SETHU INSTITUTE OF TECHNOLOGY

PULLOOR, KARIAPATTI – 626 115.

(AN AUTONOMOUS INSTITUTION)

REGULATION – 2019

M.E COMMUNICATION SYSTEMS

CHOICE BASED CREDIT SYSTEM

CURRICULUM & SYLLABI

CHAIRPERSON

ACADEMIC COUNCIL

SETHU INSTITUTE OF TECHNOLOGY

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M.E COMMUNICATION SYSTEMS

CURRICULUM & SYLLABI

Chairman
Board of Studies

Chair Person
Academic Council

SETHU INSTITUTE OF TECHNOLOGY

Pulloor, Kariapatti – 626 115

M.E. Degree Programme

CURRICULUM

Regulation 2019

Master of Engineering in COMMUNICATION SYSTEMS

OVERALL COURSE STRUCTURE

Category	Total No. of Courses	Credits	Credit Percentage (%)
PROGRAM CORE (PC)	4	12	17.2
PROGRAM ELECTIVE (PE)	5	15	21.4
OPEN ELECTIVE (OE)	1	3	4.3
MANDATORY COURSE (MC)	1	3	4.3
AUDIT COURSE (AC)	2	-	-
LABORATORIES	4	8	11.4
MINI PROJECT WITH SEMINAR	1	3	4.3
PROJECT WORK (PW)	2	26	37.1
TOTAL	20	70	100

SEMESTER-WISE COURSE STRUCTURE – NUMBER OF COURSES

Semester	PC	PE	OE	PW	MC	AC	TOTAL
I	4	1	-	-	1	1	7
II	4	1	-	1	-	1	7
III	-	3	1	1	-	-	5
IV	-	-	-	1	-	-	1
TOTAL	9	6	1	3	1	2	20

SEMESTER-WISE COURSE STRUCTURE – CREDITS

Semester	PC	PE	OE	PW	MC	AC	TOTAL
I	10	3	-	-	3	-	16
II	10	3	-	3	-	-	16
III	-	9	3	10	-	-	22
IV	-	-	-	16	-	-	16
TOTAL	20	15	3	29	3	-	70

SUMMER/ WINTER COURSES

Winter Courses									
Sl.No	**Subject Code**	**Subject Name**	**Sem**	**L**	**T**	**P**	**C**	**Summer/ Winter**	**Category**
1.	19PCM101	Adaptive Signal Processing	I	3	0	0	3	Winter	Program Core
2.	19PCM102	Antennas and Radiating Systems	I	3	0	0	3	Winter	Program Core
3.	-	Elective I	I	3	0	0	3	Winter	Program Elective
4.	19PCM103	Antennas and Radiating Systems lab	I	0	0	4	2	Winter	Program Core
5.	19PCM104	Adaptive Signal Processing Lab	I	0	0	4	2	Winter	Program Core
6.	19PGM701	Research Methodology and IPR	I	3	0	0	3	Winter	Program Core
7.	19PGM801	Pedagogy Studies	I	3	0	0	0	Winter	Program Core
8.	-	Elective III	III	3	0	0	3	Winter	Program Elective
9.	-	Elective IV	III	3	0	0	3	Winter	Program Elective
10.	-	Elective V	III	3	0	0	3	Winter	Program Elective
11.	-	Open Elective	III	3	0	0	3	Winter	Open Elective
12.	19PCM301	Dissertation Phase – I	III	0	0	20	10	Winter	Dissertation

Summer Courses									
13.	19PCM201	Advanced Communication Networks	II	3	0	0	3	Summer	Program Core
14.	19PCM202	Wireless and Mobile Communication	II	3	0	0	3	Summer	Program Core
15.	-	Elective II	II	3	0	0	3	Summer	Program Elective
16.	19PCM203	Advanced Communication Networks Lab	II	0	0	4	2	Summer	Program Core
17.	19PCM204	Wireless and Mobile Communication Lab	II	0	0	4	2	Summer	Program Core
18.	19PCM205	Mini Project with seminar	II	0	0	6	3	Summer	Program Core
19.	19PGM802	English for Research Paper Writing	II	3	0	0	0	Summer	Program Core
20.	19PCM401	Dissertation Phase — II	IV	0	0	32	16	Summer	Dissertation

COURSE CATEGORY: PROGRAM ELECTIVES

S.No	Course Code	Course Title	L	T	P	C
1.	**19PCM501**	Wireless Sensor Networks	**3**	**0**	**0**	**3**
2.	**19PCM502**	Optical Networks	**3**	**0**	**0**	**3**
3.	**19PCM503**	Cognitive Radio	**3**	**0**	**0**	**3**
4.	**19PCM504**	RF Circuits and Microwave Systems	**3**	**0**	**0**	**3**
5.	**19PCM505**	Communication Network Security	**3**	**0**	**0**	**3**
6.	**19PCM506**	Satellite Communication	**3**	**0**	**0**	**3**
7.	**19PCM507**	Communication Protocol Engineering	**3**	**0**	**0**	**3**
8.	**19PCM508**	Speech and Audio Signal Processing	**3**	**0**	**0**	**3**
9.	**19PCM509**	MIMO System	**3**	**0**	**0**	**3**
10.	**19PCM510**	High Performance Communication Networks	**3**	**0**	**0**	**3**
11.	**19PCM511**	Pattern Recognition	**3**	**0**	**0**	**3**
12.	**19PCM512**	Microelectronics and VLSI Technology	**3**	**0**	**0**	**3**
13.	**19PCM513**	Smart Devices and Emerging Mobile Technologies	**3**	**0**	**0**	**3**
14.	**19PCM514**	Network Management System	**3**	**0**	**0**	**3**
15.	**19PCM515**	Ubiquitous Computing and Pervasive Computing	**3**	**0**	**0**	**3**
16.	**19PCM516**	DSP Processor Architecture and Programming	**3**	**0**	**0**	**3**
17.	**19PCM517**	Mobile and Social Computing	**3**	**0**	**0**	**3**
18.	**19PCM518**	Data Compression	**3**	**0**	**0**	**3**
19.	**19PCM519**	Medical Imaging Techniques	**3**	**0**	**0**	**3**
20.	**19PCM520**	Global Positioning Systems	**3**	**0**	**0**	**3**

COURSE CATEGORY: OPEN ELECTIVE

S.No	Course Code	Course Title	L	T	P	C
1.	**19PCD601**	Industrial Safety	**3**	**0**	**0**	**3**
2.	**19PCS602**	Business analytics	**3**	**0**	**0**	**3**
3.	**19PCM603**	IoT for Smart Applications	**3**	**0**	**0**	**3**
4.	**19PPE604**	Bio Energy from Waste	**3**	**0**	**0**	**3**
5.	**19PSE605**	Smart City Technologies	**3**	**0**	**0**	**3**

COURSE CATEGORY: AUDIT COURSES

S.No	Course Code	Course Title	L	T	P	C
1.	**19PGM801**	Pedagogy Studies	**2**	**0**	**0**	**0**
2.	**19PGM802**	English for Research Paper Writing	**2**	**0**	**0**	**0**

REGULATION – 2019

(Applicable to the students admitted from the Academic Year 2019 – 2020 onwards)

CURRICULUM I TO IV SEMESTERS (FULL TIME)

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**19PCM101**	Adaptive Signal Processing	**3**	**0**	**0**	**3**
2.	**19PCM102**	Antennas and Radiating Systems	**3**	**0**	**0**	**3**
3.	**-**	Elective I	**3**	**0**	**0**	**3**
4.	**19PGM701**	Research Methodology and IPR (Mandatory course)	**3**	**0**	**0**	**3**
5.	**19PGM801**	Pedagogy Studies (Audit course-1)	**2**	**0**	**0**	**0**
PRACTICAL						
6.	**19PCM103**	Antennas and Radiating Systems lab	**0**	**0**	**4**	**2**
7.	**19PCM104**	Adaptive Signal Processing Lab	**0**	**0**	**4**	**2**
		Total	**14**	**0**	**8**	**16**
Total Number of Credits: 16						

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**19PCM201**	Advanced Communication Networks	**3**	**0**	**0**	**3**
2.	**19PCM202**	Wireless and Mobile Communication	**3**	**0**	**0**	**3**
3.	**-**	Elective II	**3**	**0**	**0**	**3**
4.	**19PGM802**	English for Research Paper Writing (Audit Course-2)	**2**	**0**	**0**	**0**
PRACTICAL						
5.	**19PCM203**	Advanced Communication Networks Lab	**0**	**0**	**4**	**2**
6.	**19PCM204**	Wireless and Mobile Communication Lab	**0**	**0**	**4**	**2**
7.	**19PCM205**	Mini Project with seminar	**0**	**0**	**6**	**3**
		Total	**11**	**0**	**14**	**16**
Total Number of Credits: 16						

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**-**	Elective III	**3**	**0**	**0**	**3**
2.	**-**	Elective IV	**3**	**0**	**0**	**3**
3.	**-**	Elective V	**3**	**0**	**0**	**3**
4.	**-**	Open Elective	**3**	**0**	**0**	**3**
PRACTICAL						
5.	**19PCM301**	Dissertation Phase – I	**0**	**0**	**20**	**10**
		Total	**12**	**0**	**20**	**22**
Total Number of Credits: 22						

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	**19PCM401**	Dissertation Phase – II	**0**	**0**	**32**	**16**
		Total	**0**	**0**	**32**	**16**
Total Number of Credits: 16						

TOTAL NO. OF CREDITS: 70

SEMESTER I

SEMESTER I

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**19PCM101**	Adaptive Signal Processing	**3**	**0**	**0**	**3**
2.	**19PCM102**	Antennas and Radiating Systems	**3**	**0**	**0**	**3**
3.	**-**	Elective I	**3**	**0**	**0**	**3**
4.	**19PGM701**	Research Methodology and IPR (Mandatory course)	**3**	**0**	**0**	**3**
5.	**19PGM801**	Pedagogy Studies (Audit course-1)	**2**	**0**	**0**	**0**
PRACTICAL						
6.	**19PCM103**	Antennas and Radiating Systems lab	**0**	**0**	**4**	**2**
7.	**19PCM104**	Adaptive Signal Processing Lab	**0**	**0**	**4**	**2**
		Total	**14**	**0**	**8**	**16**
Total Number of Credits: 16						

SYLLABUS

19PCM101	ADAPTIVE SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To impart the fundamental concepts of discrete random signal processing and spectrum estimation.
- To explain linear estimation, prediction and adaptive filters.
- To give an outline about multirate digital signal processing.

UNIT I	DISCRETE RANDOM SIGNAL PROCESSES	9

Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Auto covariance, Autocorrelation, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes — ARMA, AR, MA — Yule-Walker equations.

UNIT II	MULTIRATE DIGITAL SIGNAL PROCESSING	9

Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.

UNIT III	LINEAR PREDICTION AND ADAPTIVE FILTERS	9

Principles of adaptive filter - FIR adaptive filter - Newton's Steepest descent algorithm - Derivation of first order adaptive filter - LMS adaptation algorithms - Adaptive noise cancellation, Adaptive equalizer, Adaptive echo cancellers.

UNIT IV	SPECTRUM ESTIMATION	9

Estimation of Spectra from Finite-Duration Observations of Signals, Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.

