joints.

UNIT III

PART A: Optical sources - LEDs, Structures, Materials, Internal and External Quantum efficiency, Modulation, Power bandwidth product. **Laser Diodes**- Fabry perot resonator cavity Laser diode, Distributed feedback (DFB) Laser diode, Reliability of LED & ILD

PART B: Optical detectors - Physical principles of PIN and APD, Comparison of Photo detectors. Photo detector Noise, related problems **Optical receiver operation**- Digital signal transmission through optical data link, error sources in optical pulse detection mechanism, Receiver configuration, Digital receiver performance

UNIT IV

PART A: Source to fiber power launching – Source Output pattern, Power coupling calculations, Power launching versus wavelength, Equilibrium Numerical Aperture, Lansing schemes for coupling improvement, Measurement of Attenuation and Dispersion in optical fibers, Eye pattern.

PART B: Optical system design – Point-to- point links- Component choice and considerations, Link power budget with examples, Rise time budget with examples, Line coding in Optical links, Wavelength Division Multiplexing

TEXT BOOKS:

1. Optical Fiber Communications – Gerd Keiser, Mc Graw-Hill International edition, 3rd Edition, 2000.
2. Optical Fiber Communications – John M. Senior, PHI, 2nd Edition, 2002.

REFERENCES:

1. Fiber Optic Communications: D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner, Pearson Education, 2005.
2. Optical Fiber Communication and its Applications – S.C.Gupta, PHI, 2005.
3. Fiber Optic Communication Systems – Govind P. Agarwal , John Wiley, 3rd Edition, 2004.
4. Fiber Optic Communications – Joseph C. Palais, 4th Edition, Pearson Education, 2004.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	3	-	-	-	-	-	-	2	-	-	3	-	-
CO2	-	2	3	-	-	3	-	-	-	-	2	-	-	**3**
CO3	3	-	3	-	3	-	3	-	-	3	-	-	-	-
CO4	-	2	-	-	2	-	-	-	-	-	-	3	-	**2**
CO5	-	-	2	3	-	-	-	2	-	-	-	-	**3**	-
CO6	2	-	2	3	-	-	-	-	-	2	-	-	-	-

IV Year - I Semester **L T P C**
3 1 0 4

DIGITAL IMAGE PROCESSING

Lecture – Tutorial:	3-1 Hours	**Internal Marks:**	40
Credits:	4	**External Marks:**	60

Prerequisites: Mathematics I & II, Engineering Physics, Linear integrated circuits, Signals and Systems, Analog Communications, Digital Signal Processing.

Course Objectives:

- To introduce the concepts of image processing and basic analytical methods to be used in image processing.
- To familiarize students with image enhancement.
- To introduce different image restoration techniques.
- To introduce the concepts of colour image processing.
- To familiarize the students with image compression techniques.
- To introduce morphological processing and segmentation techniques.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the fundamentals of image processing, necessity for transforms, DFT and its properties, DCT.
CO2	Evaluate techniques for image enhancement.
CO3	Estimate the degradation of an image and apply appropriate restoration techniques.
CO4	Understand the need for colour image processing and learn the fundamentals of colour image processing.
CO5	Understand the need for image compression and learn different techniques to compress image.
CO6	Interpret morphological processing and implement different techniques to segment an image.

Course Content(Syllabus)

UNIT I

PART A: Introduction: Introduction to digital image processing, Fundamental steps in digital image processing, components of an image processing system, Image sensing and acquisition, Representing digital images, Some basic relationships between pixels, An introduction to the mathematical tools used in digital image processing.

PART B: Image transforms and Intensity transformations : Need for transforms, DFT with one variable and two variables, Properties of 2D Discrete Fourier transform, Discrete cosine transform, Basics of intensity transformations and spatial filtering, Some basic intensity transformation functions, Histogram processing.

UNIT II

PART A: Filtering in spatial and frequency domain: Fundamentals of spatial filtering, smoothing spatial filters, sharpening spatial filters Image smoothing and sharpening using frequency domain filters, Selective filtering in frequency domain filters.

PART B: Image Restoration: A model of the image degradation / Restoration process, Restoration in the presence of noise only Spatial Filtering, Periodic Noise Reduction by frequency domain filtering, Linear, Position –Invariant Degradations, Estimation the

degradation function, Inverse filtering, Minimum mean square error(Wiener) filtering.

UNIT III

PART A: Color image processing: Color fundamentals, color models, pseudo color image processing, basics of full color image processing, color transformations, smoothing and sharpening. Image segmentation based on color.

PART B: Image compression: Fundamentals, Basic compression methods: Huffman coding, Arithmetic coding, LZW coding, Run-Length coding, symbol based coding, Predictive coding , Wavelet coding, color image compression.

UNIT IV

PART A: Morphological Image Processing: Preliminaries, Erosion and dilation, opening and closing, The Hit or miss transformation, Some basic morphological algorithms, Gray scale morphology, Some basic gray scale morphological algorithms.

PART B: Image segmentation: Fundamentals, point, line, edge detection, Basic edge detection, thresholding, region –based segmentation.

TEXT BOOKS:

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.
2. Jayaraman, S. Esakkirajan, and T. Veerakumar," Digital Image Processing", Tata McGraw-Hill Education, 2011.

REFERENCES:

1. Anil K.Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India, 9th Edition, Indian Reprint, 2002.
2. B.Chanda, D.Dutta Majumder, "Digital Image Processing and Analysis", PHI, 2009.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	2	-	-	-	-	3	-	-	-	-	-	-	-
CO2	3	2	-	2	2	-	-	-	-	-	-	-	-	3
CO3	-	3	2	-	-	3	-	-	-	-	-	-	3	-
CO4	3	2	-	3	-	-	-	3	1	-	-	-	-	-
CO5	-	3	2	-	-	-	-	-	-	2	-	-	3	-
CO6	-	2	-	3	2	-	-	-	-	3	-	-	-	-

IV Year - I Semester **L T P C**

3 0 0 3

PROFESSIONAL ELECTIVE – III
SATELLITE COMMUNICATIONS & RADAR ENGINEERING

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Digital Communication, Cellular mobile Communication, Optical communication, Signals and Systems, Analog Communications, Electromagnetic Theory, Antennas and Wave Propagation.

