M. Tech. (Electronics and Telecommunication) Curriculum Structure
Specialization: Wired and Wireless Communication
(w. e. f. 2015-16)

List of Abbreviations

OEC- Institute level Open Elective Course
PSMC – Program Specific Mathematics Course
PCC- Program Core Course
DEC- Department Elective Course
LLC- Liberal Learning (Self learning) Course
MLC- Mandatory Learning Course (Non-credit course)
LC- Laboratory Course

Semester I

Sr. No.	Course Type/Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	OEC-I	Measurements and Standards in Communication Systems	3	0	0	3
2.	PSMC	Statistical Information Processing	4	0	0	4
3.	PCC1/DEC	Elective - I (1) Cognitive Radio (2) RF and Microwave Circuit Design	3	0	0	3
4.	PCC 2	Advanced Communication Networks	3	0	0	3
5.	PCC 3	Wireless and Mobile Communication	3	0	0	3
6.	LC	Department Elective Lab	0	0	2	1
7.	LC	Advanced Communication Networks lab	0	0	2	1
8.	LC	Wireless and Mobile Communication lab	0	0	2	1
9.	LC	Seminar	0	0	2	1
10.	MLC 1	Research Methodology	1	0	0	0
11.	MLC 2	Humanities	1	0	0	0
		Total	**18**	**0**	**8**	**20**

Semester II

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	PCC 1	Advances in Digital Communication	3	0	0	3
2.	PCC 2	Antennas and Radiating Systems	3	0	0	3
3.	PCC 3	High Performance Networks	3	0	0	3
4.	DEC 1	**Elective - II** (1) Satellite Communication (2) Optical Networks (3) Internet of Things	3	0	0	3
5.	DEC 2	**Elective - III** (1) Wireless Sensor Network (2) Markov Chain and Queuing System (3) MIMO System	3	0	0	3
6.	LC	Advances in Digital Communication lab	0	0	2	1
7.	LC	Antennas and Radiating Systems lab	0	0	2	1
8.	LC	High Performance Networks lab	0	0	2	1
9.	LC	Mini Project based on departmental electives	0	0	2	1
10.	MLC	IPR	1	0	0	0
11.	LLC	Liberal Learning Course	1	0	0	1
		Total	**17**	**0**	**8**	**20**

Semester-III

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Dissertation	Dissertation Phase - I	--	--	--	14
		Total	**--**	**--**	**--**	**14**

Semester-IV

Sr. No.	Course Code	Course Name	Teaching Scheme			Credits
			L	T	P	
1.	Dissertation	Dissertation Phase - II	--	--	--	20
		Total	**--**	**--**	**--**	**20**

(OEC) Measurements and Standards in Communication Systems	
Teaching Scheme Lectures: 3 hrs/week	**Examination Scheme** T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- State the key features of RF measuring and signal analysis instruments related to communication systems and elaborate the advancements in modern day measuring instruments.
- Compare and analyze various measurement techniques used in communication signal analysis.
- Elaborate key features of various standards related to WLAN, Wi-Fi, Wi-MAX systems. Elaborate key features and evolution process of various mobile communication standards from 2nd generation 4th generation systems.

Syllabus Contents:

Measurements and instruments for communication signal analysis: Spectrum analyzer, Network analyzer and related measurements, harmonic distortion analyzer, RF measurement issues, receiver related measurements.

Standards for communication systems: Study of IEEE 802.11 a, b and g (Wi-Fi) standards, 802.16 d and e Wi-MAX standards, Mobile communication standards 2G, 2.5G, 3G standards, current scenario of 3G and 4G standards, GSM, EDGE, HSCSD, CDMA, WCDMA standards, concept of convergence of the standards towards broadband communication.

References:

- Theodore S. Rappaport, **"**Wireless communications: principles and practice", Pearson education, 2nd edition.
- H. S. Kalsi, "Electronic Instrumentation", Tata McGraw-Hill, 2nd edition.
- Vijay K. Garg, Joseph E. Wilkes, "Principle & Applications of GSM", Person Education, 5th edition, 2008.
- Vijay K. Garg, "IS-95 CDMA and CDMA 2000", Pearson Education, 4th edition, 2009.