UNIT V	APPLICATIONS OF DSP	9

Application of DSP & Multi rate DSP, Application to Radar, Application to image processing, Application of DSP in design of phase shifters, DSP in speech processing & other applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the fundamental concepts of adaptive signal processing	**Understand**
CO2	Design adaptive filters for various applications	**Apply**
CO3	Design sampling rate converters and analyze its frequency response	**Apply**
CO4	Analyze the performance of adaptive signal processing algorithms in radar and communication systems using simulation software	**Analyze**
CO5	Estimate the spectrum using various signal processing algorithms	**Analyze**
CO6	Develop a signal processing algorithm for a practical application	**Evaluate**

TEXT BOOKS:

1. J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc.,2002.
3. S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
4. 2.D.G.Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

19PCM102	ANTENNAS AND RADIATING SYSTEMS	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To give an idea about radiation from different current distributions and radiation field of different types of apertures.
- To summarize the performance characteristics of various antenna arrays,micro-strip antennas and its radiation analysis.
- To review horn, micro-strip, reflector antennas and various measuring parameters of EMC antenna.

UNIT 1	ANTENNA FUNDAMENTALS	9+3

Antenna fundamental parameters,Friis Transmission equation Radiation integrals ,Radiation from surface and line current distributions – dipole, monopole, loop antenna; Mobile phone antenna- base station, hand set antenna; Image; Induction ,reciprocity theorem, Broadband antennas and matching techniques, Balance to unbalance transformer, Introduction to numerical techniques.

UNIT 2	RADIATION FROM APERTURES	9+3

Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration

UNIT 3	ARRAY ANTENNA	9+3

Linear array –uniform array, end fire and broad side array, gain, beam width, side lobe level; Two dimensional uniform array; Phased array, beam scanning, grating lobe, feed network,; Linear array synthesis techniques – Binomial and Chebyshev distributions

UNIT 4	MICROSTRIP ANTENNA	9+3

Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Application of Microstrip array antenna.

UNIT 5	EMC ANTENNA AND ANTENNA MEASUREMENTS	9+3

Concept of EMC measuring antenna; Rx and Tx antenna factors; Log periodic dipole, Biconical, Ridge guide, Multi turn loop; Antenna measurement and instrumentation – Gain, Impedance and antenna factor measurement; Antenna test range Design.

TOTAL: 45+15 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the fundamental characteristics of antenna	**Understand**
CO2	Apply the knowledge of mathematical concepts to calculate the antenna parameters	**Apply**
CO3	Determine the radiation characteristics of various antennas	**Apply**
CO4	Analyze the performance of Microstrip patch antennas	**Analyze**
CO5	Apply the knowledge of antennas to perform various antenna measurements	**Apply**
CO6	Design various antennas using simulation software	**Evaluate**

REFERENCES:

1. Balanis.A, — Antenna Theory Analysis and Design ‖, John Wiley and Sons, New York, 1982.
2. Krauss.J.D, — Antennas ‖, John Wiley and sons, II edition, New York, 1997.
3. Bahl.I.J, Bhartia.P, — Microstrip Antennas ‖, Artech House Inc, 1980..
4. Stutzman.W.L,Thiele.G.A, — Antenna Theory and Design ‖, John Wiley& Sons Inc, 2ndedition, 1998.

19PGM701	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide an overview on selection of research problem based on the Literature review.
- To enhance knowledge on the Data collection and Analysis for Research design.
- To outline the importance of ethical principles to be followed in Research work and IPR.

UNIT I	INTRODUCTION TO PROJECT FORMULATION	9

Meaning of research problem, Sources of research problem, Criteria, Characteristics of a good research problem, and Errors in selecting a research problem, Scope and objectives of research problem. Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem - Literature review - Primary and secondary sources - reviews, treatise, monographs-patents - web as a source - searching the web - Critical literature review - Identifying gap areas from literature review - Development of working hypothesis

UNIT II	DATA COLLECTION, ANALYSIS AND ETHICS	9

Execution of the research - Observation and Collection of data - Methods of data collection Sampling Methods- Data Processing and Analysis strategies - Data Analysis with Statistical Packages - Hypothesis-testing - Generalization and Interpretation - Plagiarism, Application of results and ethics - Environmental impacts - Ethical issues - ethical committees

UNIT III	REPORT,THESIS, PAPER AND RESEARCH PROPOSAL WRITING	9

Structure and components of scientific reports - Types of report - Technical reports and thesis - Significance - Different steps in the preparation - Layout, structure and Language of typical reports - Illustrations and tables - Bibliography, referencing and footnotes, how to write report- Paper Developing a Research Proposal - Format of research proposal- a presentation and assessment by a review committee

UNIT IV	INTELLECTUAL PROPERTY	9

Nature of Intellectual Property - Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V	PATENT RIGHTS AND NEW DEVELOPMENTS IN IPR	9

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications, New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After successful completion of this course, the students will be able to

CO1	Analyze the literature to identify the research gap in the given area of research	**Analyze**
CO2	Design suitable research methodology to pursue the research in scientific and systematic procedure with statistical / IT Tools	**Analyze**
CO3	Analyze and synthesize the data using research methods and	**Evaluate**

	knowledge to provide scientific interpretation and conclusion	
CO4	Prepare research reports and proposals by properly synthesizing, arranging the research documents to provide comprehensive technical and scientific report	**Communication**
CO5	Conduct patent database search in various countries for the research problem identified	**Analyze**
CO6	Apply ethical principles in research and reporting to promote healthy scientific practice	**Apply**

REFERENCES

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

ADDITIONAL READING

1. Anthony, M., Graziano, A.M. and Raulin, M.L., 2009. Research Methods: A Process of Inquiry, Allyn and Bacon.
2. Carlos, C.M., 2000. Intellectual property rights, the WTO and developing countries: the TRIPS agreement and policy options. Zed Books, New York.
3. Coley, S.M. and Scheinberg, C. A., 1990, "Proposal Writing", Sage Publications.
4. Day, R.A., 1992.How to Write and Publish a Scientific Paper, Cambridge University Press.
5. Fink, A., 2009. Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications
6. Leedy, P.D. and Ormrod, J.E., 2004 Practical Research: Planning and Design, Prentice Hall.
7. Satarkar, S.V., 2000. Intellectual property rights and copy right. Ess Publications.

19PCM103	ANTENNAS AND RADIATING SYSTEMS LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To impart the knowledge on various antenna simulation tools used in Communication engineering.

LIST OF EXPERIMENTS:

1. Simulation of half wave dipole antenna.
2. Simulation of radiation pattern of dipole antenna.
3. Simulation of radiation pattern of Monopole antenna.
4. Simulation of the numerical evaluation of the parameters for the design of a patch antenna.
5. Simulations of Micro strip patch antenna using given specifications.
6. Simulation of different types of patch antenna using same operating frequency and analyze the parameters.
7. Simulation of slot antenna using given specifications.
8. Simulation of Radiation pattern of loop antenna.
9. Simulation of half wave dipole antenna array.
10. Simulation of Radiation pattern of Broad side array and End fire array antenna.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Design and simulate an antenna for the given specifications	**Apply**
CO2	Analyze the radiation pattern of various antennas	**Analyze**
CO3	Analyze the various parameters of patch antenna	**Analyze**
CO4	Apply appropriate software tools to make measurements of physical quantities.	**Apply**
CO5	Demonstrate proficiency in using discipline-specific tools.	**Apply**
CO6	Function effectively as an individual for efficiently executing the given task.	**Organize**

21PCM104	ADAPTIVE SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To impart the knowledge on various simulation tools used in communication engineering.

LIST OF EXPERIMENTS:

1. Stability analysis using Hurwitz Routh Criteria
2. Sampling of Input Sequence using FFT
3. State Space Matrix from Differential Equation
4. Normal Equation using Levinson Durbin
5. Decimation and Interpolation using Rationale Factors
6. Maximally Decimated Analysis DFT Filter
7. Chebychev Type I, II Filter
8. Cascade Digital IIR Filter Realization
9. Parallel Realization of IIR filter
10. Estimation of PSD
11. Inverse Z Transform
12. Group Delay Calculation
13. Separation of T/F

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Analyze the stability of various signal processing algorithms for the given specification.	**Analyze**
CO2	Analyze the different digital filters using Modern Tools.	**Analyze**
CO3	Apply various transforms in time and frequency domain to realize digital filters	**Apply**
CO4	Apply appropriate software tools to make measurements of physical quantities.	**Apply**
CO5	Demonstrate proficiency in using discipline-specific tools.	**Apply**
CO6	Function effectively as an individual for efficiently executing the given task.	**Organize**

SEMESTER II

SEMESTER II

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**19PCM201**	Advanced Communication Networks	**3**	**0**	**0**	**3**
2.	**19PCM202**	Wireless and Mobile Communication	**3**	**0**	**0**	**3**
3.	**-**	Elective II	**3**	**0**	**0**	**3**
4.	**19PGM802**	English for Research Paper Writing (Audit Course-2)	**2**	**0**	**0**	**0**
PRACTICAL						
5.	**19PCM203**	Advanced Communication Networks Lab	**0**	**0**	**4**	**2**
6.	**19PCM204**	Wireless and Mobile Communication Lab	**0**	**0**	**4**	**2**
7.	**19PCM205**	Mini Project with seminar	**0**	**0**	**6**	**3**
		Total	**11**	**0**	**14**	**16**
Total Number of Credits: 16						

19PCM201	ADVANCED COMMUNICATION NETWORK	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand advanced concepts, design and develop protocols for Communication Networks.
- To understand the mechanisms in QoS in networking and optimize the network design.
- To implement project based learning in recent communication networks

UNIT I	INTRODUCTION	9

Overview of Internet-Concepts, challenges and history. Overview of - ATM.TCP/IP. Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. TCP for high bandwidth delay networks. Fairness issues in TCP.

UNIT II	REAL TIME COMMUNICATIONS	9

Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model (intServ). Resource reservation in Internet. RSVP; Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP). Leaky bucket algorithm and its properties.

UNIT III	INTERNET QOS	9

Interference Management - Users' Distributions Modeling in Cognitive Radio Networks - Analysis of the Signal-to-Interference Plus Noise Ratio - Introducing Machine and Deep Learning into Cognitive Radio Networks - Training a Deep Learning Model- Application of Deep Learning in Spectrum Management - Deep Reinforcement Learning - The Role of Cognitive Radio Networks in Fifth-Generation Communication.

UNIT IV	INTERNET PROTOCOLS	9

IP address lookup-challenges. Routing Algorithm classification. Link -State Routing Algorithm State Routing Algorithm Packet classification algorithms and Flow Identification- Grid of Tries, Cross Producting and controlled prefix expansion algorithms. IP tunneling, IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS, QoS Protocols and Algorithms, Security Protocols and Algorithms

UNIT V	APPLICATIONS	9

Securing network connected applications with proposed security models. Locality of Internet Traffic: An analysis based upon traffic in an IP access network. 4G, 5G and Internet Protocols Integration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Explain the advanced concepts in Communication Networking	**Understand**
CO2	Apply the knowledge of protocols to develop Communication Networks.	**Apply**
CO3	Analyze the Quality-of-Service parameters in various networks	**Analyze**
CO4	Formulate optimization algorithms for the design of a network	**Apply**
CO5	Analyze the architectural issues of the application level services in the Internetworking for a given scenario	**Analyze**
CO6	Analyze the encryption techniques for security in a network	**Analyze**

REFERENCES:

1. Jean Wairand and PravinVaraiya, ―High Performance Communications Networks‖, 2nd edition, 2000.
2. Jean Le Boudec and Patrick Thiran, ―Network Calculus A Theory of Deterministic Queueing Systems for the Internet‖, Springer Veriag, 2001.
3. Zhang Wang, ―Internet QoS‖, Morgan Kaufman, 2001.
4. Anurag Kumar, D. Manjunath and Joy Kuri, ―Communication Networking: An Analytical Approach‖ , Morgan Kaufman Publishers, 2004.
5. George Kesidis, ―ATM Network Performance‖, Kluwer Academic, Research Papers, 2005.

19PCM202	WIRELESS AND MOBILE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand advanced concepts in the wireless propagation model.
- To understand the mechanisms in the different multicarrier modulation.
- To implement project based learning in recent multiple access schemes.