Course Objectives:

- To understand the basic concepts, applications, frequencies used and types of satellite communications.
- To analyze various satellite subsystems and their functionality.
- To familiarize with the concepts of satellite link design and calculation of C/N ratio.
- To understand the concepts of satellite navigation, architecture and applications of GPS.
- To gain knowledge about the basics of RADAR and its parameters.
- To learn about different types of Radars and their applications.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the concepts of satellite communications and to analyze the orbital mechanics and launching vehicles.
CO2	Acquire knowledge about various satellite subsystems and basic transmission theory.
CO3	Understand the basic concepts of satellite uplink and downlink design and to analyze the principles of satellite navigation and Global positioning system.
CO4	Acquire the knowledge of Radar system to apply and to design required parameters for a RADAR system and to derive the RADAR Equation.
CO5	Analyze the working principle of CW and Frequency Modulated Radar and their applications.
CO6	Analyze different types of tracking RADARs and to study different types of Radar receivers and displays.

Course Content(Syllabus)

UNIT I

PART A: Introduction: Basic Concepts of Satellite Communications, Frequency allocations for Satellite Services, Applications, Future Trends of Satellite Communications.

PART B: Orbital Mechanics And Launchers: Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance.

UNIT II

PART A: Satellite Subsystems: Attitude and orbit control system, telemetry, tracking, Command and Monitoring, power systems, communication subsystems, Satellite antenna Equipment reliability and Space Qualification.

PART B: Satellite Link Design: Basic transmission theory, system noise temperature and G/T ratio, Design of down links, up link design, Design of satellite links for specified C/N.
Satellite Navigation and Global positioning system- Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers and codes, GPS Navigation Message, GPS signal levels, GPS receiver operation, Differential GPS.

UNIT III

PART A: Introduction to Radar: Introduction, Maximum Unambiguous Range, simple Radar range Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Illustrative Problems.

PART B: CW and Frequency Modulated Radar: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, FM-CW Altimeter, Illustrative Problems.

UNIT IV

PART A: Introduction to MTI Radar: Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, **Tracking with Radar**- Sequential Lobing, Conical Scan, Mono pulse Tracking Radar – Amplitude Comparison Mono pulse (one- and two-coordinates).

PART B: Radar Receivers: Displays – types. Duplexers – Branch type and Balanced type, Circulators as Duplexers.

TEXT BOOKS:

1.Satellite Communications – Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003.

2. Satellite Communications Engineering – Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud, 2nd Edition, Pearson Publications, 2003.

3. Introduction to Radar Systems – Merrill I. Skolnik, TMH Special Indian Edition, 2nd Ed., 2007.

4. Radar Engineering and fundamentals of Navigational Aids-G.S.N.Raju,I.K International, 2008.

REFERENCES:

1. Satellite Communications: Design Principles – M. Richharia, BS Publications, 2nd Edition, 2003.

2. Satellite Communications – Dennis Roddy, McGraw Hill, 2nd Edition, 1996.

3. Satellite Communication – D.C. Agarwal,Khanna Publications,5th edition.

4. J.C.Toomay, Paul J. Hannen "Principles of Radar", PHI Learning.

5. Radar: Principles, Technology, Applications – Byron Edde, Pearson Education, 2004.

6. Radar Principles – Peebles, Jr., P.Z., Wiley, New York, 1998.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	2	-	-	3	-	-	-	-	-	-	-	2	-
CO2	-	3	2	-	-	2	-	-	-	-	-	-	-	-
CO3	3	2	-	3	-	-	-	-	3	-	-	2	-	2
CO4	-	3	-	2	-	-	-	-	-	-	2	-	-	2
CO5	3	2	3	-	-	-	-	-	-	-	-	2	-	-
CO6	2	3	-	-	-	-	2	-	-	-	-	-	-	3

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - III

DATABASE MANAGEMENT SYSTEMS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Fundamental knowledge on C, C++, SQL and basic functions of database systems.

Course Objectives:

- To learn the principles of systematically designing and using large scale Database Management Systems for various applications.
- To understand query processing and techniques involved in query optimization.
- To understand the principles of storage structure and recovery management.
- To understand the concepts of transaction management and concurrency control.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Describe a relational database and object-oriented database.
CO2	Create, maintain and manipulate a relational database using SQL.
CO3	Describe ER model and normalization for database design.
CO4	Examine issues in data storage and query processing and can formulate appropriate solutions.
CO5	Understand the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage.
CO6	Design and build database system for a given real world problem.

UNIT I

PART A: An Overview of Database Management: Introduction- What is Database System- What is Database-Why Database- Data Independence- Relation Systems and Others- Summary.

PART B: Database system architecture, Introduction: The Three Levels of Architecture-The External Level- the Conceptual Level- the Internal Level- Mapping- the Database Administrator- The Database Management Systems- Client/Server Architecture.

UNIT II

PART A: The E/R Models: The Relational Model, Relational Calculus, Introduction to Database Design, Database Design and Er Diagrams-Entities Attributes, and Entity Sets-Relationship and Relationship Sets-Conceptual Design With the Er Models, The Relational Model Integrity Constraints Over Relations.

PART B: Key Constraints: Foreign Key Constraints-General Constraints, Relational Algebra and Calculus, Relational Algebra- Selection and Projection- Set Operation, Renaming – Joins- Division- More Examples of Queries, Relational Calculus, Tuple Relational Calculus- Domain Relational Calculus.

UNIT III

PART A: Queries, Constraints, Triggers: The Form of Basic SQL Query, Union, Intersect, and Except, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and Active Database.

PART B: Transaction Management and Concurrency Control: Transaction, properties of transactions, transaction log, and transaction management with SQL using commit rollback and save point, Concurrency control for lost updates, uncommitted data,

inconsistent retrievals and the Scheduler.

UNIT IV

PART A: Concurrency control with locking methods : lock granularity, lock types, two phase Locking for ensuring serializability, deadlocks, Concurrency control with time stamp ordering: Wait/Die and Wound/Wait Schemes, Database Recovery management: Transaction recovery.

PART B: Overview of Storages and Indexing: Data on External Storage- File Organization and Indexing –Clustered Indexing – Primary and Secondary Indexes, Index Data Structures, Hash-Based Indexing – Tree-Based Indexing, Comparison of File Organization.

TEXT BOOKS:

1. Introduction to Database Systems, CJ Date, Pearson.
2. Data base Management Systems, Raghurama Krishnan, Johannes Gherkin, TATA McGraw
Hill 3rd Edition
3. Database Systems - The Complete Book, H G Molina, J D Ullman, J Widom Pearson

REFERENCE BOOKS:

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education.
3. Introduction to Database Systems, C.J.Date Pearson Education.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	2	3	-	-	2	-	-	-	-	-	3	-	-	-
CO3	-	-	3	-	2	-	-	-	3	-	-	-	3	-
CO4	3	-	3	-	-	-	-	2	-	-	-	-	2	-
CO5	3	-	2	-	-	2	-	-	-	-	-	-	-	-
CO6	-	-	3	-	-	-	-	-	-	-	-	2	-	-

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE - III

EMBEDDED SYSTEM DESIGN

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Operating Systems, Microcontrollers, C Programming.

