Date: 20-08-2018

To

Dean Academic

RIT, Sakharale.

Sub: Regarding approval of syllabus.

Dear Sir,

We are sending herewith the structure and syllabus of M. Tech Electronics of academic year 2018-19 for approval.

Thanking you.

Head & BOS Chairman
E&TC Dept.

HEAD,
Department of Electronics & Telecomm.Engg.
R. I. T. Rajaramnagar (Sakharale)
415414.

K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Curriculum Structure and Evaluation Scheme
To be implemented from Academic Year 2018-19

Rev: *Electronics*
Course Structure/RIT/01/2018-19

Department: Electronics & Telecommunication Engineering
Class: F. Y. M. Tech. Electronics **Semester:** I

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory			Practical	
		L	T	P	Credits	Scheme	Max Marks	Min % for Passing		Max Marks	Min % for Passing
ECS 1014	Advanced Communication Networks	3	-	-	3	ISE	20	40	40	--	--
						UT1	15			--	--
						UT2	15				
						ESE	50	40		--	--
ECS 1024	Advanced Digital Signal Processing	3	-	-	3	ISE	20	40	40	--	--
						UT1	15			--	--
						UT2	15				
						ESE	50	40		--	--
PE-I	Program Elective -I	3	-	-	3	ISE	20	40	40	--	--
						UT1	15			--	--
						UT2	15				
						ESE	50	40		--	--
PE-II	Program Elective -II	3	-	-	3	ISE	20	40	40	--	--
						UT1	15			--	--
						UT2	15				
						ESE	50	40		--	--
ECS 1094	Research Methodology & IPR	1	1	-	2	ISE	50	40	40	--	--
						ESE	50	40			
ECS 1104	Advanced Communication Networks Lab	-	-	4	2	ISE	--	--	--	50	50
						ESE	--	--		50	50
ECS 1114	Advanced Digital Signal Processing Lab	-	-	4	2	ISE	--	--	--	50	50
						ESE	--	--		50	50
	TOTAL	13	1	08	18						

Total Contact Hours/week : 22
Total Credits : 18

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Exam,

P = Pass, NP = Not Pass

K.E. Society's
Rajarambapu Institute of Technology, Sakharale
(An Autonomous Institute, affiliated to Shivaji University, Kolhapur)
Curriculum Structure and Evaluation Scheme
To be implemented from Academic Year 2018-19

Rev: *Electronics Course Structure/RIT/01/2018-19*

Department: Electronics & Telecommunication Engineering
Class: F. Y. M. Tech. Electronics **Semester:** II

Course Code	Course	Teaching Scheme				Evaluation Scheme					
							Theory			Practical	
		L	T	P	Credits	Scheme	Max Marks	Min % for Passing		Max Marks	Min % for Passing
SHP 515	Numerical Computation Techniques	3	-	-	3	ISE	20	40	40	--	--
						UT1	15			--	--
						UT2	15				
						ESE	50	40		--	--
ECS 2014	Antennas and Radiating Systems	3	-	-	3	ISE	20	40	40	--	--
						UT1	15			--	--
						UT2	15				
						ESE	50	40		--	--
ECS 2024	Wireless and Mobile Communication	3	-	-	3	ISE	20	40	40	--	--
						UT1	15			--	--
						UT2	15				
						ESE	50	40		--	--
PE-III	Program Elective -III	3	-	-	3	ISE	20	40	40	--	--
						UT1	15			--	--
						UT2	15				
						ESE	50	40		--	--
PE-IV	Program Elective -IV	3	-	-	3	ISE	20	40	40	--	--
						UT1	15				
						UT2	15				
						ESE	50	40			
SHP 551	Technical Communication	2	-	-	Audit	ISE	P/NP			--	-
ECS 2094	Antennas and Radiating Systems lab	-	-	4	2	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
ECS 2104	Wireless and Mobile Communication Lab	-	-	4	2	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
ECS 2114	Mini project	-	-	4	2	ISE	--	--	--	50	50
						ESE	--	--	--	50	50
	TOTAL	17	-	8	19						

Total Contact Hours/week : 29
Total Credits : 21

ISE = In Semester Evaluation, UT-I = Unit Test-I, UT-II = Unit Test-II, ESE = End Semester Exam,