(PSMC) Statistical Information Processing	
Teaching Scheme Lectures: 4 hrs/week	**Examination Scheme** T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations.
- Demonstrate mathematical modelling and problem solving using such models.

- Comparatively evolve key results developed in this course for applications to signal processing, communications systems.
- Develop frameworks based in probabilistic and stochastic themes for modelling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection.

Syllabus Contents:

Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Tchebaychef inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables.

Random process: Expectations, Moments , Ergodicity ,Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Random signal modelling: MA(q), AR(p) ,ARMA(p,q) models, Hidden Markov Model & its applications ,Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm.

Statistical Decision Theory: Bayes' Criterion , Binary Hypothesis Testing ,M-ary Hypothesis Testing ,Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing.

Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test ,Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate , Multiple Parameter Estimation Best Linear Unbiased Estimator ,Least-Square Estimation Recursive Least-Square Estimator.

Spectral analysis: Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.

Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman , Shanon Fano , Arithmetic , Adaptive coding , RLE , LZW Data compaction, , LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

Application of Information Theory: Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements ,Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes,& Decoder, Reed-Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

References:

- Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw-Hill, 2002.
- D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.
- Mourad Barkat , "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
- R G. Gallager, "Information theory and reliable reliable communication", Wiley, 1st edition, 1968.
- F. J. MacWilliams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", New York, North-Holland, 1977.
- Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.

(PCC1/DEC) Cognitive Radio	
Teaching Scheme Lectures: 3 hrs/week	**Examination Scheme** T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the fundamental concepts of cognitive radio networks.
- Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
- Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
- Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimisation techniques for better spectrum exploitation.

Syllabus Contents:

Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum of commons, real time secondary spectrum market).

Optimization Techniques of DSA: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning

algorithms and protocols.

Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).

Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross-layer design for cognitive radio networks.

References:

- Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
- Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
- Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
- Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer.
- Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
- Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

(PCC1/DEC) RF and Microwave Circuit Design

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

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

Syllabus Contents:

Transmission Line Theory: Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.

Microwave Network Analysis: Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.

Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components. Nonlinearity And Time Variance Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range,

conversion gain and distortion.

Microwave Semiconductor Devices And Modelling: PIN diode, Tunnel diodes, varactor diode, schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.

Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise , high power and broadband amplifier, oscillators, Mixers design.

References:

- Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", AuthorHouse, 2009.
- D.M.Pozar, " Microwave engineering" ,Wiley, 3rd edition.
- R.Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc.
- G.D. Vendelin, A.M. Pavoi, U. L. Rohde, "Microwave Circuit Design Using Linear And Non Linear Techniques", John Wiley 1990.
- S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987.
- Radmanesh, "RF and Microwave Electronics Illustrated" , Pearson Education.

(PCC2) Advanced Communication Network

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand advanced concepts in Communication Networking.
- Design and develop protocols for Communication Networks.
- Understand the mechanisms in Quality of Service in networking.
- Optimise the Network Design.

Syllabus Contents:

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.

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.

Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.;

Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

IP address lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producting and controlled prefix expansion algorithms.

Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.

IP switching and MPLS, Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic engineering issues in MPLS.

References:

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

(PCC3) Wireless and Mobile Communication

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Design appropriate mobile communication systems.
- Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques
- Distinguish various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
- Analyze path loss and interference for wireless telephony and their influences on a mobile-communication system's performance.
- Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology
- Understanding upcoming technologies like 3G, 4G etc.

Syllabus Contents:

Cellular Communication Fundamentals: 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.

Multiple access technologies: Comparison of TDMA, FDMA and CDMA technologies based on their signal separation techniques, advantages, disadvantages and application areas, spectral efficiency calculations for these techniques.

Mobile Radio Propagation: 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.

Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

Code Division Multiple Access: 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 (cdmaOne) to cdma 2000, cdma 2000 layering structure and channels.