Course Objectives:

- Provide in-depth knowledge about embedded systems embedded processors, and its hardware and software.
- Explain design metrics or challenges in designing an embedded system.
- Explain real time operating systems, inter task communication and an embedded software development tools.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Analyze the differences between general computing system and the embedded systems, also recognize the classification of embedded systems, core of the embedded systems and need for communication interfaces.
CO2	Understand design approaches of embedded hardware and firmware.
CO3	Know about RTOS, RTOS principles, kernel, tasks, threads, multitasking and multiprocessing.
CO4	Understand kernel objects; inter task communication-pipes, signals, message queues, dead lock, and live lock.
CO5	Apply embedded software development tools, understand unique design problems and challenges of real time systems.
CO6	Understand ARM processor architecture and register organization of ARM.

Course Content(Syllabus)

UNIT I

PART A: INTRODUCTION TO EMBEDDED SYSTEMS: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.

PART B: TYPICAL EMBEDDED SYSTEM: Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.

UNIT II

PART A: EMBEDDED HARDWARE DESIGN: Analog and digital electronic components, I/O types and examples, Timer and counting devices, Watchdog timer, Real time clock.

PART B: EMBEDDED FIRMWARE DESIGN: Embedded Firmware design approaches, Embedded Firmware development languages, ISR concept, Interrupt sources, Concepts of C versus Embedded C and Compiler versus Cross-compiler.

UNIT III

PART A: REAL TIME OPERATING SYSTEM: Operating system basics, Types of operating systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Threads, Processes and Scheduling, Task communication, Task synchronisation.

PART B: HARDWARE SOFTWARE CO-DESIGN: Fundamental Issues in Hardware Software Co-Design, Computational models in embedded design, Hardware software Trade-offs.

UNIT IV

PART A: Embedded System Development And Testing: The integrated development environment, Types of files generated on cross-compilation, Simulators, Emulators and Debugging, Target hardware debugging, testing on host machine, Embedded Software development process.

PART B: Advanced RISC Machine: Features of ARM, Architecture of ARM, Modes of ARM, Register Organization of ARM, CPSR, Instruction set, Exception handling in ARM, ARM Families.

TEXT BOOKS:

1. Embedded Systems Architecture- By Tammy Noergaard, Elsevier Publications, 2013.
2. Embedded Systems-By Shibu.K.V-Tata McGraw Hill Education Private Limited, 2013.
3. Embedded Systems-By Shibu.K.V-Tata McGraw Hill Education Private Limited, 2013.
4.ARM System on Chip Architecture – Steve Furber –2nd Eed., 2000, Addison Wesley Professional

REFERENCES:

1. Embedded System Design, Frank Vahid, Tony Givargis, John Wiley Publications, 2013.
2.Embedded Systems-Lila Beda's-Pearson Publications, 2013

SWAYAM/NPTEL/MOOCS Courses

1. https://nptel.ac.in/courses/108/102/108102045/
2. https://nptel.ac.in/courses/106105193/

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	2	3	-	-	-	-	-	-	-	2	-	-	3	-
CO2	-	-	3	-	2	-	-	3	-	-	-	-	-	3
CO3	2	-	-	3	3	-	1	-	-	-	-	3	-	-
CO4	-	2	2	-	-	-	-	-	-	-	-	-	3	2
CO5	3	-	-	-	-	2	-	-	-	-	-	-	3	-
CO6	-	3	-	2	2	-	-	-	2	-	-	-	--	-

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE-IV
DATA COMMUNICATIONS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Analog Communication, Digital Communication.

Course Objectives:

- To learn about basics of Data Communication networks, different protocols, standards and layering concepts.
- To know circuits for serial and parallel Data transmission.
- To study about error detection and correction techniques.
- To describe character synchronization and explain the differences between asynchronous and synchronous data formats.
- To understand Data-Link Protocols and Data Communications Networks,
- Define and describe the Congestion Control and Quality of Service in Data communication traffic control.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the concepts of Data Communication networks, different protocols, Standards and layering.
CO2	Analyze open systems interconnection model and various Data Communication circuits.
CO3	Explore the error investigation techniques in data transmission process.
CO4	Demonstrate the character synchronization and explain the differences between asynchronous and synchronous data formats.
CO5	Analyze different Data-Link Protocols and Data Communications Networks.
CO6	Elaborate the Congestion control and Quality of Service in Data traffic control.

Course Content(Syllabus)

UNIT I

Data Communications and Networking:

Part-A: Introduction, Data Communications Network Architecture, Data Communications Protocols, and Standards, Layered Network Architecture, Protocol data unit.

Part-B: Open Systems Interconnection, Data Communications Circuits, Serial and Parallel Data Transmission, Data Communications Circuit Arrangements, Circuit configurations, Transmission modes, Data Communications Networks, components, functions, features, network models.

UNIT II

Fundamental Concepts of Data Communications:

Part-A: Introduction, Error Control, Error Detection, redundancy checking, Error Correction, retransmission, Forward error correction, hamming code, examples.

Part-B: Character Synchronization, Asynchronous serial data, synchronous serial data, Data Communications Circuits, Data Communications Modems, block diagram, modem classifications,

Asynchronous and synchronous voice band modems.

UNIT III

Data-Link Protocols and Data Communications Networks

Part-A: Introduction, Data-Link Protocol Functions, Line discipline, flow control, error control, Character- and Bit-Oriented Data-Link Protocols, Asynchronous Data-Link Protocols, X-modem, Y-modem Synchronous Data-Link Protocols, binary synchronous communications.

Part-B : Synchronous Data-Link Control, Frame format, loop operation, message abort, Invert on zero encoding, High-Level Data-Link Control, subdivisions, information field, elements of procedure.

UNIT IV

Congestion Control and Quality of Service (QoS)

Part-A: Data traffic, congestion, congestion control-open loop and closed loop, congestion control in TCP and congestion control in frame relay.

Part-B: Flow Characterization, Flow Classes, Need For QoS, Techniques to improve QoS, scheduling, traffic shaping, resource reservation and admission control, integrated and differentiated Services.

TEXT BOOKS:

1. Advanced Electronic Communication Systems – W.Tomasi, 6th ed. 2014, PEI.
2. Data Communications and Networking – B.A.Forouzan, 4th ed.2008, TMH.
3. Data Communications and Computer Nerworks – Prakash C.Gupta, 2006, PHI.