UNIT I	CELLULAR COMMUNICATION FUNDAMENTALS	9

Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD),General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

UNIT II	SPECTRAL EFFICIENCY ANALYSIS FOR MULTIPLE ACCESS TECHNOLOGIES	9

TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas. Wireless network planning (Link budget and power spectrum calculations) Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

UNIT III	MOBILE RADIO PROPAGATION	9

Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

UNIT IV	CODE DIVISION MULTIPLE ACCESS	9

Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.

UNIT V	HIGHER GENERATION CELLULAR STANDARDS	9

3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Explain the fundamentals of cellular communication	**Understand**
CO2	Apply the knowledge of multiple access technique to mitigate the degrading effects of fading channels	**Apply**
CO3	Analyze the different propagation models for cellular communication	**Analyze**
CO4	Classify various cellular network standards.	**Apply**
CO5	Apply the knowledge of cellular concept to compute the parameters	**Apply**

	of cellular services	
CO6	Analyze the error performance of various signaling schemes for fading channels	**Analyze**

REFERENCES:

1. Andrea Goldsmith, — Wireless Communications, Cambridge University Press ǁ, 2007.
2. Harry r. Anderson, — Fixed Broadband Wireless System Design ǁ, John Wiley, India, 2003.
3. Simon Haykin & Michael Moher, — Modern Wireless Communications ǁ, Pearson Education, 2007.
4. Yong Soo Cho, Jaekwon Kim et. al. MIMO-OFDM wireless Communication with Matlab, Wiley IEEE Press, 2010.
5. V.K.Garg, J.E.Wilkes, “Principle and Application of GSM”, Pearson Education, 5th edition, 2008.
6. V.K.Garg, “IS-95 CDMA & CDMA 2000”, Pearson Education, 4th edition, 2009.
7. William C. Y. Lee “Mobile Communications Engineering” Mc Graw Hill Publications,2017
8. Mobile cellular Telecommunication system Lee.C. Y William , Mc Graw Hill education ,Newdelhi 2017 ,ISBN13:978 -0070635999

19PCM203	ADVANCED COMMUNICATION NETWORKS LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To impart the knowledge on various advanced networking concepts in communication engineering.

LIST OF EXPERIMENTS:

1. Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.
2. Linux Network Configuration.
    a. Configuring NIC's IP Address.
    b. Determining IP Address and MAC Address using if-config command.
    c. Changing IP Address using if-config.
    d. Static IP Address and Configuration by Editing.
    e. Determining IP Address using DHCP.
    f. Configuring Hostname in /etc/hosts file.
3. Design TCP iterative Client and Server application to reverse the given input sentence.
4. Design a TCP concurrent Server to convert a given text into upper case using multiplexing system call —selectll.
5. Design UDP Client Server to transfer a file.
6. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
    a. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterize traffic when the DNS server is up and when it is down.
7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails.
8. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterize file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
9. Signaling and QoS of labeled paths using RSVP in MPLS.
10. Find shortest paths through provider network for RSVP and BGP.
11. Understand configuration, forwarding tables, and debugging of MPLS.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Demonstrate the different types of network devices and their functions.	**Apply**
CO2	Analyze the skills of subnetting to build a different routing mechanism	**Analyze**
CO3	Apply the knowledge of basic protocols to design network for a different configurations	**Apply**

CO4	Apply appropriate software tools to make measurements of physical quantities.	**Apply**
CO5	Demonstrate proficiency in using discipline-specific tools.	**Apply**
CO6	Function effectively as an individual for efficiently executing the given task.	**Organize**

19PCM204	WIRELESS AND MOBILE COMMUNICATION LAB	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To impart the knowledge on various simulation tools used in communication engineering.

LIST OF EXPERIMENTS:

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.
2. Knowing GSM architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.
3. Study of GSM handset for various signaling and fault insertion techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboard, User interface).
4. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK modulating signal.
5. To study various GSM AT Commands their use and developing new application using it.
6. Understating of 3G Communication System with features like; transmission of voice and video calls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network.
7. Knowing CDMA architecture, network concepts, call management, call setup, call release, Security and Power Control, Handoff Process and types, Rake Receiver etc.
8. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.
9. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, convolution encoder, Interleaver and De-Interleaver.
10. To study and analyze different modulation techniques in time and frequency domain using SDR kit.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Analyze different modulation techniques using simulation Software	**Analyze**
CO2	Design a cellular system for the given specification	**Apply**
CO3	Analyze different digital modulation techniques using SDR	**Analyze**
CO4	Apply appropriate software tools to make measurements of physical quantities.	**Apply-K3**
CO5	Demonstrate proficiency in using discipline-specific tools.	**Apply-K3**
CO6	Function effectively as an individual for efficiently executing the given task.	**Organize -A4**

19PCM205	MINI PROJECT WITH SEMINAR	L	T	P	C
		0	0	4	2

OBJECTIVE:

- To inculcate the importance of communication skills
- To familiarize with the concepts in emerging engineering field

DESCRIPTION:

This course is introduced to enrich the communication skills of the student and to create awareness on recent development in Electrical and Electronics Engineering through Technical presentation. In this course, a student has to present at least two technical papers or recent advances in Engineering / Technology that will be evaluated by a committee constituted by the Head of the Department. Students should work on a small research problem. Students have to carry out the project under the guidance of faculty member using the knowledge of subjects that he/she has learned. The student should submit the report at the end of the semester. The product should be demonstrated at the time of examination.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After the successful completion of this course, the student will be able to

CO1	Understand the basic concept of core subject	**Understand-K2**
CO2	Analyze the problem identification, formulation and Solution to solve the innovative ideas	**Apply-K3**
CO3	Develop innovative ideas to solve research problems	**Apply-K3**
CO4	Analyze and review research literature to solve the proposed innovative idea	**Apply-K3**
CO5	Implement the novelty in Mini reports with seminars	**Apply-K3**
CO6	Write effective reports and make clear presentations	**Organize-A4**

SEMESTER III

SEMESTER III

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**-**	Elective III	**3**	**0**	**0**	**3**
2.	**-**	Elective IV	**3**	**0**	**0**	**3**
3.	**-**	Elective V	**3**	**0**	**0**	**3**
4.	**-**	Open Elective	**3**	**0**	**0**	**3**
PRACTICAL						
5.	**19PCM301**	Dissertation Phase – I	**0**	**0**	**20**	**10**
		Total	**12**	**0**	**20**	**22**
Total Number of Credits: 22						

19PCM301	PHASE-I DISSERTATION	L	T	P	C
		0	0	20	10

- Every candidate shall be permitted to undertake a research-based project work of his/her choice related to his/her discipline/ interdisciplinary / multidisciplinary in consultation with the Head of the Department. The project shall be supervised by faculty members of the department in which the candidate registered a course.
- In case of a project work at Industrial/research organization, the project work shall be jointly supervised by the faculty supervisor and an expert from the organization. He/she shall be required to undergo three reviews in a semester to assess the progress of the project work.
- The project work shall be evaluated based on the project report submitted by the candidate and viva-voce examination conducted by a committee consisting of an external examiner, internal examiner and the supervisor of the candidate.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After the successful completion of this course, the student will be able to

CO1	Apply the knowledge gained from theoretical and practical courses in solving problems with innovative solutions and by planning organizing and coordinating for the execution of the project work	**Apply**
CO2	Analyze and interpret the data/information from various literature sources and synthesize the information to provide valid conclusions about the problem identification, formulation and solution of the project	**Analyze**
CO3	Design, model and develop optimal solutions for problems being investigated	**Create**
CO4	Demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context [Psychomotor Domain]	
CO5	Engage in learning for effective project implementation in the broadest context of technological change with consideration for public health, safety, cultural and societal needs.	
CO6	Write effective reports and make clear presentation to the engineering community and society.	

SEMESTER IV

SEMESTER IV

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1.	**19PCM401**	Dissertation Phase – II	**0**	**0**	**32**	**16**
		Total	**0**	**0**	**32**	**16**
Total Number of Credits: 16						

19PCM401	PHASE-II DISSERTATION	L	T	P	C
		0	0	24	12

- Every candidate shall be permitted to undertake a research-based project work of his/her choice related to his/her discipline/ interdisciplinary / multidisciplinary in consultation with the Head of the Department. The project shall be supervised by faculty members of the department in which the candidate registered a course.
- In case of a project work at Industrial/research organization, the project work shall be jointly supervised by the faculty supervisor and an expert from the organization. He/she shall be required to undergo three reviews in a semester to assess the progress of the project work.
- The project work shall be evaluated based on the project report submitted by the candidate and viva-voce examination conducted by a committee consisting of an external examiner, internal examiner and the supervisor of the candidate.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After the successful completion of this course, the student will be able to

CO1	Analyze and review the research literature critically and evolve suitable methodologies for solving the complex engineering problem	**Analyze**
CO2	Analyze the complex engineering problem critically to provide optimal solution after considering public health, safety, ethical, societal and environmental factors	**Analyze**
CO3	Design, model and develop optimal solutions for problems being investigated	**Create**
CO4	Utilize modern engineering and IT tools, techniques including prediction and modeling for complex engineering activities and augment the effectiveness of the solution with an understanding of the limitations	
CO5	Write effective reports and make clear presentation to the engineering community and society	
CO6	Engage in learning for effective project implementation with a commitment to improve knowledge and competence in context of technological updation.	

COURSE CATEGORY: PROGRAM ELECTIVES

S.No	Course Code	Course Title	L	T	P	C
1.	**19PCM501**	Wireless Sensor Networks	**3**	**0**	**0**	**3**
2.	**19PCM502**	Optical Networks	**3**	**0**	**0**	**3**
3.	**19PCM503**	Cognitive Radio	**3**	**0**	**0**	**3**
4.	**19PCM504**	RF Circuits and Microwave Systems	**3**	**0**	**0**	**3**
5.	**19PCM505**	Communication Network Security	**3**	**0**	**0**	**3**
6.	**19PCM506**	Satellite Communication	**3**	**0**	**0**	**3**
7.	**19PCM507**	Communication Protocol Engineering	**3**	**0**	**0**	**3**
8.	**19PCM508**	Speech and Audio Signal Processing	**3**	**0**	**0**	**3**
9.	**19PCM509**	MIMO System	**3**	**0**	**0**	**3**
10.	**19PCM510**	High Performance Communication Networks	**3**	**0**	**0**	**3**
11.	**19PCM511**	Pattern Recognition	**3**	**0**	**0**	**3**
12.	**19PCM512**	Microelectronics and VLSI Technology	**3**	**0**	**0**	**3**
13.	**19PCM513**	Smart Devices and Emerging Mobile Technologies	**3**	**0**	**0**	**3**
14.	**19PCM514**	Network Management System	**3**	**0**	**0**	**3**
15.	**19PCM515**	Ubiquitous Computing and Pervasive Computing	**3**	**0**	**0**	**3**
16.	**19PCM516**	DSP Processor Architecture and Programming	**3**	**0**	**0**	**3**
17.	**19PCM517**	Mobile and Social Computing	**3**	**0**	**0**	**3**
18.	**19PCM518**	Data Compression	**3**	**0**	**0**	**3**
19.	**19PCM519**	Medical Imaging Techniques	**3**	**0**	**0**	**3**
20.	**19PCM520**	Global Positioning Systems	**3**	**0**	**0**	**3**

COURSE CATEGORY: OPEN ELECTIVE

S.No	Course Code	Course Title	L	T	P	C
1.	**19PCD601**	Industrial Safety	**3**	**0**	**0**	**3**
2.	**19PCS602**	Business analytics	**3**	**0**	**0**	**3**
3.	**19PCM603**	IoT for Smart Applications	**3**	**0**	**0**	**3**
4.	**19PPE604**	Bio Energy from Waste	**3**	**0**	**0**	**3**
5.	**19PSE605**	Smart City Technologies	**3**	**0**	**0**	**3**

COURSE CATEGORY: AUDIT COURSES

S.No	Course Code	Course Title	L	T	P	C
1.	**19PGM801**	Pedagogy Studies	**2**	**0**	**0**	**0**
2.	**19PGM802**	English for Research Paper Writing	**2**	**0**	**0**	**0**

19PCM501	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To expertise on sensor networks and their Applications, localization and positioning.
- To explain the concepts of routing protocols and topology control.
- To summarize the Operating Systems and Programming Concepts for WSNs

UNIT 1	INTRODUCTION	9

Wireless Sensor Networks - Characteristics requirements- -Unique Constraints and Challenges – Difference between Mobile adhoc and Sensor Networks- Advantages of sensor networks - Sensor Node Architecture - Sensor Network Architecture - Sensor Networks Applications: Environmental Monitoring, Industry Automation, Disaster Management, Mobile Crowd Sensing Applications -Smart Cities, Road Transportation, Health Care and Well-Being, Marketing/Advertising.