P = Pass, NP = Not Pass

Department: Electronics & Telecommunication Engineering
Class: S. Y. M. Tech. Electronics **Semester:** III

Course Code	Course	Teaching Scheme				Evaluation Scheme				
							Theory		Practical	
		L	T	P	Credits	Scheme	Max Marks	Min % for Passing	Max Marks	Min % for Passing
ECS 3014	Industry Internship	-	-	2	Audit	ISE	--	--	P/NP	
ECS 3024	MOOC Course	-	-	-	3	ESE*	-	-	50	50
ECS 3034	Dissertation Phase-I	-	-	8	4	ISE	-	-	100	50
ECS 3044	Dissertation Phase-II	-	-	12	6	ISE	-	-	100	50
						ESE			100	50
	TOTAL	-	-	22	13	-	-	-	-	-

Total Contact Hours/week : 22
Total Credits : 13

* Indicates that, student needs to complete Online/Certification course approved by DPGC and produce certificate of online or certification course at the time of ESE. If student fails to produce this certificate, he or she will not be eligible to give ESE of Online/certification course.

Department: Electronics & Telecommunication Engineering
Class: S. Y. M. Tech. Electronics **Semester:** IV

Course Code	Course	Teaching Scheme				Evaluation Scheme				
							Theory		Practical	
		L	T	P	Credits	Scheme	Max Marks	Min % for Passing	Max Marks	Min % for Passing
ECS 4014	Dissertation Phase-III	-	-	12	6	ISE	-	-	100	50
ECS 4024	Dissertation Viva Voce	-	-	20	10	ISE	-	-	100	50
						ESE			100	50
	TOTAL	-	-	32	16	-	-	-	-	-

Total Contact Hours/week : 32
Total Credits : 16

List of Program Elective (PE) choice based courses:

Course Code	PE-I
ECS1034	Wireless Sensor Networks
ECS1044	Advanced Power Electronics
ECS1054	Statistical Information Processing

Course Code	PE-II
ECS1064	MIMO System
ECS1074	RF and Microwave Circuit Design
ECS1084	Mechatronics based system

Course Code	PE-III
ECS2034	Automotive Electronics
ECS2044	Internet of Things
ECS2054	Voice and data networks

Course Code	PE-IV
ECS2064	Soft computing
ECS2074	Electric Drives
ECS2084	High Performance Networks

Class: - **First Year M.Tech Electronics**	Semester- **I**
Course Code : **ECS1014**	Course Name: **Advanced Communication Network**

L	T	P	Credits
3	--	--	3

Course Description: This course provides a robust understanding of networking. It teaches the fundamentals of networking systems, their architecture, function and operation and how those fundamentals are reflected in current network technologies. Students will learn the principles that underlie all networks and the application of those principles to current network protocols and systems. The course explains how layers of different scope are combined to create a network.

Course Learning Outcomes:

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

1. Outline advanced concepts in Communication Networking.
2. Design and develop protocols for Communication Networks.
3. Identify the mechanisms in Quality of Service in networking.
4. Optimize the Network Design.

Prerequisite:

Fundamental knowledge of network communication.

Course Content

Unit No	Description	Hrs
1.	**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.	06

2.	**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.	**06**
3.	**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	**06**
4.	**IP address:** lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producing and controlled prefix expansion algorithms.	**06**
5.	**Admission control in Internet**: Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.	**06**
6.	**IPV4 and IPV6:** IP tunneling, 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.	**06**

References -

1. Jean Wairand and Pravin Varaiya, "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

Class:- **First Year M.Tech Electronics**	Semester-**I**
Course Code : **ECS1024**	Course Name : **Advanced Digital Signal Processing**

L	T	P	Credits
3	--	--	3

Course Description:

Advances in integrated circuit technology have had a major impact on the technical areas to which digital signal processing techniques and hardware are being applied. The efficient use of such hardware devices requires thorough understanding of various digital signal processing techniques. These techniques encompass filter design methods, power spectrum estimation and sampling rate conversion. The subject is essential for anyone whose work is concerned with signal processing applications.

Course Learning Outcomes:

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

1. Explain techniques available for implementation of digital signal processing system
2. Design and simulate the working of given digital signal processing system
3. Evaluate performance of digital signal processing system
4. Interpret the performance of digital signal processing system
5. Write limitations of digital signal processing system designed with specific technique.