Higher Generation Cellular Standards: 2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE, 3 G Standards: evolved EDGE, enhancements in 4G standard.

References:

- V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
- V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
- T.S.Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI
- William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH.
- Asha Mrhrotra, "A GSM system Engineering" Artech House Publishers Bosten, London.

(LC) Cognitive Radio Laboratory	
Teaching Scheme Lectures: 2 hrs/week	**Examination Scheme** Term work – 50 marks, Oral – 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Analyze the software defined radios..
- Design the wireless networks based on the cognitive radios.
- Design various types of filters, amplifiers, oscillators and mixer at RF using micro strip

line.

List of Assignments:

1. Experiments on SDR and application to cognitive radio networking.
2. Implementation of spectrum sensing Algorithms.
3. Implementation of Dynamic Spectrum Access Algorithms.
4. Optimization of DSA.
5. Cooperative Spectrum Sensing.
6. Compressive Spectrum Sensing.
7. Cognitive Radio Network Standards.

(LC) RF and Microwave Circuit Design Laboratory	
Teaching Scheme Lectures: 2 hrs/week	**Examination Scheme** Term work – 50 marks, Oral – 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Analyze the transmission lines and estimate voltage, current and impedance at any point on transmission line for various load conditions.
- Analyze parameters of two port network.
- Design various types of filters, amplifiers, oscillators and mixer at RF using micro strip line.

List of Assignments:

1. Calculate reflection coefficient, VSWR and plot the pattern along a slotted transmission line for different load conditions.
2. Find impedance transformation using Smith chart.
3. Find the scattering matrix parameters of a two port network.
4. Design of low pass and high pass filters at RF using micro strip line
5. Design of band pass and band stop filters at RF using micro strip line.
6. Design of RF amplifier.
7. Design of RF oscillator.
8. Design of RF mixer.

(LC) Advanced Communication Networks Laboratory	
Teaching Scheme Lectures: 2 hrs/week	**Examination Scheme** Term work – 50 marks, Oral – 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Identify the different types of network devices and their functions within a network.
- Understand and build the skills of sub-netting and routing mechanisms.
- Understand basic protocols of computer networks, and how they can be used to assist in network design and implementation.

List of Assignments:

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 "select".
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 characterise 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 characterise 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 labelled 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.

(LC) Wireless and Mobile Communication Laboratory

Teaching Scheme	**Examination Scheme**
Lectures: 2 hrs/week	Term work – 50 marks, Oral - 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understanding Cellular concepts, GSM and CDMA networks

- To study GSM handset by experimentation and fault insertion techniques
- Understating of 3G communication system by means of various AT commands usage in GSM
- Understanding CDMA concept using DSSS kit
- To learn, understand and develop concepts of Software Radio in real time environment

List of Assignments:

1. Understanding Cellular Fundamentals like Frequency Reuse, Interference, cell splitting, multi path environment, Coverage and Capacity issues using communication software.
2. Knowing GSM and CDMA 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. 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.
6. Study of DSSS technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance.
7. 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.
8. To study and analyze different modulation techniques in time and frequency domain using SDR kit.

(LC) Seminar	
Teaching Scheme Lectures: 2 hrs/week	**Examination Scheme** Term work – 50 marks, Oral – 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand of contemporary / emerging technology for various processes and systems.
- Share knowledge effectively in oral and written form and formulate documents.

Syllabus Contents:

The students are required to search / gather the material / information on a specific a topic comprehend it and present / discuss in the class.

(MLC 1) Research Methodology	
Teaching Scheme Lectures: 1 hrs/week	**Examination Scheme** End Sem Exam – 50 marks

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
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Syllabus Contents:

- Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.
- Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations
- Effective literature studies approaches, analysis
- Plagiarism , Research ethics,
- Effective technical writing, how to write report, Paper
- Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

References:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2 nd Edition , "Research Methodology: A Step by Step Guide for beginners"

(MLC 2) Humanities	
Teaching Scheme Lectures: 1 hrs/week	**Examination Scheme** Mid-Sem – 20, Assignments, Quiz -50, End-Sem Exam - 30

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the need, basic guidelines, content and process for value education.
- Understand the need of self and body, harmony of self with body.
- Understand the harmony in the family, difference between respect and differentiation.