UNIT II	LOCALIZATION AND POSITIONING	9

Properties of localization and positioning procedures, Possible approaches, Mathematical basics for the lateration problem, Single-hop localization, Positioning in multi hop environments, Impact of anchor placement.

UNIT 3	ROUTING PROTOCOLS FOR WIRELESS SENSOR NETWORK	9

Medium Access Control - The S-MAC Protocol- IEEE 802.15.4 Standard and ZigBee - General Issues **-** Geographic, Energy-Aware Routing - Unicast Geographic Routing - Routing on a Curve-Energy-Minimizing Broadcast - Energy-Aware Routing to a Region - Attribute-Based Routing - Directed Diffusion - Rumor Routing - Geographic Hash Tables .

UNIT 4	TOPOLOGY CONTROL	9

Topology Control - Clustering - Time Synchronization - Clocks and Communication Delays - Interval Methods - Reference Broadcasts - Localization and Localization Services -Ranging Techniques - Range-Based Localization Algorithms - Other Localization Algorithms - Location Services

UNIT V	OPERATING SYSTEMS AND PROGRAMMING WSN	9

Operating Systems for WSNs: Introduction, Architecture, Execution Model Case Study: Popular Operating Systems-TinyOS, Contiki, MagnetOS, Mantis OS. Programming WSNs: Simulation Tools-TOSSIM, COOJA, Castalia, NS-3 Case study: Performance comparison of energy efficient cluster based routing protocols

Total :45 Periods

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the advantages and applications of sensor networks.	**Understand-K2**
CO2	Discuss the different methods of localization and positioning methods.	**Understand-K2**
CO3	Apply the knowledge of sensor network to design different network architecture.	**Apply-K3**
CO4	Analyze the flat and hierarchical network topology control.	**Apply-K3**
CO5	Analyze the various routing protocols in sensor networks.	**Analyze-K4**
CO6	Develop Energy efficient protocols for wireless sensor networks.	**Evaluate-K5**

TEXT BOOKS:

1. Feng Zhao Feng Zhao Leonidas Guibas Leonidas Guibas, Wireless Sensor Networks,"An Information Processing Approach, 1st Edition, 2004, Elsevier.

REFERENCES:

1. Holger Karl And Andreas Willig, " Protocols and Architectures for Wireless Sensor Networks ", John Wiley & Sons, 2005.
2. KazemSohraby, Daniel Minoli, &TaiebZnati, "Wireless Sensor Networks-s Technology, Protocols, And Applications ", John Wiley, 2007.
3. Nandini Mukherjee SarmisthaNeogySarbani Roy, Building Wireless Sensor Networks Theoretical & Practical Perspectives, CRC Press, 2016.
4. John R. Vacca, Handbook of Sensor Networking Advanced Technologies and Applications, CRC Press, 2015.

19PCM502	OPTICAL NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge on optical system components and optical network architectures.
- To give an idea about the wavelength routing networks and packet switching and access networks**.**

To familiarize the students on the network design and management

Unit1	OPTICAL SYSTEM COMPONENTS	9

Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

Unit2	OPTICAL NETWORK ARCHITECTURES	9

Introduction to Optical Networks; Metropolitan-Area Networks, Layered Architecture Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Test beds for Broadcast & Select WDM; Introduction to PON, GPON, APON

Unit 3	WAVELENGTH ROUTING NETWORKS	9

The optical layer, Node Designs, Optical layer cost tradeoff, Routing andwavelength assignment, Virtual topology design, Wavelength Routing Test beds, Architectural variations

Unit 4	PACKET SWITCHING AND ACCESS NETWORKS	9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks; Access Networks – Network Architecture overview, Future Access Networks, Optical Access Network Architectures; and OTDM networks.

Unit 5	NETWORK DESIGN AND MANAGEMENT	9

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion; Wavelength stabilization ; Overall design considerations; Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe various optical network components and architectures.	**Understand**
CO2	Apply the concept of data communication network to study optical transmission systems and management.	**Apply**
CO3	Design simple optical networks using modern engineering tools.	**Apply**
CO4	Analyze the characteristics of various optical modulation and demodulation techniques.	**Analyze**

CO5	Analyze the performance of different optical network architectures.	**Analyze**
CO6	Evaluate the photonic packet switching and access networks.	**Evaluate**

TEXTBOOKS:

1. Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki, “Optical Networks: A practical perspective,” Morgan Kaufman Publishers, Third edition, 2010.

REFERENCES:

1. Mohammad Ilyas, Hussein T. Mouftah, “Handbook of Optical Communication Networks”, Taylor and Francis, First edition, 2007.
2. C.Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Prentice Hall of India, First Edition, 2002.
3. Biswanath Mukherjee, “Optical Communication Networks”, McGrawHill Revised Edition 2006.
6. 4. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.

19PCM503	COGNITIVE RADIO	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concept of Cognitive Radio Networks.
- To impart the knowledge of Cognitive Radio and Networks
- To introduce the different Dynamic Spectrum Access of Cognitive radio.

Unit1	Introduction to Cognitive Radio Networks (CRN)	9

Software-defined radio - Cognitive radio features and capabilities - Research challenges in cognitive radio - Cognitive radio architectures for Next Generation (XG) networks - Cognitive radio standardization - Limitations with Cognitive Radio Network Applications - Architectural Descriptions of Cognitive Radio Networks - Cognitive Radio Networks as Heterogeneous Systems - Technologies to Drive Cognitive Radio Network.

Unit2	Spectrum Sensing in Cognitive Radio Networks	9

Energy Detection Techniques - Matched Filter Detection Techniques - Cyclo-stationary Feature Detection Techniques - Waveform-Based Sensing Techniques - Radio Identification Sensing Techniques - Techniques that Employ Multiple Antennas - Problems Associated with Spectrum Sensing in CRN - Determining Sensing Accuracy- Cooperative Spectrum Sensing in Cognitive Radio Networks - Spectrum Prediction for Cognitive Radio Network Applications - Spectrum Sensing for Cognitive OFDMA Systems - Spectrum Sensing for Cognitive Multi-Radio Networks.

Unit 3	Resource Management inCognitive Radio Networks	9

Interference Management - Users' Distributions Modeling in Cognitive Radio Networks - Analysis of the Signal-to-Interference Plus Noise Ratio - Introducing Machine and Deep Learning into CognitiveRadio Networks - Training a Deep Learning Model- Application of Deep Learning in Spectrum Management - Deep Reinforcement Learning - The Role of Cognitive Radio Networks in Fifth-Generation Communication.

Unit 4	Dynamic Spectrum Access of Cognitive Radio	9

Spectrum access models - Dynamic spectrum access architecture - Medium access control for dynamic spectrum access - Open issues in dynamic spectrum access - Centralized dynamic spectrum access - Distributed dynamic spectrum access: cooperative and non-cooperative approaches.

Unit 5	Trusted Cognitive Radio Networks	9

Framework of Trust in CRN - Trusted Association and Routing - Trust with Learning - Security in CRN - Spectrum Management of Cognitive Radio Networks: Spectrum Sharing - Spectrum Pricing - Mobility Management of Heterogeneous Wireless Networks - Regulatory Issues and International Standards - Public safety and cognitive radio.

TOTAL:45 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to:

CO1	Explain the concept of Cognitive Radio Networks	**Understand-K2**
CO2	Apply appropriate techniques for the Spectrum Sensing in Cognitive Radio Networks	**Apply-K3**

CO3	Apply the Cognitive Radio design methodologies for wireless applications.	**Apply-K3**
CO4	Analyze the Spectrum Access of Cognitive Radio	**Analyze-K4**
CO5	Analyze the different cognitive radio techniques for spectrum holes detection	**Analyze-K4**
CO6	Compare the various sensing techniques in cognitive radio networks using modern tools.	**Analyze-K4**

TEXTBOOKS:

2. Bodhaswar TJ Maharaj, Babatunde Seun Awoyemi, Developments in Cognitive Radio Networks: Future Directions for Beyond 5G, Springer, 2022.
3. Ekram Hossain, Dusit Niyato, Zhu Han, Dynamic Spectrum Accessand Management in CognitiveRadio Networks, Cambridge University Press 2009.
4. Kwang-Cheng Chen, Ramjee Prasad, Cognitive Radio Networks, John Wiley &Sons Ltd., 2009.

REFERENCES:

7. Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, “Cognitive Radio Communications and Networks - Principles And Practice”, Elsevier Inc., 2010.
8. Bruce Fette, Cognitive Radio Technology - Second Edition, Elsevier, 2009.
9. Huseyin Arslan, Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.

19PCM504	RF CIRCUITS AND MICROWAVE SYSTEMS	L	T	P	C
		3	0	0	3

PRE-REQUISITE: MICROWAVE ENGINEERING

COURSE OBJECTIVES :

- To familiarize the concept of filters and RF amplifier design
- To familiarize with the usage of active and passive components of microwave systems.
- To know the various microwave measurements and its effect on different applications

UNIT I	RF TRANSISTOR AMPLIFIER DESIGN	9

RF Components : Diodes, BJT,FET, Characteristics of Amplifiers-Amplifiers Power relations-Stability Considerations-Constant Gain-Noise Figure Circles-Constant VSWR circles-Broadband High Power and Multistage Amplifiers.

UNIT II	RF FILTER DESIGN	9

Generalization-Basic Resonator and Filter configurations: Low pass, High Pass, Band Pass and Band stop type Filters-Special filter Realizations-Filter Implementations using unit element and kuroda`s identities-Coupled Filters.

UNIT III	RF OSCILLATORS AND MIXERS	9

Basic Oscillator Model, High-Frequency Oscillator Configuration, Dielectric Resonator Oscillators, YIG-Tuned Oscillator, Basic Characteristics of Mixers, Single-Ended Mixer Design, Single-Balanced Mixer, Double-Balanced Mixer.

UNIT IV	INTRODUCTION TO MICROWAVE SYSTEMS	9

Wireless Communications system, Radar Systems, Radiometer Systems, Satellite Communication, Remote sensing, Radio Navigation and Global Positioning Systems, Microwave Propagation, Microwave Antennas .

UNIT V	MICROWAVE MEASUREMENTS	9

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.