Prerequisite:
Knowledge of signal processing

Course Content

Unit No	Description	Hrs
1.	**Overview of DSP** : Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR..	06
2.	**Multi rate DSP**: Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.	06
3.	**Linear prediction & optimum linear filters** : stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction	06
4.	**Adaptive Filters** : Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm	06
5.	**Estimation of Spectra :** 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	06
6.	**Application of DSP & Multi rate DSP** : Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.	06

References -

1. J.G.Proakis and D.G.Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.

3. Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.
4. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
5. S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.

Class: - **First Year M.Tech Electronics**	Semester- **I**
Course Code : **ECS1034**	Course Name: **(PE-I) Wireless Sensor Networks**

L	T	P	Credits
3	--	--	3

Course description: A wireless sensor network generally consists of compact low power sensors, which collect information and pass the information via wireless networks to achieve a high level of desired monitoring and control in coordinated manners. WSN applications can be found in areas such as environmental monitoring, smart energy systems, battle field surveillance, home automation, medical monitoring, mobile computing, etc. WSN has integrated network engineering, embedded system engineering and sensor technology. This course covers fundamentals of wireless network technology and distributed sensor networks and be able to design and maintain WSNs.

Course Learning Outcomes:

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

1. Design wireless sensor network system for different applications under consideration
2. Select correct type of sensor for various applications.
3. Identify radio standards and communication protocols to be used for wireless sensor network based systems and application.
4. Decide operating systems and programming languages for wireless sensor nodes
5. Estimate special issues related to sensors like energy conservation and security challenges.

Prerequisite:

Knowledge of Sensor network

Course Content

Unit No	Description	Hrs
1.	**Over view of WSN:** 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.	06
2.	**Hardware:** Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.	06
3.	**Programming tools:** C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)	06
4.	**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, BLE (Bluetooth low energy), UWB.	06
5.	**Data dissemination and processing** ; differences compared with other database management systems, data storage; query processing.	06
6.	**WSN Features** ; Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.	06

References -

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

Class:- **First Year M.Tech Electronics**	Semester- **I**
Course Code : **ECS1044**	Course Name : **(PE-I) Advanced Power Electronics**

L	T	P	Credits
3	--	--	3

Course Description:
Advanced Power Electronics is offered as elective course for Electronics Engineering postgraduate programme. The contents of the course focus on design of DC-DC converters, AC voltage controllers, magnetic components and heat sink. It also deals with instrumentation used in power electronics and Electric utility interface. This course is useful for developing upcoming areas of autonomous vehicles.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Describe operation and applications of converters.
2. Design magnetic components, heat sinks and converters.
3. Illustrate methods of high power parameters measurements.
4. Justify requirement of power factor correction in utility interface

Prerequisite:
Knowledge of construction, working principle and V-I characteristics of the power devices.

Course Content

Unit No	Description	Hrs
1.	**SWITCHING MODE REGULATORS:** Buck-boost converter, Cuk converter, fly back converter, forward converter, control strategies of switching regulators, FPGA based converters	06
2.	**AC VOLTAGE CONTROLLERS AND CYCLO-CONVERTERS:** Principle of integral cycle control and phase control, phase controlled single-phase half wave and full wave ac controllers with resistive and inductive loads, three phase ac voltage controllers, applications of ac voltage controllers, Single-phase cyclo-converter, three phase cyclo-converters, reduction of output harmonics.	06
3.	**DESIGN OF MAGNETIC COMPONENTS AND HEAT SINK:** Magnetic materials and cores, Copper windings, Thermal considerations, special inductor design and procedure, power and converter transformer design procedure and K-factor transformer design, inductor, magnetic shielding design. Heat sink design and selection of heat sink	06
4.	**INSTRUMENTATION IN POWER ELECTRONICS:** Sensing of voltage, current and speed in AC/DC circuits, measurement of voltage, current, speed, power, power factor in ac/dc circuits using methods like hall effect sensor, DCCT, DCPT, shaft encoder and tachogenerator, true RMS meter, power analyzer	06
5.	**POWER FACTOR IMPROVEMENT TECHNIQUES:** Need of power factor improvement, phase angle, extinction angle, symmetrical angle and PWM control. Operation, waveforms and analytical treatment based on DF, DPF, PF, HF. Comparison.	06
6.	**UTILITY INTERFACE WITH POWER ELECTRONIC SYSTEMS:** Generation of current harmonics, current harmonics and power factor, Total Harmonic Distortion, harmonic standards and recommended practices, need for improved utility interface, improved line quality converters	06

Text Books:

1. M. H. Rashid, Power Electronics circuits devices and applications, III[rd] edition, PHI New Delhi, 2004.
2. Ned Mohan, T. Undeland & W. Robbins, Power Electronics Converters applications and design III[rd] edition, John Willey & sons, Singapore, 2003.