- Understand the harmony in nature, interconnectedness and mutual fulfillment in nature, holistic perception of harmony.
- Understand natural acceptance of human values, competence in professional ethics.

Syllabus Contents:

Communication skills: Introduction to the scope and significance of learning Humanities. And communication.

- Comprehension.
- Written communication: Formal letters, CV, Reports, and Paragraphs.
- Grammar and Vocabulary building exercises

Social Science and Development: Indian and western concept, Process of social change in modern India, Impact of development of Science and technology on culture and civilization. Urban sociology and Industrial sociology, Social problems in India: overpopulated cities, no skilled farmers, unemployment, addictions and abuses, illiteracy, too much cash flow, stressful working schedules, nuclear families etc.

Technology assessment and transfer**:** Sociological problems of economic development and social change Assessment and transfer of technology, problems related with tech transfer with reference to India. Roles of an engineer in value formation and their effects on society.

References:

- Mcmillan, "English for everyone", (India) Ltd.
- Jude paramjit S and Sharma Satish K Ed, "dimensions of social change".
- Raman Sharma, "Social Changes in India".

Semester II

(PCC1) Advances in Digital Communication	
Teaching Scheme Lectures: 3 hrs/week	**Examination Scheme** T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand and visualize the different Digital modulation and coding techniques.
- Design optimum receiver for different channels.

Syllabus Contents:

Overview of digital communication principles, base-band and band-pass digital modulation-demodulation schemes and coding techniques in digital communication.

Communication through band limited linear filter channels, Optimum receiver for channels with ISI and AWGN, Linear equalization, Decision feedback equalization, Iterative equalization

and decoding, Adaptive equalization.

Spread Spectrum signals for digital communication, DS-SS and FHSS systems, CDMA, Digital communication through fading multi-path channels, Characterization of fading multi-path channels, Effect of signal characteristics on the choice of a channel model, Diversity techniques for fading multi-path channels.

References:

- John G. Proakis, "Digital Communications", McGraw Hill, 4th edition.
- John R. Barry, Edward A. Lee and David G. Messerschmitt, "Digital Communication", Springer 2003, 3rd edition.
- Bernard Sklar, "Digital Communication – Fundamentals and Applications", Pearson Education Asia, 2nd Edition.
- Andrew J. Viterbi, "CDMA: Principles of Spread Spectrum Communications", Prentice Hall, USA.

(PCC2) Antennas and Radiating Systems	
Teaching Scheme Lectures: 3 hrs/week	**Examination Scheme** T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.
- Estimate the input impedance, efficiency and ease of match for antennas.
- Compute the array factor for an array of identical antennas.
- Design antennas and antenna arrays for various desired radiation pattern characteristics.

Syllabus Contents:

Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna.

Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects.

Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non

uniform current.

Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.

Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture.

Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.

Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.

Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors.

References:

- Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 2nd edition.
- John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
- R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
- I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

(PCC3) High Performance Networks	
Teaching Scheme Lectures: 3 hrs/week	**Examination Scheme** T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols.
- Design, implement, and analyze computer networks.
- Identify, formulate, and solve network engineering problems.
- Show knowledge of contemporary issues in high performance computer networks. Use techniques, skills, and modern networking tools necessary for engineering practice.

Syllabus Contents:

Types of Networks, Network design issues, Data in support of network design. Network design tools, protocols and architecture. Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, and RSVP-differentiated services.

VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols for the transport of voice media over IP networks. Providing IP quality of service for voice, signaling

protocols for VoIP, PSTN gateways, VoIP applications.

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS-operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections.

Traffic Modeling: Little's theorem, Need for modeling, Poisson modeling, Non-poisson models, Network performance evaluation.

Network Security and Management: Principles of cryptography, Authentication, integrity, key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers. Infrastructure for network management, The internet standard management framework –SMI, MIB, SNMP, Security and administration, ASN.1.