REFERENCES:

1 Data and Computer Communications – William Stallings, 8th ed.2007, PHI
2. Computer Networks by Andrew S. Tanenbaum

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	-	2	-	-	-	-	-	-	-	-	2	-	-
CO2	-	3	3	-	-	-	2	2	-	-	-	-	-	-
CO3	2	3	-	3	-	-	-	-	-	-	-	-	-	3
CO4	2	-	3	-	-	-	-	-	-	-	2	-	-	2
CO5	-	3	2	-	-	2	-	2	-	-	-	-	3	
CO6	3	2	2		-	-	-	-	-	-	-	-	-	3

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE-IV
OPERATING SYSTEMS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Basic Hardware and Software concepts of Computer Systems and Organization.

Course Objectives:

- Study the basic concepts and functions of operating systems.
- Understand the structure and functions of OS.
- Learn about Processes, Threads and Scheduling algorithms.
- Understand the principles of concurrency and Deadlocks.
- Learn various memory management schemes.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Design various Scheduling algorithms.
CO2	Apply the principles of concurrency.
CO3	Design deadlock, prevention and avoidance algorithms.
CO4	Compare and contrast various memory management schemes.
CO5	Design and Implement a prototype file systems.
CO6	Perform administrative tasks on Servers.

Course Content(Syllabus)

UNIT I

PART A: Introduction to Operating System Concept: Types of operating systems, operating systems Concepts, operating systems services, Introduction to System call, System call types.

PART B: Process Management – Process concept, The process, Process State Diagram , Process control block, Process Scheduling- Scheduling Queues, Schedulers, Operations on Processes,
Interprocess Communication, Threading Issues, Scheduling-Basic Concepts, Scheduling Criteria,
Scheduling Algorithms.

UNIT II

PART A: Memory Management: Swapping, Contiguous Memory Allocation, Paging, structure of the Page Table, Segmentation.

PART B: Virtual Memory Management:
Virtual Memory, Demand Paging, Page-Replacement Algorithms, Thrashing.

UNIT III

PART A: Concurrency: Process Synchronization, The Critical- Section Problem, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization
Examples.

PART B: Principles of deadlock – System Model, Deadlock Characterization, Deadlock Prevention,

Detection and Avoidance, Recovery form Deadlock

UNIT IV

PART A: File system Interface- the concept of a file, Access Methods, Directory structure, File system mounting, file sharing, protection.

PART B: File System implementation- File system structure, allocation methods, free-space management
Mass-storage structure overview of Mass-storage structure, Disk scheduling, Device drivers.

TEXT BOOKS:

1.Operating System Concepts, Abraham Silberschatz, Peter Baer Galvin and Greg Gagne 9th Edition, John Wiley and Sons Inc., 2012.
2. Operating Systems – Internals and Design Principles, William Stallings, 7th Edition, Prentice Hall, 2011.
3. Operating Systems-S Halder, Alex A Aravind Pearson Education Second Edition 2016.

REFERENCES:

1. Modern Operating Systems, Andrew S. Tanenbaum, Second Edition, Addison Wesley, 2001.
2. Operating Systems: A Design-Oriented Approach, Charles Crowley, Tata Mc Graw Hill Education", 1996.
3. Operating Systems: A Concept-Based Approach, D M Dhamdhere, Second Edition, Tata Mc Graw-Hill Education, 2007.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	3	2	-	-	2	-	-	-	-	-	-	-	2
CO3	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO4	-	2	-	2	-3	-	-	-	-	-	-	-	-	-
CO5	2	-	3	-	-	-	-	-	-	-	-	2	3	-
CO6	-	3	2	-	-	-	-	-	-	-	-	-	-	-

IV Year - I Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE-IV
ANALOG IC DESIGN

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Electronic Devices and circuits, Linear IC Applications.

Course Objectives:

Understand the behavior of MOS Devices and Small-Signal & Large-Signal Modeling of MOS Transistor and Analog Sub-Circuits.

Study CMOS Amplifiers like Differential Amplifiers, Cascade Amplifiers, Output Amplifiers, and Operational Amplifiers.

Design and to develop the Analog CMOS Circuits for different Analog operations.

Understand the concepts of Sample and Hold circuits and Open-Loop Comparators.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the knowledge of MOS devices and modeling.
CO2	Use different styles of CMOS Circuit modelling to synthesize analog ICs.
CO3	Apply appropriate biasing techniques to improve performance of analog circuits.
CO4	Design and Develop Analog Integrated Circuits using MOS Transistor.
CO5	Design and Develop CMOS Op Amps.
CO6	Assess the performance of sample and hold circuits and comparators in analog ICs suitable for societal use.

Course Content(Syllabus)

UNIT I

PART A: Basic MOS Devices: The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, Latch up in CMOS Technology, Short Channel Effects in MOS Transistors.

PART B: CMOS Device Modelling: Weak Inversion in MOS Transistors Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Sub-threshold MOS Model.

UNIT II

PART A: Current Mirrors: Current Sinks and Sources, Simple Current Mirrors, Simple Current Mirror with Source Degeneration, Cascode Current Mirror and Wilson Current Mirror.

PART B: Biasing Techniques: CS Biasing, CG Biasing, Source Follower Biasing, Differential Pair Biasing.

UNIT III

PART A: Single Stage Amplifiers: Common Source Stage with resistive load, Source follower, Common Gate Stage, Cascode Stage.

PART B: CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

UNIT IV

PART A: Sample and Hold Circuits:

Performance of Sample and Hold Circuits, MOS Sample and Hold Basics, Examples of CMOS S/H circuits, Bipolar and BICMOS Sample and Hold circuits.

PART B:Comparators:

Using an Opamp for a Comparator, Charge-Injection Errors, Latched Comparators, Examples of CMOS and BiCMOS Comparators.

TEXT BOOKS:

1. Design of Analog CMOS Integrated Circuits, Behzad Razavi, Tata McGraw Hill, 2nd Edition, 2008.

2.Analog Integrated Circuit Design- David A.Johns, Ken Martin, Wiley Student Edn, 2013.

REFERENCES:

1. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.

2.CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	-	-	-	2	-	-	2	-	-	-	-	3	-
CO2	-	-	2	-	3	-	3	-	-	-	-	3	-	3
CO3	3	3	-	-	-	-	-	-	-	-	2	-	2	-
CO4	-	-	3	3	-	-	-	-	3	-	-	-	-	-
CO5	-	2	-	-	3	-	-	-	-	2	-	-	-	-
CO6	3	2	-	-	-	3	-	-	-	-	-	3	-	-

IV Year - I Semester **L T P C**
3 0 0 0

MANDATORY COURSE
INDIAN CONSTITUTION

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	0	**External Marks:**	60

Prerequisites: Civics, Basics of Political Science.