Reference Books:

1. P. C. Sen, Modern Power Electronics, S. Chand and Co, New Delhi, V[th] edition, 2012.
2. MD Singh and K.B Khanchandani, "Power Electronics", II[nd] edition, Tata McGraw Hill, 2010.

Class:- **First Year M.Tech Electronics**	Semester- **I**
Course Code : **ECS1054**	Course Name : **(PE-I) Statistical Information Processing**

L	T	P	Credits
3	--	--	3

Course Description:

Course is of study in probability theory, highly regarded for its strong mathematical orientation and comprehensive coverage. The course classifies topics in probability, random variables, and stochastic processes very logically, carefully incorporating a wide range of illustrations and applications. This Course provides greater emphasis on realistic methods of spectral estimation and analysis, and many new problems, examples and applications.

Course Learning Outcomes:

At the end of this course, students will be able to

1. Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations.
2. Demonstrate mathematical modeling and problem solving using such models.
3. Compare applications to signal processing, communications systems.
4. Develop frameworks based in probabilistic and stochastic themes for modeling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection.

Prerequisite:

Knowledge of Calculus and Linear Algebra

Course Content		
Unit No	**Description**	**Hrs**
1.	**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.	**06**
2.	**Random signal modeling:** 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.	**06**
3.	**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.	**06**
4.	**Spectral analysis:** Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.	**06**
5.	**Information Theory and Source Coding:** Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon Fano	**06**

	, 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.	
6.	**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.	**06**

References -

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

Class:- **First Year M.Tech Electronics**	Semester- **I**
Course Code : **ECS1064**	Course Name : **(PE-II) MIMO Systems**

L	T	P	Credits
3	--	--	3

Course Description:

The course deals with the recent trends in Wireless communications. In this course the fundamentals and advances of Multiple In Multiple Out system are discussed. The advanced concepts such as beam forming and antenna considerations are also considered which are helpful for the research in this area. The practical aspects of MIMO with respect to 4G and 5G communication are also taken care in this course.

Course Learning Outcomes:

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

1. Explain the concepts of MIMO capacity, beam forming, channel modelling and estimation.
2. Solve numerical and apply different modeling and estimation techniques of MIMO.
3. Analyze the diversity, beam forming and channel coding and estimation techniques in MIMO systems.
4. Evaluate the the diversity, coding and related case studies of MIMO systems.

Prerequisite:

Knowledge of Mathematics, Antennas and Digital Communications

Course Content

Unit No	Description	Hrs
1.	**Introduction to Multi-antenna Systems**: Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems.	06

2.	**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.	**06**
3.	**MIMO problem** : Singular Value Decomposition, Eigen values and eigenvectors, Equalizing MIMO systems, Disadvantages of equalizing MIMO systems, Pre-distortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of pre-coding and combining, Channel state information.	**06**
4.	**Codebooks for MIMO** : Beam forming, Beam forming principles, Increased spectrum efficiency, Interference cancellation, Switched beam former, Adaptive beam former, Narrowband beam former, Wideband beam former	**06**
5.	**Case study:** MIMO in LTE, Codeword to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beam forming in LTE, Cyclic delay diversity based pre-coding, Pre-coding 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	**06**
6.	**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.	**06**

Text Books:

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

Reference Books:

1. T.L. Marzetta " Fundamentals of Massive MIMO" Cambridge Press, 1st Edition 2016.
2. Ramjee Prasad, Muhammad Imadur Rahman, Suvra Sekhar Das and Nicola Marchetti, " Single- and Multi-Carrier MIMO Transmission for Broadband Wireless Systems " River Publishers Series in Communications, 1st edition 2009.