References:

- Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill.
- Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann, 2003.
- Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia.
- Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.
- Stallings W., "High-Speed Networks: TCP/IP and ATM Design Principles", Prentice Hall, 1998.
- Leon Garcia, Widjaja, "Communication networks", TMH 7th reprint 2002.
- William Stalling, "Network security, essentials", Pearson education Asia publication.

(DEC 1) Satellite Communication

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Visualize the architecture of satellite systems as a means of high speed, high range communication system.
- State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
- Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

Syllabus Contents:

Architecture of Satellite Communication System: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications, and frequency bands used for satellite communication and their advantages/drawbacks.

Orbital Analysis: Orbital equations, Kepler's laws of planetary motion, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc of a satellite, concepts of Solar day and Sidereal day.

Satellite sub-systems: Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems, antenna sub-system.

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Satellite link budget: Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions, Case study of Personal Communication system (satellite telephony) using LEO.

Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO.

References:

- Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition.
- S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India.
- Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill.
- Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition.

(DEC 1) Optical Network

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Contribute in the areas of optical network and WDM network design.
- Implement simple optical network and understand further technology developments for future enhanced network.

Syllabus Contents:

SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.

WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers,

OADM architectures, reconfigurable OADM, optical cross connects.

Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.

Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes

WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.

Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds.

References:

- Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3 rd edition, 2010.
- C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE.

(DEC 1) Internet of things	
Teaching Scheme Lectures: 3 hrs/week	**Examination Scheme** T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand what IoT technologies are used for today, and what is required in certain scenarios.
- Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.
- Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications.

Syllabus Contents:

Smart cities and IoT revolution, Fractal cities, From IT to IoT, M2M and peer networking concepts, Ipv4 and IPV6.

Software Defined Networks SDN, From Cloud to Fog and MIST networking for IoT communications, Principles of Edge/P2P networking, Protocols to support IoT communications, modular design and abstraction, security and privacy in fog.

Wireless sensor networks: introduction, Edge resource pooling and caching, client side control and configuration.

Smart objects as building blocks for IoT, Embedded systems platforms for IoT, IO drivers, C Programming, multithreading concepts.

Operating systems requirement of IoT environment, study of mbed, RIoT, and Contiki operating systems, Introductory concepts of big data for IoT applications.

Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT, Security and legal considerationsn, IT Act 2000 and scope for IoT legislation.

References:

- A Bahaga, V. Madisetti, "Internet of Things- Hands on approach", VPT publisher, 2014.
- A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
- Cuno Pfister, "Getting started with Internet of Things", Maker Media, 1st edition, 2011.
- Samuel Greenguard, "Internet of things", MIT Press.

Web resources :

- http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things-1.html
- https://developer.mbed.org/handbook/AnalogIn
- http://www.libelium.com/50_sensor_applications/
- M2MLabs Mainspring http://www.m2mlabs.com/framework
- Node-RED http://nodered.org/

(DEC 2) Wireless Sensor Networks

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Design wireless sensor network system for different applications under consideration.
- Understand the hardware details of different types of sensors and select right type of sensor for various applications.
- Understand radio standards and communication protocols to be used for wireless sensor network based systems and application.
- Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.
- Handle special issues related to sensors like energy conservation and security challenges.

Syllabus Contents:

Introduction and overview of sensor network architecture and its applications, sensor network comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT,

Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)

Overview of sensor network protocols: Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, and UWB;

Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid.

Data dissemination and processing; differences compared with other database management systems, data storage; query processing.

Specialized features: Energy preservation and efficiency; security challenges; fault-tolerance. Open issues for future research, and Enabling technologies in wireless sensor network.

References:

- H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.
- C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.
- F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
- Yingshu Li, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

(DEC 1) Markov Chains and Queueing Systems

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand Markov Chains and regenerative processes used in modelling a wide variety of systems and phenomena.
- Model a system as queueing system with some aspect of the queue governed by a random process.
- Understand telecommunication systems modelling using Markov chains with special emphasis on developing queueing models.