Course Objectives:

- Understand the importance of constitution.
- Understand the structure of executive, legislature and judiciary.
- Understand philosophy of fundamental rights and duties.
- Understand the central and state relations, financial and administrative duties.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the meaning, history, features and characteristics of Indian Constitution.
CO2	Gain knowledge on fundamental rights duties and Principles and importance of State Policy.
CO3	Understand the powers of Union, the States and Indian President.
CO4	Know about amendments of the constitution and Emergency Provisions.
CO5	Understand the functioning of three wings of the government i.e., executive, legislative and judiciary.
CO6	Analyze the decentralization of power between central, state and local self-government.

Course Content(Syllabus)

UNIT I

Meaning of the constitution law and constitutionalism, Historical perspective of the constitution of India, Salient features and characteristics of the constitution of India.

UNIT II

Fundamental Rights under Indian constitution, scheme of the fundamental Rights, Scheme of the fundamental Right to Equality, Scheme of the fundamental Right to certain freedoms under Article 19 Scope of the right to life and personal Liberty under Article 21.

UNIT III

Federal structure and distribution of legislative and financial powers between the union and the states, Parliamentary form of government in India-the constitution powers and status of the President of India, Amendment of the constitutional powers and procedure, The historical perspectives of the constitutional amendments in India, Local self government-Constitutional Scheme in India.

UNIT IV

Emergency Provisions, National Emergency, President Rule, Financial Emergency
Statutory Institutions: Elections-Election Commission of India, National Human Rights Commission, National Commission for Women.

TEXT BOOKS:

1.The Constitution of India‖, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar, —*Framing of Indian Constitution* , 1st Edition, 2015.

REFERENCES:

1.M. P. Jain, —*Indian Constitution Law*‖, 7th Edition., Lexis Nexis, 2014.
2.D.D. Basu, —*Introduction to the Constitution of India*‖, Lexis Nexis, 2015.
3. SubhashKashyap, Our Parliament, National Book Trust, New Delhi

4. Peu Ghosh, Indian Government &Politics, Prentice Hall of India, New Delhi
5. B.Z. Fadia&KuldeepFadia, Indian Government &Politics, Lexis Nexis, New Delhi

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	2	-	-	-	3-	-	-	-	-	-	-	-	-
CO2		3	2	-	-	-	-	2	-	-	-	-	-	-
CO3	3	-	2	-	-	-	3	-	3	-	-	2	-	-
CO4	-	-	3	-	-	-	-	2	-	-	-	2	-	-
CO5		2	-	3	-	-	-	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-		-	-

IV Year - I Semester **L T P C**
0 0 2 1

Microwave Engineering and Optical Communication lab

Minimum 10 experiments should be conducted.
{ 6 experiments from part A and 4 experiments from part B}

Pre-Requisites: Analog Communication and Digital Communication.

Course Outcomes: The Students will be able to

- Verify characteristics of various microwave sources by conducting experiments with microwave bench setup.
- Analyze various parameters of Waveguide Components by conducting experiments with microwave bench setup.
- Estimate the power measurements of RF Components such as directional Couplers and circulators.
- Demonstrate characteristics of various optical sources by conducting experiments.
- Analyze the characteristics of optical fiber by conducting experiments and measuring various parameters.
- To demonstrate the Working of various Microwave Devices and components through microwave bench setup.

Part-A

Microwave Communications (Any Six Experiments)

1. Characteristics of the Reflex Klystron Tube

2. Characteristics of Gunn Diode

3. Determination of Voltage Standing Wave Ratio (**VSWR**)

4. Waveguide Parameters Measurement

5. Attenuation Measurement

6. Characteristics of Multihole Directional Coupler

7. Scattering Parameters of Circulator

8. Scattering Parameters of Magic Tee

Part-B

Optical Communications (Any Four Experiments)

1. V-I Characteristics of LED

2. Characteristics of Laser Diode

3. Measurement of Numerical Aperture of Optical fiber

4. Measurement of Losses in Analog Optical Link

5. Measurement of Data Rate Using Digital Optical Link

Equipment required for Laboratories:

1. Klystron Power Supply
2. Gunn Power Supply
3. VSWR Meter
4. Reflex klystron Tube
5. Gunn Diode
6. PIN diode
7. Waveguide Components
8. Microwave Bench setup with klystron Tube
9. Microwave Bench setup with Gunn diode
10. Optical Fibre Link Setup with LED
11. Optical Fibre Link Setup with LASER diode
12. CRO - 0 – 30 M Hz.

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AUTONOMOUS SYLLABUS

IV - II

IV Year - II Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE-V
WIRELESS COMMUNICATIONS AND NETWORKS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Antennas and Wave Propagation, Cellular Mobile communication, Analog Communication, Digital Communication.

Course Objectives:

- To understand the functions of wireless communication system and evolution of different wireless communication systems and standards.
- To be able to compare recent technologies used for wireless communication.
- To analyze and be able to explain the architecture, functioning, protocols, capabilities and applications of various wireless communication networks.
- To understand the concepts and be able to explain multiple access techniques for Wireless Communication.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the functioning of wireless communication system and evolution of different wireless communication systems and standards.
CO2	Compare different technologies used for wireless communication systems.
CO3	Explore the architecture, functioning, protocols, capabilities and application of various wireless communication networks.
CO4	Analyze various multiple access techniques for Wireless Communication.
CO5	Evaluate design challenges, constraints and security issues associated with wireless networks.
CO6	Acquire knowledge about various wireless data services and their performance.

Course Content(Syllabus)

UNIT I

PART A: Mobile Radio Propagation: Large-Scale Path Loss:
Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, Basic Propagation Mechanisms, **Reflection**: Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, **Diffraction**: Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering.
PART B: Outdoor Propagation Models- Longley-Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, **Indoor Propagation Models**- Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model.

UNIT II

PART A:Mobile Radio Propagation: Small –Scale Fading and Multipath
Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel, **Small-Scale Multipath Measurements**-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, **Parameters of Mobile Multipath Channels**-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time.
PART B:Types of Small- Scale Fading- Fading effects Due to Multipath Time Delay Spread, Flat fading and Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, **Statistical Models for multipath Fading Channels**-Clarke‟s model for flat fading,

spectral shape due to Doppler spread in Clarke‟s model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

UNIT III

PART A: Equalization and Diversity-Introduction, Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non-linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer.

PART B: Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. **Diversity** -Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, **Practical Space Diversity Consideration**-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT IV

PART A: Wireless Networking. Introduction to Wireless Networks. Differences Between Wireless and Fixed Telephone Networks. Development of Wireless Networks. Fixed Network Transmission Hierarchy. Traffic Routing in Wireless Networks.

PART B: Wireless Data Services: Common Channel Signaling (CCS). Integrated Services Digital Network (ISDN). Signaling System No. 7 (SS7). Network Service part (NSP) of SS7,The SS7 user parts, Signaling Traffic in SS7, SS7 services, Performance of SS7.