TOTAL: 45 Periods

COURSE OUTCOMES

After completion, the student will be able to

CO1	Explain the basic concept of RF circuits and microwave systems.	**Understand-K2**
CO2	Apply the knowledge of active components to design the RF devices.	**Apply-K3**
CO3	Apply the knowledge of spectrum analyzer to measure the spectrum of a microwave signal.	**Apply-K3**
CO4	Analyze the performance parameters of filters used for	**AnalyzeK4**

	RF circuits.	
CO5	Analyze the RF signals using the various measurement techniques.	**Analyze-K4**
CO6	Design a circuit using RF and Microwave components for wireless communication system.	**Analyze-K4**

REFERENCE BOOKS:

1. Reinhold .Ludwig and Pavel Bretshko, “RF Circuit Design”, Pearson Education, 2006.
2. Joseph J. Carr, “RF Components and Circuits”, Newnes, 2002.
3. AnanjanBasu “An Introduction to Microwave Measurements”, CRC Press July 2017.
4. Kai chang, “RF and Microwave Wireless Systems” wiley edition 2000.

19PCM505	COMMUNICATION NETWORK SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concept of security and explain symmetric and asymmetric key algorithms
- To impart knowledge on integrity, authentication and key management.
- To outline the concept of network security and wireless network security.

UNIT 1	INTRODUCTION ON SECURITY	9

Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and availability. Security services and mechanisms, Techniques: Cryptography, Steganography, Revision on Mathematics for Cryptography.

UNIT II	SYMMETRIC & ASYMMETRIC KEY ALGORITHMS	9

Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers, Data Encryption Standards (DES), Advanced Encryption Standard (AES), RC4, principle of asymmetric key algorithms, RSA Cryptosystem , Shamir's secret sharing and BE, Identity-based Encryption (IBE), Attribute-based Encryption (ABE). Introduction to Quantum Cryptography, Block chain, Bit coin and Crypto currency.

UNIT III	INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT	9

Message Integrity, Hash functions: SHA, Digital signatures: Digital signature standards. Authentication: Entity Authentication: Biometrics, Key management Techniques

UNIT IV	NETWORK SECURITY , FIREWALLS AND WEB SECURITY	9

Introduction on Firewalls, Types of Firewalls, Firewall Configuration and Limitation of Firewall. IP Security Overview, IP security Architecture, authentication Header, Security payload, security associations, Key Management. Web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature. Side-channel attack, Pretty Good Privacy (PGP).

UNIT V	WIRELESS NETWORK SECURITY	9

Security Attack issues specific to Wireless systems: Worm hole, Tunneling, DoS. WEP for Wi-Fi network, Security for 4G networks: Secure Ad hoc Network, Secure Sensor Network Projects for Teaching cryptography and network security. Research projects, Programming projects reading report assignment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Explain the basic concepts in Communication Network Security	**Understand-K2**
CO2	Describe the various network security services and mechanism.	**Understand-K2**
CO3	Apply the knowledge of mathematical theory to develop different network security algorithms	**Apply-K3**
CO4	Apply the concepts of Digital Signature, Authentication to secure communication networks.	**Apply-K3**
CO5	Analyze the performance of different encryption techniques .	**Analyze-K4**
CO6	Analyze and resolve security issues in networks.	**Analyze-K4**

TEXTBOOKS:

1. Behrouz Forouzan.A , " Cryptography and Network security ", Tata McGraw- Hill, 2008.
2. William Stallings, " Cryptography and Network security: principles and practice ", Prentice Hall of India, 2nd Edition, New Delhi, 2002.

REFERENCE BOOKS:

1. Atul Kahate, " Cryptography and Network security ", Tata McGraw- Hill , 2nd Edition, 2008.
2. Yang.H, " Security in Mobile Ad Hoc Networks: Challenges and Solution ", IEEE Wireless Communications, 2004.

19PCM506	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce about the elements of satellite Communication.
- To explain the modulation and multiple access schemes.
- To summarize about satellites and its applications

Unit – 1	ELEMENTS OF SATELLITE COMMUNICATION	9

Satellite Systems, Orbital description and Orbital mechanics of LEO, MEO and GSO, Placement of a Satellite in a GSO, Satellite – description of different Communication subsystems, Bandwidth allocation.

Unit – 2	TRANSMISSION, MODULATION, MULTIPLE ACCESS	9

Phased arrays for satellite communications, satellite laser communications, Features of RF and optical space communication systems, wireless standards in satellite networking, Tracking and Data Relay Satellite K (TDRS-K) , Multiple Access Techniques – DMA, TDMA, CDMA, and DAMA.

Unit – 3	SATELLITE LINK DESIGN	9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

Unit – 4	SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM	9

Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Receiver Operation and Differential GPS.

Unit – 5	SERVICES AND APPLICATIONS	9

Mixed and mobile services - Multimedia satellite services - Advanced applications based on satellite platforms - INTELSAT series ,Remote Sensing - Special services, E-mail, Video conferencing and Internet connectivity ,Mission Chandrayan and Mission Mangalyaan.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the fundamental concepts of satellite communication	**Understand-K2**
CO2	Apply various modulation techniques and interference involved in satellite communication.	**Apply-K3**

CO3	Apply the knowledge of GPS to analyze the satellite Navigation.	**Apply-K3**
CO4	Design real time applications for satellite communication.	**Apply-K3**
CO5	Apply the knowledge of various services in satellite communication.	**Apply-K3**
CO6	Analyze the various interference in satellite link design	**Analyze-K4**

TEXT BOOKS:

1. Wilbur Pritchard.L,Suyderhoud.H.D,RobertNelson.A, " Satellite Communication Systems Engineering ", Prentice Hall, New Jersey, 2006.

REFERENCES:

1. Timothy Pratt, Charles Bostian.W, " Satellite Communications ", John Wiley and Sons, 2010.
2. Roddy.D, " Satellite Communication ", McGrawHill, 2008.
3. Tri T Ha, " Digital Satellite Communication ", McGraw Hill, 2009.

19PCM507	COMMUNICATION PROTOCOL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the specifications of protocol and various protocol verification/validation approaches
- Give knowledge on protocol conformance, performance testing and their implementation and synthesis.
- To impart knowledge in Networking protocols and standards used in Internet of Things

Unit – 1	PROTOCOL SPECIFICATIONS	9

Components of protocol, Specifications of Communication service, Protocol entity, Interface, Interactions, Multimedia protocol, Internet protocol, SDL, SDL based protocol other protocol specification languages

Unit – 2	PROTOCOL VERIFICATION / VALIDATION	9

Protocol verification, Verification of a protocol using finite state machines, Protocol validation, protocol design errors, Protocol validation approaches, SDL based protocol verification and validation.

Unit – 3	PROTOCOL CONFORMANCE/PERFORMANCE TESTING	9

Conformance testing methodology and frame work, Conformance test architectures, Test sequence generation methods, Distributed architecture by local methods, Conformance testing with TTCN, systems with semi controllable interfaces - RIP,SDL based tools for conformance testing, SDL based conformance testing of MPLS Performance testing, SDL based performance testing of TCP and OSPF, Interoperability testing, SDL based interoperability testing of CSMA/CD and CSMA/CA protocol using Bridge, Scalability testing.

Unit – 4	PROTOCOL SYNTHESIS AND IMPLEMENTATION	9

Protocol synthesis, Interactive synthesis algorithm, Automatic synthesis algorithm, Automatic synthesis of SDL from MSC, Protocol Re-synthesis; Requirements of protocol implementation, Object based approach to protocol implementation, Protocol compilers, Tool for protocol engineering

Unit – 5	INTERNET OF THINGS PROTOCOLS AND STANDARDS	9

IoT Data Link Protocol, Network Layer Routing Protocols, Network Layer Encapsulation Protocols, MQTT,SMQTT,CoAP Protocols, IoT Management Protocol, and Security in IoT Protocols, IoT Challenges.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Explain the basic concepts in Communication Network Security	**Understand-K2**

CO2	Describe the various network security services and mechanism.	**Understand-K2**
CO3	Apply the knowledge of mathematical theory to develop different network security algorithms	**Apply-K3**
CO4	Apply the concepts of Digital Signature, Authentication to secure communication networks.	**Apply-K3**
CO5	Analyze the performance of different encryption techniques .	**Analyze-K4**
CO6	Analyze and resolve security issues in networks.	**Analyze-K4**

TEXT BOOKS:

1. Behrouz Forouzan.A , " Cryptography and Network security ", Tata McGraw- Hill, 2008.
2.William Stallings, " Cryptography and Network security: principles and practice ", Prentice Hall of India, 2nd Edition, New Delhi, 2002.

REFERENCES:

1. Atul Kahate, " Cryptography and Network security ", Tata McGraw- Hill , 2nd Edition, 2008.
2. Yang.H, " Security in Mobile Ad Hoc Networks: Challenges and Solution ", IEEE Wireless Communications, 2004.

19PCM508	SPEECH AND AUDIO SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of speech signal, speech production mechanisms
- To explore time domain and frequency domain analysis of speech signal
- To impart LPC based characterization applications of speech signal processing .

UNIT I	MECHANICS OF SPEECH	9

Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Representation of Speech signals – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Music production – Auditory perception – Anatomical pathways from the ear to the perception of sound – Peripheral auditory system – Psycho acoustics.

Unit – 2	TIME DOMAIN METHODS FOR SPEECH PROCESSING	9

Time domain parameters of Speech signal – Methods for extracting the parameters Energy-Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy – Short Time Auto Correlation Function – Pitch period estimation using Auto Correlation Function.

Unit – 3	FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING	9

Short Time Fourier analysis – Filter bank analysis – Formant extraction – Pitch Extraction – Analysis by Synthesis-Analysis synthesis systems- Phase vocoder—Channel vocoder. Homomorphic speech analysis: Cepstral analysis of Speech – Formant and Pitch Estimation Speech enhancement techniques in time domain –Homomorphic vocoders.

UNIT – 4	LINEAR PREDICTIVE ANALYSIS OF SPEECH	9

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin's Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP.

Unit – 5	APPLICATION OF SPEECH & AUDIO SIGNAL PROCESSING ALGORITHMS	9

Spectral Estimation, dynamic time warping – Hidden Markov model – Music analysis – Pitch Detection– Feature analysis for recognition – Music synthesis – Automatic Speech Recognition – Feature Extraction for ASR – Deterministic sequence recognition – Statistical Sequence recognition – ASR systems – Speaker identification and verification – Voice response system ,Voice activity detection for speech coding-simulation of audio coding techniques

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Understand Speech and audio signal production and perception mechanisms.	**Understand-K2**
CO2	Apply speech processing solutions based on filter banks	**Apply-K3**
CO3	Analyze speech and audio signals in the time and frequency domains.	**Analyze-K4**
CO4	Analyze speech signals using LPC coder	**Analyze-K4**
CO5	Analyze speech recognition, speaker identification and speech synthesis schemes.	**Analyze-K4**
CO6	Analyze various applications of Automatic speech recognition algorithms	**Analyze-K4**

REFERENCES:

1. L.R.Rabiner and R.W. Schaffer., Digital Processing of Speech signals – Prentice Hall – 1978.
2. Ben Gold and Nelson Morgan, Speech and Audio Signal Processing, John Wiley and Sons Inc., 2004.
3. Quatieri ,Discrete-time Speech Signal Processing , Prentice Hall, 2001.
4. J.L.Flanagan ,Speech analysis: Synthesis and Perception ,Berlin,1972.
5. I.H. Witten, Principles of Computer Speech – Academic Press, 1982.

19PCM509	MIMO Systems	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge about MIMO Channel modeling and system architecture.
- To introduce space time block codes and space time trellis codes.
- To explain the practical applications of MIMO systems.

UNIT – 1	Spatial Multiplexing And Channel Modeling	9

Review of SISO fading communication channels- Multiplexing capability of deterministic MIMO, Physical modeling of MIMO Channels, Modeling of MIMO fading channels, MIMO wireless communication, MIMO channel and signal model, A fundamental trade-off, MIMO transceiver design, MIMO in wireless networks, MIMO in wireless standards.