Syllabus Contents:

Introduction: Review of basic probability, properties of nonnegative random variables, laws of large numbers and the Central Limit Theorem.

Renewal Processes: Basic definitions, recurrence times, rewards and renewal reward theorem, point processes, Poisson process, Walds equation, Blackwell's theorem.

Discrete time Markov chains: definitions and properties, matrix representation, Perron-Frobenius theory.

Continuous time Markov chains: basic definitions, Q-matrix, birth-death processes, quasi birth death processes.;Embedded Markov processes, semi Markov processes, reversible Markov chains, Random walks.

Fundamental queueing results: Little's theorem, invariance of the mean delay, Conservation law.

Markovian queues: Jackson and BCMP networks, numerical Algorithms. M/G/1 & G/M/1 queues and G/G/1 queues.

Advanced queueing models: priority, vacation and retrials in queues.

References:

- Cliffs, "Stochastic Modelling and the Theory Queues", Prentice Hall, 1989.
- P.Bremaud, "Markov Chains", Springer-Verlag, 1999.
- E.Seneta, "Non Negative Matrices and Markov Chains", Springer Series in Statistics, Springer, 1981.
- R.Gallager, "Discrete Stochastic Processes", Kluwer Academic Press, 1996.
- L.Kleinrock, "Queueing Systems", vols I and II, John Wiley and Sons 1976.

(DEC 2) MIMO Systems

Teaching Scheme	**Examination Scheme**
Lectures: 3 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers, MIMO for multi-carrier systems (e.g. MIMO-OFDM), multi-user communications, multi-user MIMO.
- Understand cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G (LTE, LTE-Advanced, WiMAX).
- Perform Mathematical modelling and analysis of MIMO systems.

Syllabus Contents:

Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems.

Diversity, Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, The

rake receiver, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation, The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalising MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of predistortion in MIMO systems, Precoding and combining in MIMO systems, Advantages of precoding and combining, Disadvantages of precoding and combining, Channel state information.

Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beam beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer, Case study: MIMO in LTE, Codewords to layers mapping, Precoding for spatial multiplexing, Precoding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based precoding, Precoding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models, Channel Estimation, Channel estimation techniques, Estimation and tracking, Training based channel estimation, Blind channel estimation, Channel estimation architectures, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

References:

- Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications : From Real-world Propagation to Space-time Code Design", Academic Press, 1st edition, 2010.
- Mohinder Janakiraman, “Space - Time Codes and MIMO Systems”, Artech House Publishers, 2004.

(LC) Advances in Digital Communication Laboratory	
Teaching Scheme Lectures: 2 hrs/week	**Examination Scheme** Term work – 50 marks, Oral – 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand concepts in Digital Communication by simulating and computing numerically.
- Use MATLAB or C/C++ tools to verify the concepts.

List of Assignments:

1. Study and Plot of Useful Distributions in Communication
2. Numericals/Problems Based on Theory Covered
3. Computation and Plot of Autocorrelation and Power Spectrum, Linear Filtering of Random Processes

4. Generation of Bandpass and Lowpass Processes
5. Binary Antipodal Simulation
6. Noise Effect on Different Constellations
7. Monte Carlo Simulation of a Binary Communication System
8. Match Filtering of Signal Waveforms

References:

- Proakis, Salehi and Bauch, "Modern Communication System Using MATLAB", Cengage Learning, 2013.

(LC) Antennas and Radiating Systems Laboratory	
Teaching Scheme Lectures: 2 hrs/week	**Examination Scheme** Term work – 50 marks, Oral – 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Determine specifications, design, construct and test antenna.
- Explore and use tools for designing, analyzing and testing antennas. These tools include Antenna design and analysis software, network analyzers, spectrum analyzers, and antenna pattern measurement techniques.