TEXT BOOKS:

1 Wireless Communications, Principles, Practice – Theodore, S. Rappaport, 2nd Ed., 2002, PHI.
2. Wireless Communications-Andrea Goldsmith, 2005 Cambridge University Press.
3. Mobile Cellular Communication – Gottapu Sasibhushana Rao, Pearson Education, 2012.

REFERENCES:

1. Principles of Wireless Networks – KavehPahLaven and P. Krishna Murthy, 2002, PE
2. Wireless Digital Communications – KamiloFeher, 1999, PHI.
3. Wireless Communication and Networking – William Stallings, 2003, PHI.
4. Wireless Communication – UpenDalal, Oxford Univ. Press.
5. Wireless Communications and Networking – Vijay K. Gary, Elsevier.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	3	-	2	-	-	-	-	-	-	-	-	-	3
CO2	3	-	-	-	3	-	3	-	-	3	-	-	-	2
CO3	3	3	-	-	-	-	-	3	-	-	-	-	3	-
CO4	-	-	3	-	3	-	-	-		-	-	2	-	-
CO5	3	2	2	-	3	-	-	-	-	-	-	-	-	3
CO6	-	2	-	-	-	2	-	-	-	-	2	-	-	-

IV Year - II Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE-V
SOFT COMPUTING TECHNIQUES

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Electronic Devices and circuits, Linear IC Applications.

Course Objectives:

- To provide an introduction to the basic principles, techniques, and applications of soft computing.
- To understand the basic areas of Soft Computing including Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms.
- To provide the mathematical background for carrying out the optimization associated with neural network learning.
- To develop some familiarity with current research problems and research methods in Soft Computing by working on a research or design project.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand human intelligence and artificial intelligence.
CO2	Know how intelligent system works.
CO3	Apply basics of Fuzzy logic and neural networks.
CO4	Analyze the fuzzy sets, fuzzy logic and use of heuristics based on human experience.
CO5	Relate with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
CO6	Understand genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations.

Course Content(Syllabus)

UNIT I

Part-A (Introduction to Soft Computing): What is Soft Computing? Difference between Hard and Soft computing, Requirement of Soft computing, Major Areas of Soft Computing, Applications of Soft Computing.

Part-B: various types of soft computing techniques, Fuzzy Computing, Neural Computing Genetic Algorithms, Associative Memory, Adaptive Resonance Theory, Classification, Probabilistic reasoning.

UNIT II

Part-A (Fundamentals of Artificial Neural Network):

What is Neural Network, Learning rules and various activation functions, Single layer Perceptrons , Back Propagation networks, Architecture of Back propagation(BP) Networks, Back propagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory.

Part-B: Introduction, Model of Artificial Neuron, Architectures, Learning Methods, Deep learning, Taxonomy of ANN Systems, Single- Layer ANN System, Supervised Learning Neural Networks, Perceptrons, Adaline, Mutilayer Perceptrons Applications of ANN in research.

UNIT III

Part-A (.Fuzzy Set Theory & Fuzzy Systems) :

Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, introduction & features of membership functions, Extension Principle, Fuzzy If-Then Rules, Sugeno Fuzzy Models, Fuzzification, Defuzzification, Applications.

Part-B: (Fuzzy Logic) : Fuzzy Sets – Properties – Membership Functions – Fuzzy Operations. Fuzzy Logic and Fuzzy Inference System

UNIT IV

Part-A(Genetic Algorithms and Hybrid Systems) :

Fundamentals of Genetic Algorithms, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling,

Part-B: Hybrid Systems: Integration of Neural Networks, Fuzzy Logic and Genetic Algorithms, Research orientation of soft computing techniques**.**

TEXT BOOKS:

1 J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.

2. Simon O. Haykin "Artificial Neural Network", PHI, 2003

3. Elaine Rich, Kevin Knight, Artificial Intelligence TMH, 2009

REFERENCES:

1 Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.

2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

3. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.

4. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence – PC Tools", AP Professional, Boston, 1996.

5. Dan W. Patterson, Introduction to AI and Expert System, PHI, 2009.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	-	2	-	3	-	-	-	-	-	-	2	-	-
CO2	-	3		2	-	-	-	2	-	-	-	-	-	3
CO3	2	3	-	3	-	3	-	-	-	-	-	-	-	-
CO4	2	-	3	3	-	-	-	-	2	-	2	-	-	2
CO5	2	3	-	-	-	-	-	2	-	-	-	-	3	-
CO6	-	3	2	-	-	-	-	-	-	3	-	-	-	-

IV Year – II Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE-V
DIGITAL IC DESIGN

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Electronic Devices and circuits, Linear IC Applications.

Course Objectives:

- Understand the behavior of MOS Devices and Small-Signal & Large-Signal Modeling of MOS Transistor and Analog Sub-Circuits.
- Study CMOS Amplifiers like Differential Amplifiers, Cascade Amplifiers, Output Amplifiers, and Operational Amplifiers.
- Design and to develop the Analog CMOS Circuits for different Analog operations.
- Understand the concepts of Sample and Hold circuits and Open-Loop Comparators.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Understand the knowledge of MOS devices and modeling.
CO2	Use different styles of CMOS Circuit odeling to synthesize analog Ics.
CO3	Apply appropriate biasing techniques to improve performance of analog circuits.
CO4	Design and Develop Analog Integrated Circuits using MOS Transistor.
CO5	Design and Develop CMOS Op Amps.
CO6	Assess the performance of sample and hold circuits and comparators in analog Ics suitable for societal use.

Course Content(Syllabus)

UNIT I

PART A: Basic MOS Devices: The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, Latch up in CMOS Technology, Short Channel Effects in MOS Transistors.

PART B: CMOS Device Modelling: Weak Inversion in MOS Transistors Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Sub-threshold MOS Model.

UNIT II

PART A: Current Mirrors: Current Sinks and Sources, Simple Current Mirrors, Simple Current Mirror with Source Degeneration, Cascode Current Mirror and Wilson Current Mirror.

PART B: Biasing Techniques: CS Biasing, CG Biasing, Source Follower Biasing, Differential Pair Biasing.

UNIT III

PART A: Single Stage Amplifiers: Common Source Stage with resistive load, Source follower, Common Gate Stage, Cascode Stage.

PART B: CMOS Operational Amplifiers: Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power- Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

UNIT IV

PART A: Sample and Hold Circuits:

Performance of Sample and Hold Circuits, MOS Sample and Hold Basics, Examples of CMOS S/H circuits, Bipolar and BICMOS Sample and Hold circuits.

PART B: Comparators:

Using an Opamp for a Comparator, Charge-Injection Errors, Latched Comparators, Examples of CMOS and BiCMOS Comparators.