Class:- **First Year M.Tech Electronics**	Semester- **I**
Course Code : **ECS1074**	Course Name : **(PE-II) RF AND MICROWAVE CIRCUIT DESIGN**

L	T	P	Credits
3	--	--	3

Course Description: RF and Microwave Circuit Design course consist of two modules. The first module constitutes the study of various types of impedance matching circuits, and the design of various types of microwave filters. The second module covers the analysis of planer power dividers and directional couplers, design of microwave amplifier and oscillator.

Course Learning Outcomes:

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

1. Describe the behavior of RF passive components and model active components.
2. Perform transmission line analysis.
3. Demonstrate use of Smith Chart for high frequency circuit design.
4. Justify the choice/selection of components from the design aspects.
5. Design applications of RF circuit.

Prerequisite:

Basic Knowledge of Electromagnetic Engineering and Antennas.

Course Content

Unit No	Description	Hrs
1.	**Transmission Line Theory:** Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance.	06
2.	**Microwave Network Analysis:** Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix,	06

	transmission matrix, Signal flow graph.	
3.	**Nonlinearity And Time Variance** Inter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion	**06**
4.	**Microwave Filter Design:** ABCD parameters of networks, Filter design by the insertion loss method, low pass prototypes, Filter transformations, impedance and frequency scaling, Richard's Transformation, Kuroda's identities, Impedance and Admittance inverters, Stepped impedance low pass filters, Coupled line filters: Filter properties of a coupled line section, Design of Coupled line Band pass Filters, Microstrip discontinuities and their compensation.	**06**
5.	**PLANAR POWER DIVIDERS AND DIRECTIONAL COUPLERS :** S-parameters of terminated two port network, Basic Properties of Dividers and Couplers: Three-port networks, four port networks, The T-junction Power divider: Lossless Divider, Resistive Divider, The Wilkinson Power divider: Even-odd mode analysis, The Quadrature (90^0) hybrid.	**06**
6.	**MICROWAVE AMPLIFIER AND OSCILLATOR DESIGN** Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators.	**06**

Reference Books:

1. D.M.Pozar, " Microwave engineering" ,Wiley, 4th edition, 2011.
2. Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", AuthorHouse, 2009.
3. R.Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc, 2009.
4. G.D. Vendelin, A.M. Pavoi, U. L. Rohde, "Microwave Circuit Design Using Linear And Non Linear Techniques", John Wiley 1990.
5. S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987

Class:- **First Year M.Tech Electronics**	Semester-I
Course Code : **ECS1084**	Course Name : **(PE-II) Mechatronics Based systems**

L	T	P	Credits
3	--	--	3

Course Description:

The course is helpful to provide knowledge of mechanical and electronic systems used in industry. Automation is emerging demand of todays world, which can be accomplished through Mechatronics based systems. Mechatronics is a multidisciplinary field of science that includes a combination of mechanical engineering, electronics, computer engineering, telecommunications engineering, systems engineering and control engineering.

Course Learning Outcomes:

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

1. Explain elements required to develop mechatronics system.
2. Design mechatronics based system for specified application.
3. Describe applications of Mechatronics systems.

Prerequisite:

Knowledge of control system, Instrumentation system and linear algebra

Unit No.	Description	Hrs
1.	**Elements of Mechatronics systems :** Multichannel Data Acquisition System, Data Logger, Smart sensors, Sensors for Motion and Position Measurement, Force, Torque and Tactile Sensors, Flow sensors, Temperature sensors, Ultrasonic sensors, Range sensors, Fiber optic	06

	sensor, Liquid level sensor, Active Vibration Control	
2.	**Mechatronics System Design, Modeling and Simulation:** Integrated Design Issues in Mechatronics, Mechatronics Design Process, Mechatronics Key Elements, Simulation and Block Diagrams, Analogies and Impedance Diagrams, Electrical Systems, Fluid Systems, Electromechanical Coupling.	**06**
3.	**Hydraulic system: Hydraulic** systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Design of hydraulic circuits.	**06**
4.	**Pneumatic system :** Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems.	**06**
5.	**Actuating Devices And Applications In Mechatronics :**Electric drives, Fluid Power Actuation, Piezoelectric Actuators, Mechatronics Control in Automated Manufacturing, Artificial Intelligence in Mechatronics, Fuzzy Logic Applications in Mechatronics	**06**
6.	**Case Studies :**Interfacing with microcontroller, transducer calibration system for automotive applications, strain gauge weighing system, data acquisition and control case studies	**06**