List of Assignments:

1. Simulation of half wave dipole antenna.
2. Simulation of change of the radius and length of dipole wire on frequency of resonance of antenna.
3. Simulation of quarter wave, full wave antenna and comparison of their parameters.
4. Simulation of monopole antenna with and without ground plane.
5. Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.
6. Simulation of a half wave dipole antenna array.
7. Study the effect of change in distance between elements of array on radiation pattern of dipole array.
8. Study the effect of the variation of phase difference 'beta' between the elements of the array on the radiation pattern of the dipole array.
9. Case study.

(LC) High Performance Network Laboratory	
Teaching Scheme Lectures: 2 hrs/week	**Examination Scheme** Term work – 50 marks, Oral – 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand design issues and various application areas of High Performance network
- Perform Simulations on ns-2 or ns-3 which are free open source simulation platforms.
- Optimize the performance of the networks using different techniques.

List of Assignments:

1. Installation and study the features of ns-2.
2. Installation and study the features of ns-3.
3. Simulate and evaluate the performance of Flow control and Error control protocols for High performance Network.
4. Implementation of congestion control protocols for High Performance Networks.
5. Implementation of protocols for Quality of Service (QoS) support.
6. Performance improvement in Wireless Networks.
7. Implementation of Network Security Algorithms.
8. Case study of High Performance Networks.

(LC) Mini Projects Based on Departmental Electives	
Teaching Scheme Lectures: 2 hrs/week	**Examination Scheme** Term work – 50 marks, Oral – 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Grasp the knowledge about practical tools / techniques in order to solve real life problems related to the industry.
- Implement the concepts learned in courses.
- Design the systems, make prototype and test the system.

Course Details:

The mini Projects are based on the Department Electives opted by the students. They are suppose to design and implement the systems learned in Dept Electives. Project titles are selected by students, by consulting the course faculty.
A demonstration and oral examination on the mini project should be conducted at the end of the semester.

(MLC) Intellectual Property Rights	
Teaching Scheme Lectures: 3 hrs/week	**Examination Scheme** T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand that today's world is controlled by Computer, Information Technology, but

tomorrow world will be ruled by ideas, concept, and creativity.

- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Syllabus Contents:

Introduction: Nature of Intellectual Property: Patents, Designs, Trademarks 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.

Patent Rights: Scope of Patent Rights. Licensingand 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 Softwares etc. Traditional knowledge Case Studies, IPR and IITs.

References:

- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
- Mayall , "Industrial Design", McGraw Hill.
- Niebel , "Product Design", McGraw Hill.
- Asimov , "Introduction to Design", Prentice Hall.
- Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age".
- T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand.

(LLC) Liberal Learning Course

Teaching Scheme	**Examination Scheme**
Lectures: 1 hrs/week	T1, T2 – 20 marks each, End-Sem Exam - 60

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Ability to exhibit self learning capabilities and its use in effective communication.
- An ability to inculcate impact of various areas to relate with society at large.
- Demonstrate the familiarity with one or more multi-disciplinary areas of their choice.

Syllabus Contents:

Identification of topic and resources, scope, and synthesize viewpoints for the areas such as performing arts, basic Sciences, business, philosophy, sports and athletics, defence studies and education.

(Dissertation) Dissertation Phase – I and Phase - II	
Teaching Scheme Lectures: 4 hrs/week	**Examination Scheme** Term work – 50 marks, Oral – 50

Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
- Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
- Ability to present the findings of their technical solution in a written report.
- Presenting the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

- Relevance to social needs of society
- Relevance to value addition to existing facilities in the institute
- Relevance to industry need
- Problems of national importance
- Research and development in various domain

The student should complete the following:

- Literature survey Problem Definition
- Motivation for study and Objectives
- Preliminary design / feasibility / modular approaches
- Implementation and Verification
- Report and presentation

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

- Experimental verification / Proof of concept.
- Design, fabrication, testing of Communication System.
- The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I and II at M. Tech. (Electronics):

- As per the AICTE directives, the dissertation is a year long activity, to be carried out and

evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

- The dissertation may be carried out preferably in-house i.e. department"s laboratories and centers OR in industry allotted through department"s T & P coordinator.
- After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.
- Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.
- Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.
- Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the phase-I work.
- During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.
- Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.
- Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work