TEXT BOOKS:

1. Design of Analog CMOS Integrated Circuits, Behzad Razavi, Tata McGraw Hill, 2nd Edition, 2008.

2.Analog Integrated Circuit Design- David A.Johns, Ken Martin, Wiley Student Edn, 2013.

REFERENCES:

1. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.

2.CMOS Analog Circuit Design – Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	3	-	-	2	-	-	-	-	-	2	-	-	2
CO2	3	3	-	-		-	-	-	-	-	-	3	3	-
CO3	3	3	-	-	-	-	2	-	-	3	-	-	-	-
CO4	-	-	3	3	3	-	-	-	2	-	-	-	3	-
CO5	3	2	-	-	3	-	-	-	-	-	-	-	3	-
CO6	3	2	-	-	-	3	-	3	-	-	-	3	-	-

IV Year – II Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE-VI
COMPUTER NETWORKS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Basic concepts of networks, Analog Communication, Digital Communication.

Course Objectives:

- Understand the layered communication architectures (OSI and TCP/IP).
- Understand various network topologies required for communications.
- Demonstrate the Functions of various protocols of Data link layer and understand the basics of error detection including parity, checksums, and CRC.
- Demonstrate Functioning of various Routing protocols.
- Analyze the Functions of various Transport layer protocols.
- Understand the significance of application layer protocols.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Acquire knowledge about different network models like OSI and TCP/IP and various network topologies like WAN, LAN and MAN.
CO2	Distinguish different modes of wired transmission media such as copper wire, twisted pair wire, OFC and wireless transmission media.
CO3	Analyze various error detection techniques and functions of various protocols of Data link layer.
CO4	Analyze MAC layer protocols and LAN technologies.
CO5	Design different routing protocols and acquire knowledge on significance of various Flow control and Congestion control Mechanisms.
CO6	Acquire Knowledge on functioning of various Application layer Protocols.

Course Content(Syllabus)

UNIT I

PART A: Introduction: Network Topologies WAN, LAN, MAN. Reference models- The OSI Reference Model- the TCP/IP Reference Model - A Comparison of the OSI and TCP/IP Reference Models.

PART B: Data Link Layer Design Issues, Error Detection and Correction, Elementary Data Link Protocols, Sliding Window Protocols

UNIT II

PART A: The Data Link Layer - Services Provided to the Network Layer – Framing – Error Control – Flow Control, Error Detection and Correction, Sliding Window Protocols-A One Bit Sliding Window Protocol-A Protocol Using Go-Back-N- A Protocol Using Selective Repeat.

PART B: The Medium Access Control Sublayer -The Channel Allocation Problem-Static Channel Allocation-Assumptions for Dynamic Channel Allocation, Multiple Access Protocols-Aloha-Carrier Sense Multiple Multiple Access Protocols- Collision-Free Protocols-Limited Contention Protocols-Wireless LAN Protocols.

UNIT III

PART A: The Network Layer - Design Issues – Store and Forward Packet Switching-Services Provided to the Transport layer- Implementation of Connectionless Service-Implementation of Connection Oriented Service- Comparison of Virtual Circuit and Datagram Networks

PART B: Routing Algorithms-The Optimality principle-Shortest path Algorithm, Congestion Control Algorithms-Approaches to Congestion Control-Traffic Aware Routing-Admission Control-Traffic Throttling-Load Shedding.

UNIT IV

PART A: Transport Layer: Introduction and Transport Layer Services : Relationship Between Transport and Network Layers, Overview of the Transport Layer in the Internet, Multiplexing and De-multiplexing.

PART B: Connectionless Transport: UDP -UDP Segment Structure, UDP Checksum, Principles of Reliable Data Transfer-Building a Reliable Data Transfer Protocol, Pipelined Reliable Data Transfer Protocols, Go-Back-N(GBN), Selective Repeat(SR),**Connection Oriented Transport:** TCP - The TCP Connection, TCP Segment Structure. **Application Layer:** The DNS, Electronic Mail , FTP Commands and Replies

TEXT BOOKS:

1.Computer Networks, Tanenbaum and David J Wetherall, 5th Edition, Pearson Edu, 2010
2.Computer Networks: A Top Down Approach, Behrouz A. Forouzan, Firouz Mosharraf, McGraw Hill Education

REFERENCES:

1.Larry L. Peterson and Bruce S. Davie, "Computer Networks - A Systems Approach" (5th ed), Morgan Kaufmann/ Elsevier, 2011

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	2	-	2	-	-	-	-	-	-	-	3	3	-
CO2	2	-	2	-	1	-	-	-	3	-	-	-	-	-
CO3	3	2	-	2	-	3	-	-	-	-	-	-	-	2
CO4	2	-	1	-	-	-	-	2	-	-	2	-	3	-
CO5	-	2	2	-	2	-	2	-	-	-	-	-	-	-
CO6	3	-	2	-	2	-	-	-	-	2	-	2	-	2

IV Year - II Semester **L T P C**
3 0 0 3

PROFESSIONAL ELECTIVE-VI
INTERNET OF THINGS AND APPLICATIONS

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Embedded Systems, Microcontrollers, Operating Systems.

Course Objectives:

- To Understand Smart Objects and IoT architecture.
- To introduce the concept of M2M (machine to machine) with necessary protocols.
- To acquaint with the various security concepts in IoT architecture.
- To build simple IOT system using Arduino and Raspberry PI platform.
- To understand data analytics and cloud in the context of IOT.

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Summarize on the term 'internet of things' in different contexts and to analyze various protocols for IoT.
CO2	Comprehend and analyze Software defined networks.
CO3	Explore IT Access Technologies and security for IEEE 802.15.4, 802.15.4g, 802.15.4e, 802.11ah and Lora WAN.
CO4	Explore and learn about Internet of Things with the help of preparing projects designed using Arduino and Raspberry Pi.
CO5	Apply data analytics and use cloud offerings related to design and develop a solution for a given application using APIs and test for errors in the application.
CO6	Implement real field problem by gained knowledge of Industrial applications with IoT capability.

Course Content(Syllabus)

UNIT I

PART A: INTRODUCTION TO INTERNET OF THINGS:
Definition and characteristics of IOT, Evolution of IOT, Logical view of IOT ecosystem, Functional blocks of IOT: Sensors, Actuators, Smart Objects and connecting smart objects, Physical design of IOT-IOT Protocols, IOT Communication models, Calm and Ambient Technologies.

PART B:FUNDAMENTALS OF IOT:
The Internet of Things: An overview, The Flavor of the IOT, Design principles for connected devices, IOT Architectures, OneM2M, IOT World Forum (IoTWF) and alternative IOT Models.