UNIT – 2	Capacity and Multiplexing Architectures	9

The V-BLAST architecture, Fast fading MIMO channel. Receiver architectures, Slow fading MIMO channel, D-BLAST: an outage-optimal architecture.

UNIT – 3	Diversity–Multiplexing Tradeoff And Space Time Block Codes	9

Diversity–multiplexing tradeoff, Space time block codes on real and complex orthogonal designs, Code design criteria for quasi-static channels (Rank, determinant and Euclidean distance), Quasi-orthogonal designs and Performance analysis.

UNIT – 4	Space Time Trellis Codes	9

Representation of STTC, shift register, generator matrix, state-transition diagram, trellis diagram, Code construction, Delay diversity as a special case of STTC and Performance analysis.

UNIT – 5	Multiuser Communication	9

Access protocols: duty-cycle, scheduled, random access, polling-based, Uplink with multiple receive antennas, MIMO uplink, Downlink with multiple transmit antennas, MIMO downlink, MIMO in 4G (LTE, LTE-Advanced and WiMAX) and 5G, Antenna partitioning technique for MIMO-CDMA systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the concepts of mathematical model for the design of MIMO channels	**Understand-K2**
CO2	Design a space time MIMO wireless communication architecture for the given specifications	**Apply-K3**
CO3	Analyze and Design various space time block codes.	**Apply-K3**
CO4	Analyze the wireless channel characteristics and identify appropriate channel models.	**Analyze-K4**

CO5	Analyze the performance of MIMO systems in various applications.	**Analyze-K4**
CO6	Design space time trellis codes for a given specification and develops skills to solve engineering problems	**Evaluate-K5**

TEXT BOOKS:

1. Nei David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication ”, Cambridge University Press 2005, Press 2005.
2. Hamid Jafarkhani, , “ Space-Time Coding: Theory and Practice ”, Cambridge University, Press 2005.

REFERENCES:

1. Paulraj, R. Nabar and D. Gore, “Introduction to Space-Time Wireless Communications ”, Cambridge University, Press 2005.
2. E.G. Larsson and P. Stoica,“Space-Time Block Coding for Wireless Communications ”, Cambridge University, Press 2008.
3. M. Janakiraman,“Space-time codes and MIMO systems ”, Artech House, 2004.
4. Ezio Biglieri , Robert Calder bank et al, “ MIMO Wireless Communications ”, Cambridge University, Press 2007.

19PCM510	HIGH PERFORMANCE COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on Fundamentals of computer networks and wireless networks.
- To learn the architecture and uniqueness of high performance networks.

To familiarize the students on the network design and management

UNIT 1	INTRODUCTION COMMUNICATION NETWORKS	9

Telephone and computer networks - cable television networks - wireless networks - networking principles - digitalization - traffic characterization and QoS - network services - network elements - network mechanisms - layered architecture - network bottlenecks.

UNIT II	BROADBAND WIRELESS NETWORKS	9

Evolution of Broadband wireless – fixed broadband wireless – mobile broadband wireless – MANET architecture – mobile adhoc routing protocols – modeling and simulation tools for MANET – performance of MANET routing protocols – routing modeling – mathematical analysis.

UNIT III	INTERNET AND TCP/IP NETWORKS	9

Technology trends in IP networks - IP packet communications in mobile communication networks - TCP and UDP - performance of TCP/ IP networks - Circuit Switched Networks: SONET - DWDM - fiber to the home – DSL - Intelligent Network (IN) scheme - comparison with conventional systems - merits of the IN scheme – CATV and layered network – services over CATV.

UNIT IV	ATM NETWORKS	9

ATM reference model – Addressing - Signaling – Routing - ATM Adaptation Layer (AAL) – ATM Traffic and service parameterization - ATM traffic management - Switching in ATM - ATM Network Interfaces and Architecture – Multiprotocol over ATM.

UNIT V	HIGH PERFORMANCE NETWORKS	9

WiMAX overview - WIMAX physical layer - Overview of MAC Layer - Network Reference Model - Overview of LTE - Overview of LTE-A - Uplink transmission scheme and frame structure - Downlink multi antenna techniques - Transmission modes.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Explain the concepts of the various network topologies.	**Understand-K2**
CO2	Design ATM Networks using different protocols	**Apply-K3**
CO3	Design routing networks and virtual topology.	**Apply-K3**
CO4	Select the most appropriate wireless broadband network and analyze its structure	**Analyze-K4**
CO5	Analyze the various advanced high performance networks.	**Analyze-K4**
CO6	Analyze the various network services.	**Analyze-K4**

TEXT BOOKS:

1. Jean Warland and Pravin Varaiya, “High Performance Communication Networks”, 2nd Edn. (onwards), Harcourt and Morgan Kanffman Publishers, London, 2008.
2. Leo , Jonathan. “Mobile Ad Hoc Networks”, Taylor and series, 2011.
3. Sumit Kasera and Pankaj Sethi, “ATM Networks: Concepts and Protocols”, Tata McGraw Hill, 2007.
4. Jeffrey G. Andrews, Arunabha Ghosh and Rias Muhamed, “Fundamentals of WiMAX Understanding Broadband Wireless Networking”, Prentice Hall of India, 2008.
5. Amitabha Ghosh and RapeepatRatasuk, “Essentials of LTE and LTE-A”, CambridgeUniversity, 2011.

19PCM511	PATTERN RECOGNITION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce statistical theory in pattern recognition.
- To give knowledge on parametric and nonparametric models.
- To explain the various clustering algorithms and fuzzy based classification in Pattern Recognition

UNIT – 1	INTRODUCTION	9

Introduction: Basics of pattern recognition – Design principles of pattern recognition system – Learning and adaptation – Pattern recognition approaches. Mathematical foundations: Linear algebra – Probability theory – Expectation – Mean and Covariance – Normal distribution – Multivariate normal densities – Chi square test of hypothesis.

UNIT – 2	STATISTICAL PATTERN RECOGNITION	9

Bayesian Decision Theory – Classifiers- linear and nonlinear classifiers – Normal density and discriminant functions.

UNIT – 3	GENERATIVE METHODS	9

Maximum-Likelihood and Bayesian Parameter Estimation -Maximum-Likelihood estimation – Bayesian Parameter estimation – Dimension reduction methods – Principal Component Analysis (PCA) – Fisher Linear Discriminant analysis – Expectation – maximization (EM) – Hidden Markov Models (HMM) – Gaussian mixture models. Nonparametric Techniques-Density Estimation.

UNIT – 4	DISCRIMINATIVE METHODS	9

Distance-based Method -Nearest neighbor Classification ,Metrics and Tangent Distance, Fuzzy Linear Discriminant Functions -Geometry, Gradient, Minimum, Support,Artificial Neural Networks -Biological Motivation and Back-Propagation.

UNIT – 5	UNSUPERVISED LEARNING AND CLUSTERING	9

Criterion functions for clustering – Clustering Techniques: Iterative square – Error partitional clustering – K-Means – agglomerative hierarchical clustering – Cluster validation, SVM, CNN, RNN algorithms.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the basic principles in pattern recognition	**Understand-K2**
CO2	Apply pattern recognition techniques to solve real-world problems	**Apply-K3**
CO3	Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers for an application	**Apply-K3**
CO4	Analyze Parametric and non-parametric methods for pattern recognition	**Analyze-K4**

CO5	Evaluate the performance of the supervised and unsupervised classification in pattern recognition.	**Evaluate-K5**
CO6	Modern Tool Usage: Create the pattern recognition application using Fuzzy classification and clustering techniques**.**	**Create-K6**

TEXT BOOKS:

1. Richard O. Duda, Peter E. Hart, David G. Stork, " Pattern Classification ", John Wiley, 2nd Edition, 2006.
2. Bishop Christopher M, "Pattern Recognition and Machine Learning ", Springer, 1st Edition, 2009.
3. Theodoridis S, Koutroumbas K, "PatternRecognition ", Academic Press, 4th Edition, 2009.

REFERENCES:

1. Keinosuke Fukunaga, "Introduction to Statistical Pattern Recognition ", Academic Press, 2nd Edition, 2003.
2. Statistics and the Evaluation of Evidence for Forensic Scientists by C. Aitken and F. Taroni, Wiley, 2004.

19PCM512	MICROELECTRONICS AND VLSI TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVE:

- To Impart Knowledge on physics of semiconductors and quantitative models.
- To understand the basics of semiconductor crystal properties, IC fabrication and automation.
- To identify the issues at various stages of VLSI physical design involved in fabrications.

UNIT I	PHYSICS OF SEMICONDUCTORS	9

Review of semiconductor physics –quantum foundations -Semiconductor band structure, Simplified band structure models, Carrier concentration –non equilibrium –quasi Fermi levels -drift and diffusion –mobility –generation and recombination –continuity equation.

UNIT II	BASICS OF SEMICONDUCTOR CRYSTAL PROPERTIES	9

Material properties, crystal structure, lattice, basis, planes, directions, angle between different planes, phase diagram and solid solubility, Crystal growth techniques, Epitaxy, Clean room and safety requirements. Oxidation: wet and dry oxidation, Deal-Grove model, Diffusion process, Ion implantation, modeling of Ion implantation, statistics of ion implantation, rapid thermal annealing, SIMS.

UNIT III	ADVANCED METHODS IN FABRICATIONS	9

Deposition & Growth: Various deposition techniques CVD, PVD, evaporation, sputtering, spin coating, LPCVD, MBE, ALCVD, Growth of High k and low k dielectrics, Etching -wet and dry etch, plasma and RIE etch, Photolithography: Positive photo resist, negative photo resist, comparison of photo resists, components of a resist, light sources, exposure, resolution, depth of focus, numerical aperture sensitivity, contrast, proximity and projection lithography, step and scan, optical proximity correction.

UNIT IV	PHYSICAL DESIGN AUTOMATION	9

Introduction to digital IC design -custom and semicustom flow, combinational logic synthesis -Technology independent and technology dependent optimization -Binary decision diagrams -High level synthesis-Scheduling and allocation –Physical design –terminology –graph algorithms –heuristic algorithms–Basic Unix/Linux commands –introduction to C shell/Perl scripting.

UNIT V	NANO –ELECTRONICS	9

Nano-scale electronics; Foundation of nano-electronics – low dimension transport, quantum confinement, Coulomb blockade and quantum dot; Ballistic transport and Quantum interferences; Landauer formula, quantization of conductance, example of Quantum point contact.

TOTAL : 45 PERIODS

COURSE OUTCOMES: At the end of the course the student will be able to:		
CO1	Outline the basics of semiconductor crystal properties	**Understand-K2**
CO2	Build an idea on nano-electronics and its technology	**Understand-K2**
CO3	Apply the semiconductor phenomena relevant to the field of electronics	**Apply-K3**
CO4	Apply the VLSI technology into IC circuits	**Apply-K3**
CO5	Analyze the various advanced methods involved in deposition and photolithography	**Analyze-K4**
CO6	Analyze the various applications of nanometer technology	**Analyze-K4**

REFERENCES:

1. S.M. Sze& Kwok K. Ng, Physics of Semiconductor Devices, 3rdEdition, Wiley, 2007.
2. B.L. Anderson & R. L. Anderson, Fundamentals of Semiconductor Devices, McGraw-Hill, 2005.
3. Naveed A. Sherwani, Algorithms for VLSI Physical Design Automation, Springer, 3rdEdition,1999.
4. James Plummer, M. Deal and P.Griffin, Silicon VLSI Technology, Prentice Hall Electronics, 2010

19PCM514	NETWORK MANAGEMENT SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the principles of network management, different standards and protocols used in managing complex networks.
- To explain the automation of network management operations and making use of readily available network management systems.
- To explain the concept of Broadband Access Networks

UNIT 1	DATA COMMUNICATION AND NETWORK MANAGEMENT	9

Analogy of Telephone Network Management, Distributed computing environments, TCP/IP based Networks: The INTERNET AND INTRANETS, Communications Protocols and Standards, Case Histories on Networking and Management, Network Management Architecture And Organization**.**

UNIT 2	STANDARDS, MODELS, AND LANGUAGES	9

Network Management Standards, Network Management Models, Organization Model. Information Model, Communication Model, Functional Model, Abstract Syntax Notation One (ASN.1) Encoding Structure.