UNIT II

PART A: IOT and M2M:
Software defined networks, Network Function Virtualization, Difference between SDN and NFV for IOT, Basics of IOT system management with NETCONF, YANG-NETCONF, YANG, and NETOPEER.

PART B: IOT PRINCIPLES & IOT COMMUNNICATION ARCHITECTURE:
IOT nodes, IOT Edges, 6 LOWPAN, Optimizing IP for IOT: IP, TCP, The IP Protocol suite (TCP/IP), UDP, IP Address, Static IP Address Assignment, Dynamic IP Address Assignment, IPV4 & IPV6.

UNIT III

PART A: IOT PROTOCOLS:

IT Access Technologies: Physical and MAC Layer, Topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 802.11ah and Lora WAN.

PART B: IOT PHYSICAL DEVICES & END POINTS:

Embedded Computing basics, Microcontrollers, System-On-Chip, IOT system building blocks, Arduino, Raspberry PI – Installation, Interfaces (Serial, SPI, I2C).

UNIT IV

PART A: IOT PHYSICAL SERVERS AND CLOUD OFFERINGS:

Introduction to Cloud Storage models and Communication API Servers- Web Server for IOT , Cloud for IOT, Getting started with an API, Mashing up API, Scraping, Legalities, Writing a New API, Application Layer Protocols: MQTT, COAP, Extensible Messaging and presence protocol (xmpp).

PART B: INTRODUCTION TO INDUSTRY 4.0 AND II0T:

Defining Industry 4.0, Characteristics of Industry 4.0, and Benefits to Business, Industry 4.0 Design Principles, Building blocks of Industry 4.0, Industry 4.0 Reference Architecture, and Smart Factories. Concept of 5G Technology: A New Step to IOT Platform. Case study/ Industrial Application.

TEXT BOOKS:

1 Adrian McEwen, Hakim Cassimally - Designing the Internet of Things, Wiley Publications, 2012.

2. Internet of Things - A Hands-on Approach, ArshdeepBahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547.

3.The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012.

4. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017.

5. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.

6. Industry 4.0; The Industrial Internet of Things, Alasdair Gilchrist.

REFERENCES:

1. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015 3. Editors Ovidiu Vermesan.

2. Internet of Things Architecture Final Architectural Reference Model for the IoT v3.0, http://www.iot-a.eu/public.

3. From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier.

4. The Internet of Things, Enabling technologies and use cases – Pethuru Raj, Anupama C. Raman, CRC Press.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	3	-	-	-	2	3	-	-	3	-	2	2	3	-
CO2	-	2	-	3	-	-	-	-	2	-	-	-	-	3
CO3	-	3	2	-	-	1	-	2	-	3	3	2	2	-
CO4	3	-	-	3	-	-	-	-	3	-	-	3	-	-
CO5	-	2	-	-	-	-	-	-	2	-	2	-	-	3
CO6	-	-	2	-	2	-	2	-	-	2	-	2	-	-

IV Year - II Semester

L	T	P	C
3	0	0	3

PROFESSIONAL ELECTIVE-VI
ARTIFICIAL INTELLIGENCE

Lecture – Tutorial:	3-0 Hours	**Internal Marks:**	40
Credits:	3	**External Marks:**	60

Prerequisites: Data Structures, Algorithms and Probability

Course Objectives:

- To learn the difference between optimal reasoning vs human like reasoning.
- To understand the notions of state space representation, exhaustive search, heuristic search alongwith the time and space complexities.
- To learn different knowledge representation techniques
- To understand the applications of AI: namely Game Playing, Theorem Proving, Expert Systems,Machine Learning and Natural Language Processing

Course Outcomes:

Upon successful completion of the course, the student will be able to:

CO1	Formulate an efficient problem space for a problem expressed in English.
CO2	Identify a search algorithm for a problem and characterize its time and spacecomplexities.
CO3	Acquire skills for representing knowledge using the appropriate technique.
CO4	Apply AI techniques to solve problems of Game Playing, Expert Systems, Machine Learning and Natural Language Processing.
CO5	Apply the knowledge to develop the solutions for real life problems.
CO6	Develop new algorithms to contribute to the research arena.

Course Content(Syllabus)

UNIT I

PART A: Introduction: History, Intelligent Systems, Foundations of AI, Sub areas of AI, Applications.

PART B: Problem Solving: State-Space Search and Control Strategies: Introduction, General Problem Solving, Characteristics of Problem, Exhaustive Searches, Heuristic Search Techniques, Iterative-Deepening A*, Constraint Satisfaction.

UNIT II

PART A: Logic Concepts and Logic Programming: Introduction, Propositional Calculus, Propositional Logic, Natural Deduction System, Resolution Refutation in Propositional Logic, Predicate Logic, Logic Programming.

PART B: Representing Knowledge Using Rules: Logic programming, Procedural Vs Declarative knowledge, Forward Vs Backward Reasoning, Matching, Control Knowledge.

UNIT III

PART A: Knowledge Representation: Introduction, Approaches to Knowledge Representation, KnowledgeRepresentation using Semantic Network, Extended Semantic Networks for KR.

PART B: Knowledge Representation using Frames: Conceptual dependencies, Scripts.

UNIT IV

PART A: Natural Language Processing: Steps in The Natural Language Processing, Syntactic Processing and Augmented Transition Nets, Semantic Analysis, NLP Understanding Systems.

PART B: Fuzzy Logic: Crisp Sets, Fuzzy Sets, Fuzzy Logic Control, Fuzzy Inferences & Fuzzy Systems Planning with state-space search – partial-order planning – planning graphs – planning and acting in the real world.
AI Programming languages: Overview of LISP and PROLOG, Production System in Prolog.

TEXT BOOKS:

1. Artificial Intelligence, Elaine Rich and Kevin Knight, Tata Mc graw-Hill Publications.

2. Introduction To Artificial Intelligence & Expert Systems, Patterson, PHI publications.

REFERENCES:

1. Artificial Intelligence, George F Luger, Pearson Education Publications
2.Artificial Intelligence : A modern Approach, Russell and Norvig, Printice Hall
3.Artificial Intelligence, Robert Schalkoff, Mcgraw-Hill Publications
4.Artificial Intelligence and Machine Learning, Vinod Chandra S.S., Anand Hareendran S.

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2- Medium, 3 – High)

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	3	2	2	-	-	-	-	3	-	-	-	-	-	-
CO2	-	2	2	1	-	3	-	-	-	-	-	-	3	-
CO3	3	-		-	1	-	3	-	-	3	-	-	-	-
CO4	-	2	3	-	-	-	-	-	-	-	-	-	3	2
CO5	3	-	2	-	2	-	-	-	-	3	2	-	-	-
CO6	-	2	3	1	-	-	-	-	1	-	-	-	3	1