UNIT 3	SNMPv1 Network Management	9

Managed Network, Organization Model, Information Model, SNMP Communication Model, Functional Model SNMP Management, Remote Monitoring system RMON1, Remote Monitoring system RMON2

UNIT 4	Broadband Access Networks	9

Broadband Access Technology, Cable Modem Technology, HFC Management, DSL Technology, Asymmetric Digital Subscriber Line Technology, ADSL Management, MIB Integration with Interfaces Groups in MIB-2.

UNIT 5	Network Management Applications	9

Configuration Management, Fault Management, Performance Management, Event Correlation Techniques, Security Management, Report Management, Policy- Based Management.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the network topologies and its components used in computer networks	**Understand-K2**
CO2	Describe network management standards to manage practical networks	**Understand-K2**
CO3	Acquire the knowledge about various network management tools and the skill to use them in monitoring a network	**Apply-K3**
CO4	Apply the knowledge of network topologies in network management systems	**Apply-K3**

CO5	Analyze the challenges faced by Network managers.	**Analyze-K4**
CO6	Evaluate various commercial network management systems and open network management systems	**Evaluate-K5**

TEXT BOOKS:

1. Network Management – Principles and Practice" by Mani Subramanian, Addison Wesley Pub Co, First Edition, 2000.

REFERENCES:

1. Salah Aiidarous,ThomasPlevayk,"Telecommunications Network Management Technologies and Implementations ", IEEE press, Eastern Economy Edition, New Delhi, 1998.
2. BehrouzA.Forouzan, "Data Communications and Networking ", Tata McGraw Hill, 2nd Edition, 2003.
3. "SNMP, SNMPv2, SNMPv3, AND RMON 1and 2" by William Stallings, Addison Wesley, Third Edition, 1999.

19PCM515	UBIQUITOUS COMPUTING AND PERVASIVE COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on optical system components and optical network architectures.
- To give an idea about the wavelength routing networks and packet switching and access networks**.**
- To familiarize the students on the network design and management.

UNIT 1	INTRODUCTION	9

Overview- Founding Contributions to Ubiquitous Computing, Ubicomp Systems and Challenges, Creating Ubicomp Systems, Evaluating and Documenting Ubicomp Systems Networking Basics: NFC, Wireless LAN.

UNIT 2	LOCATION IN UBIQUITOUS COMPUTING	9

Introduction, Characterizing Location Technologies, Location Systems, Location based social networks (LBSN), LBSN Recommendation.

UNIT 3	CONTEXT-AWARE COMPUTING	9

Introduction, Context-Aware Applications, Designing and Implementing Context-Aware Applications, Issues to Consider when Building Context-Aware Applications.

UNIT 4	SMART DEVICES AND SERVICES	9

Pervasive Computing Device Technologies and Service Architectures: Device types, Device Characteristics, Pervasive Computing Service Architectural Paradigms, Service / Resource Discovery basics, Elements of service composition, invocation and deployment, select concepts in Operating Systems, Virtualization and their relevance to Pervasive Computing, select example Operating Systems of relevance

UNIT 5	SMART MOBILES, CARDS AND DEVICE NETWORKS	9

Smart Phones, Smart Cards and related hardware / software concepts (OS included), select case studies, connectivity through Gateway services: the OSGi Human–Computer Interaction approach: Hidden UI Via Basic Smart Devices, Human Centred Design (HCD), User Models: Acquisition and Representation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	To explore the high-level facilities, system architecture and protocols of the ubiquitous system	**Understand-K2**
CO2	To apply data analytics to facilitate next generation computing	**Understand-K2**

CO3	To provide a sound conceptual foundation in the area of Pervasive Computing aspects	**Apply-K3**
CO4	To conceptualize, analyse and design select classes of pervasive computing systems	**Apply-K3**
CO5	Apply the semiconductor phenomena relevant to the field of electronics	**Apply-K3**
CO6	Apply the VLSI technology into IC circuits	**Apply-K3**

TEXT BOOKS:

1. Ubiquitous Computing Fundamentals, John Krumm, CRC Press, 2010
StefenPoslad: Ubiquitous Computing: Smart Devices, Environments and Interactions, Wiley, London, 2009, Indian reprint, 2014.

19PCM516	DSP PROCESSOR ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

The objective of this course is to provide in-depth knowledge on

- Basics of programmable Digital Signal Processor
- Various DSP processor and programming skills
- Advanced DSP architectures and some applications

UNIT – I	INTRODUCTION TO PROGRAMMABLE DSPS	9

Overview :Multirate Signal Processing- Discrete wavelet transform- Adaptive filters-Image Data Compression -Linear Predictive Coder and Speech Compression - Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in P-DSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

UNIT – II	TMS320C5X PROCESSOR	9

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT – III	TMS320C6X PROCESSOR	9

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction– DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

UNIT – IV	ADSP PROCESSORS	9

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

UNIT – V	PROGRAMMABLE DIGITAL SIGNAL PROCESSORS	9

Architecture of TMS320C54X: Pipe line operation, Addressing modes, Instruction Set, Code Composer studio - Implementation of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, interpolation Filters, Decimation filters, Adaptive Filters, 2-D Signal Processing. Implementation of FFT Algorithms

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the architecture details and instruction sets of various DSP processors	**Understand-K2**
CO2	Apply the knowledge of programming skills to develop code for processing real time signals.	**Apply-K3**
CO3	Design and implement DSP algorithm using code composer studio.	**Apply-K3**
CO4	Analyze various DSP algorithms for real time application.	**Analyze-K4**

CO5	Compare and evaluate various DSP algorithms.	**Evaluate-K5**
CO6	Design DSP based system for real time applications.	**Create-K6**

TEXT BOOKS:

1.Venkataramani.B, Bhaskar.M, " Digital Signal Processors – Architecture, Programming and Applications ", Hill Publishing Company Limited, 2003.
2. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSPMicroprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited,Delhi 2012.
3.https://www.analog.com/media/en/technical-documentation/data-sheets/ADSP-2101_2103_2105_2115.pdf
4.https://www.analog.com/en/products/landing-pages/001/adsp-manuals.html

REFERENCES:

1. RulphChassaing and Donald Reay, Digital Signal Processing and Applications with theC6713 and C6416 DSK, John Wiley & Sons, Inc., Publication, 2012 (Reprint).
2. Peter Pirsch ,"Architectures for Digital Signal Processing", John Weily, 2007
3. User guides: Texas Instrumentation, Analog Devices, Motorola.

19PCM517	MOBILE AND SOCIAL COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on social network structures.
- To give knowledge on mobile computing application.
- To give knowledge on social media in the public sector and business use.

UNIT – 1	INTRODUCTION TO MOBILE COMPUTING	9

Mobile Computing – Mobile Computing Vs wireless Networking – Mobile Computing Applications- Characteristics of Mobile computing – Structure of Mobile Computing Application. MAC Protocols – Wireless MAC Issues. Fixed Assignment Schemes – Random Assignment Schemes – Reservation Based Schemes

UNIT – 2	MOBILE PLATFORMS AND APPLICATIONS	9

Mobile Device Operating Systems – Special Constrains and Requirements of Mobile OS- Commercial Mobile Operating Systems: Windows Mobile- Palm OS- Symbian OS- iOS, Android-BlackBerry- Mobile Application Development and Protocols: Mobile Devices as Web clients-WAP-J2ME-Android application Development.

UNIT – 3	BASIC SOCIAL NETWORKS STRUCTURES	9

Introduction - Analyzing the social web - A brief history of the social web-Websites discussed-Tools used. Basics of network structure- Representing networks-Basic network structures and properties-Social Networks - Basic Structure and Measures- Network Visualization

UNIT – 4	BUILDING SOCIAL NETWORKS AND ITS PROPAGATION	9

Modeling networks- Sampling methods- Egocentric network analysis- Link prediction-Entity resolution- Incorporating network data-Case study- Topic Models-Epidemic models - Threshold models-The firefighter problem -Stochastic models -Applications of epidemic models to social media.

UNIT – 5	CASE STUDY - SOCIAL MEDIA IN THE PUBLIC SECTOR, BUSINESS USE & ITS PRIVACY	9

Analyzing public-sector social media –Case study- Measuring success- Broadcast example-Interaction and monitoring example- Social media failure example- Privacy policies and settings-Aggregation and data mining- Data ownership and maintaining privacy online - Respecting privacy in social media analysis- Case Study: Social Network Strategies for Surviving the Zombie Apocalyps.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Explain the basic concepts of mobile computing under various system aspects.	**Understand-K2**
CO2	Describe the basic concepts of social networking with different datasets.	**Apply-K3**
CO3	Apply Level: Apply various mobile platforms for implementing different applications.	**Apply-K3**
CO4	Analyze Level: Analyze the social media data with different topic models.	**Analyze-K4**

CO5	Analyze Level: Analyze different social networking structures for the given problem specifications.	**Evaluate-K5**
CO6	Analyze social networking concepts for various public sector problems.	**Create-K6**

TEXT BOOKS:

1.Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing",2nd Edition, PHI Learning Pvt. Ltd, New Delhi – 2015.

2. Cioffi-Revilla, Claudio. *Introduction to Computational Social Science*, Springer, 2014

3.. Jennifer Golbeck, *Analyzing the social web*, Morgan Kaufmann, 2013.

REFERENCES:

1.Jochen H. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007.

2.Matthew A. Russell. *Mining the Social Web: Data Mining Facebook, Twitter, Linkedin, Google+, Github, and More*, 2nd Edition, O'Reilly Media, 2013.

3. Robert Hanneman and Mark Riddle. *Introduction to social network methods.* Online Text Book, 2005.

19PCM518	DATA COMPRESSION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the concepts of compression techniques.
- Give knowledge on text compression and audio compression.
- To impart the concepts of image and video compression techniques.

UNIT 1	INTRODUCTION	9

Compression Techniques - Lossless compression - Lossy compression- Measures of performance- A brief introduction to Information theory - Models - Physical, Probability, Markov, Composite source model - Coding - uniquely Decodable codes, Prefix Codes - Huffman coding

UNIT 2	CONTEXT-BASED COMPRESSION	9

Arithmetic Coding - Dictionary techniques - The basic algorithm, the escape symbol, Length of context, the Exclusion principle - The Burrows-Wheeler transform - Move to front coding

UNIT 3	LOSSLESS IMAGE COMPRESSION	9

The Old JPEG Standard - CALIC - JPEG-LS - Multi resolution Approaches - Scalar quantization- Adaptive Quantization, Non uniform Quantization -Vector quantization -Structured Vector Quantizers, Variations on the Theme

UNIT 4	AUDIO AND VIDEO COMPRESSION	9

MPEG advanced audio coding - MPEG-2 AAC, MPEG-4 AAC - Dolby AC3 (Dolby Digital) - Speech Compression - The MPEG-1 Video Standard - The MPEG-2 Video Standard - MPEG-4 Part 10, Advanced Video Coding - Packet Video

UNIT 5	ADVANCED TECHOLOGIES	9

CALIC - CCSDS - JPEG 2000 - EBCOT - LZ77 - LZ78- LZSS algorithm - Multi-Layer Perceptron (MLP) based Compression - Dee Coder- Deep Neural Network Based Video Compression - Convolutional Neural Network (CNN) based compression

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to:

CO1	Explain the various compression techniques.	**Understand**
CO2	Apply the knowledge of various data compression algorithms to compute the data efficiency in terms of speed and compression ratio for various applications	**Apply**
CO3	Analyze different compression techniques and standards for image	**Analyze**
CO4	Compare various video compression standards for real time applications.	**Analyze**
CO5	Analyze basic compression algorithms using various modern tools.	**Analyze**
CO6	Evaluate the performance of coding techniques for real time applications.	**Evaluate**

TEXT BOOKS:

1. Khalid Sayood, " Introduction to Data Compression ", Morgan Kauffman Harcourt India, 3rd Edition, 2011.
2. David Salomon, " Data Compression – The Complete Reference ", Springer Verlag, 4th Edition, New York, 2011.

REFERENCES:

1. Yun Q.Shi, Huifang Sun, " Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards ", CRC press, 2003.
2. Mark S.Drew, Ze-Nian Li, " Fundamentals of Multimedia ", PHI, 1st Edition, 2004.

19PCM520	GLOBAL POSITIONING SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart the fundamental concepts of GPS.
- To give an idea about the GPS Navigation and Satellite.
- To understand the fundamentals of GPS Receiver.

UNIT 1	GPS FUNDAMENTALS	9

Introductory GPS System ,Description and Technical Design, History of Satellites, Launches, Initial Testing ,Applications OF GPS ,Pioneers of the GPS.

UNIT II	GPS NAVIGATION DATA	9

Introduction, Detailed Description of the Navigation Data Time, Satellite Clocks and Clock Errors, Satellite Orbit And Position ,Ionosphere Correction Using Measured Data.

UNIT III	GPS SATELLITE AND PAYLOAD	9

Spacecraft and Navigation Payload Heritage, Navigation Payload Requirements, Block IIR Space Vehicle Configuration, Block IIR Payload Design, Characteristics of the GPS L-Band Satellite Antenna, Future performance Improvements.

UNIT IV	FUNDAMENTALS OF SIGNAL TRACKING THEORY	9

GPS User Equipment –System Architecture, Delay lock loop Receivers for Signal tracking, Coherent and Non coherent Delay lock loop, Vector Delay lock loop, Processing of GPS signals- Quasi optimal and channel Capacity .

UNIT V	GPS RECEIVER	9

Generic Receiver Description, Technology Evolution ,System Design Details, Receiver Software signal Processing, Bit synchronization.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Explain the fundamental concepts of GPS.	**Understand-K2**
CO2	Describe the basic concept of Navigation payload in GPS.	**Understand-K2**
CO3	Apply the knowledge of Navigation Payload to compute various parameters of GPS.	**Apply-K3**
CO4	Apply the knowledge of the GPS Receiver used in different applications	**Apply-K2**
CO5	Analyze the various types of Signals in GPS communication .	**Analyze-K4**

CO6	Develop an application using GPS.	**Create-K6**

Reference Books:

1. Parkinson.B, Spilker.J,“GPS: Theory and Applications ”, Vol.I&Vol.II, AIAA,370 L'Enfant Promenade SW, Washington, DC 20024, 1996.
2. Hoffman.B, Wellenhof, Lichtenegger.H and Collins.J, “GPS: Theory and Practice ”, Springer, Wein, 4th revised edition, New York, 1997.
3. Leick.A, “GPS Satellites Surveying ”, John Wiley & Sons, 2nd edition, NewYork, 1995.

Open Electives

19PCM603	IOT FOR SMART APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To obtain and analyze data from things (devices)
  - To Learn the architecture of IoT Protocol standards
  - To design and implement Smart IoT applications

UNIT – 1	M2M and IoT- Introduction	9

The Vision-Introduction, From M2M to IoT, M2M towards IoT-the global context, A use case example, Differing Characteristics.

UNIT – 2	M2M AND ioT TECHNOLOGY FUNDAMENTALS	9

Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service(XaaS), M2M and IoT Analytics, Knowledge Management.

UNIT – 3	IOT REFERENCE ARCHITECTURE	9

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model-Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture-Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

UNIT – 4	SENSORS AND SMART APPLICATIONS	9

Principles, Classification, Parameters, Characteristics, Environmental Parameters (EP), Characterization. Mechanical and Electromechanical Sensors: Introduction, Resistive Potentiometer, Strain Gauge, Resistance Strain Gauge, Semiconductor Strain Gauges, Inductive Sensors- Sensitivity and Linearity of the Sensor, Types- Capacitive Sensors, Electrostatic Transducer, Force/Stress Sensors using Quartz Resonators, Ultrasonic Sensors, Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors, Aerospace Sensors, Sensors for Manufacturing, Sensors for environmental Monitoring.

UNIT – 5	INTERNET OF THINGS –PRIVACY, SECURITY AND GOVERNANCE	9

Introduction, Overview of Governance, Privacy and Security Issues, Smartie Approach. Data Aggregation for the IoT in Smart Cities and Securityissues**.**

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Describe the IoT communication protocol Standards and its challenges	**Understand-K2**
CO2	Describe the concept of M2M & IoT	**Understand-K2**
CO3	Apply the concept of IoT fundamentals to differentiate various IoT architecture	**Apply-K3**

CO4	Apply knowledge of IoT technology for developing smart IoT applications	**Apply-K3**
CO5	Apply the knowledge of IoT technology to select the appropriate sensors for developing real-time applications	**Apply-K3**
CO6	Analyze the security and privacy issues in IoT.	**Analyze-K4**

REFERENCES:

1. Kao-Cheng Huang and Zhaocheng Wang, "Millimeter Wave communication From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence,Jan Ho¨ller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, Academic Press,2014
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.
3. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1stEdition, A press Publications, 2013.
4. Cuno Pfister, "Getting Started with the Internet of Things", O Reilly Media, 2011.
5. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
6. Samuel Green guard, "Internet of things", MIT Press, 2015.
7. http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things1.html
8. https://developer.mbed.org/handbook/AnalogIn
9. http://www.libelium.com/50_sensor_applications

COURSE CATEGORY: AUDIT COURSES

S.No	Course Code	Course Title	L	T	P	C
1.	**21PGM801**	Pedagogy Studies	**3**	**0**	**0**	**0**
2.	**21PGM802**	English for Research Paper Writing	**3**	**0**	**0**	**0**

19PGM801	PEDAGOGY STUDIES	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To make the students understand a range of cognitive capacities in human learners
- To explain the outcome-based education system
- To describe the curriculum design process

UNIT – 1	EDUCATIONAL PSYCHOLOGY AND ENGINEERING EDUCATION	4

Learning process, motivation and engagement, ICT in learning and teaching, Facilitating the learners, Engineering education and recent trends, Research in Engineering education, General maxims of teaching, Teacher-centered, learner-centered and learning-centered approaches, Becoming a reflective teacher, Disruptive Innovation in Education.

UNIT – 2	OUTCOME BASED EDUCATION	4

Outcome Based Education: A broad context for quality teaching and learning, planning for quality teaching and learning, Necessity for learning outcomes - Course Outcomes and Program Outcomes, Defining learning outcomes, learning outcomes in the cognitive domain, learning outcomes in the affective domain, learning outcomes in the psychomotor domain, Program Outcomes, Graduate Attributes, Program Educational Objectives, linking learning outcomes to teaching and assessment.

UNIT – 3	CURRICULUM DESIGN	4

Curriculum design cycle, curriculum structure, credit and academic load, need assessment – feedback from stakeholders, concept of "Constructive alignment", the two loop approach of ABET, tuning approach of curriculum design, CDIO concept of curriculum design and implementation, Industry relevant curriculum design and implementation, concept mapping, Instructional design and delivery.

UNIT – 4	TEACHING AND ASSESSMENT STRATEGIES	4

Direct instruction as teaching strategy, co-operative learning, problem-solving, industry relevant teaching, role-play, case study, technology enabled teaching, research orientation, measurement and evaluation of students' achievement, assessment of learning outcomes - assessment tools: direct and indirect assessment tools, rubrics for assessment, attainment analysis, corrective action-curriculum updation, improvement in pedagogy, innovative assessment methods.

TOTAL : 16 PERIODS

COURSE OUTCOMES:
At the end of the course the student will be able to:

CO1	Write learning outcomes and link learning outcomes to appropriate assessments.	**Understand-K2**
CO2	Design syllabus and lesson plans that align with learning outcomes.	**Apply-K2**
CO3	Use technology to enhance teaching and learning.	**Apply-K2**
CO4	Choose teaching-learning strategies appropriate to the needs of the learners.	**Apply-K2**
CO5	Develop pedagogical expertise through an introduction to theoretically-based teaching methods and strategies.	**Create-K6**

References:

1. Dr.Sue Duchesne, Anne McMaugh, Sandra Bochner, Kerri-Lee Krause, “Educational Psychology for Learning and Teaching”, Cengage Learning, 4th Edition, 2019.
2. Lisa R. Lattuca, Patrick T. Terenzini, J. Fredericks Volkwein, and George D. Peterson, “The Changing Face of Engineering Education” The Bridge, National Academy of Engineering, Summer 2006.
3. Anderson, L. &Krathwohl , D. A Taxonomy for Learning, Teaching and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives . New York: Longman, 2001.
4. Blumberg, P. Developing learner-centred teaching: A practical guide for faculty. San Francisco: Jossey-Bass, 2017.
5. Teaching Support Services. Learning objectives. University of Guelph, Guelph, Ontario. Retrieved from http://www.uoguelph.ca/tss/resources/idres/learningobjectives1.pdf.
6. O.V. Boev, N.Gruenwald and G.Heitmann, “Engineering Curriculum Design aligned with Accrediation Standards”, Hochschule Wismar Publishers, 2013.
7. Fink, D. L. Integrated course design. Manhattan, KS: The IDEA Center, 2005. Retrieved from http://www.theideacenter.org/sites/default/files/Idea_Paper_42.pdf

19PGM802	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To give and exposure on writing skills and readability.
- To impart the knowledge of each section of the paper.
- To enhance the student to write the good quality Research paper.

UNIT – 1	INTRODUCTION TO RESEARCH	9

Introduction to Research Paper, Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs, Clarity and Removing Redundancy, Highlighting the Findings, Hedging and Criticising, Paraphrasing and Plagiarism - Useful idioms & phrases.

UNIT – 2	STRUCTURE OF RESEARCH PAPER	6

Types of the Research papers, Regular Research Paper - Review Research Paper – Case Study Research Paper – Research Letters - Sections of a Paper, Title, Author names and affiliations - Corresponding author - Abstracts, Keywords, Highlights, Graphical Abstract - Introduction, Methods, Results, Discussion, Conclusions, Acknowledgment - the First Draft.

UNIT – 3	METHODOLOGY, RESULTS & DISCUSSION AND CONCLUSION	9

Introduction – Writing preview of Research work – Review of literature – assimilating the points – Logical flow – Research gap - Writing the Methodology – Sequence - Specification – Explaining results – Interpretation and plotting – Discussion of the salient findings – Critical analysis – Writing the Conclusion .

UNIT – 4	SUBMISSION OF RESEARCH PAPER	6

References – Citations and Checking the Citations – Various forms of Citation – Guidelines for authors –Manuscript submission – Conflict of Interest - Authors reply for Reviewer comments – Point by Point Explanation – Resubmission – Acceptance – Copyright – Proofreadingand final submission.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1	Write research paper effectively with improved standard of language.	**Understand-K2**
CO2	Explain the different sections of the Research paper	**Understand-K2**
CO3	Formulate the Acceptable Research Manuscript	**Apply-K3**

References :

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Additional Reading :

1. MLA Handbook for Writers of Research Papers, The Modern Language Association of America, New York 2009.