Text Books:

1. Boucher, T. O.Computer automation in manufacturing - an Introduction, Chapman and Hall, 1996.
2. HMT ltd. Mechatronics, Tata Mcgraw-Hill, New Delhi, 1988William B. Ribbens,
3. Devdas Shetty and Richard A. Kolk, Mechatronics System Design, second, Cengage Learning Publication, 2011

Reference Books:

1. Bolton, Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering, 2nd Edition, Addison Wesly Longman Ltd., 1999.
2. M. D. Singh and J. G. Joshi, Mechatronics, PHI Publication, 2006

Class:- **First Year M.Tech Electronics**	Semester-**I**
Course Code : **ECS1094**	Course Name : **Research Methodology and IPR**

L	T	P	Credits
1	1	--	2

Course Learning Outcomes:

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

1. Formulate a research problem.
2. Analyze research related information
3. Prepare and present research proposal/paper by following research ethics
4. Make effective use of computers and computing tools to search , analyze information and prepare report.
5. Describe nature and processes involved in development of intellectual property rights

Prerequisite: --

Course Content

Unit No	Description	Hrs
1.	Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.	04
2.	Effective literature studies approaches, Plagiarism, Research ethics, Approaches of investigation of solutions for research problem, data collection, Data analysis with software, interpretation, Necessary instrumentations	04
3.	Effective technical writing, how to write technical report and paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	04

4.	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.	**04**
5.	Patent Rights: Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.	**04**
6.	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.	**04**

References -

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students", Juta & Co Ltd
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction", Juta Academic
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners", SAGE Publication
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
5. Mayall , "Industrial Design", McGraw Hill, 1992.
6. Niebel , "Product Design", McGraw Hill, 1974.
7. Asimov , "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", Wolters Kluwar,2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Class:- **First Year M.Tech Electronics**	Semester-I
Course Code : **ECS1104**	Course Name : **Advanced Communication Networks Lab**

L	T	P	Credits
0	0	4	2

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Identify the different types of network devices, their functions, required tools and techniques.
2. Build and analyze the skills of sub-netting and routing mechanisms.
3. Evaluate the performance of designed advanced communication networks.
4. Present and write laboratory reports in desired format in grammatically correct language.

Prerequisite:
Knowledge of networking

Course Content

Experiment No	Description	Hrs
1.	Study of Networking Commands (Ping, Tracert, TELNET, nslookup, netstat, ARP, RARP) and Network Configuration Files.	04
2.	Linux Network Configuration.	04
3.	Assign IP address to the PC connected to the internet.	04
4.	Connect the computers in Local Area Network.	04
5.	Design TCP iterative Client and Server application to reverse the given input sentence.	04
6.	Design a TCP concurrent Server to convert a given text into the upper case using multiplexing system call "select".	04
7.	Design UDP Client Server to transfer a file.	04
8.	Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS	04

	address.	
9.	Configuring FTP Server	**04**
10.	Creating a Network topology using Exata Emulator/Qualnet Software.	**04**
11.	Packet tracer using Exata Emulator/Qualnet Software.	**04**
12.	Testing of Routing Protocols using Exata Emulator/Qualnet Software.	**04**

References -

1. Jean Wairand and Pravin Varaiya, "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

Class:- **First Year M.Tech Electronics**	Semester- **I**
Course Code : **ECS1114**	Course Name : **Advanced Digital Signal Processing Lab**

L	T	P	Credits
0	0	4	2

Course Description:

Advances in integrated circuit technology have had a major impact on the technical areas to which digital signal processing techniques and hardware are being applied. The efficient use of such hardware devices requires thorough understanding of various digital signal processing techniques. These techniques encompass frequency analysis of signals, filter design methods, sampling rate conversion, and power spectrum estimation. The subject is essential for anyone whose work is concerned with signal processing applications.

Course Learning Outcomes:

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

1. Design digital signal processing system based on given specifications
2. Write MATLAB program to simulate the working of designed given digital signal processing system
3. Analyze performance of digital signal processing system
4. Write proper conclusion
5. Write laboratory report in desired format in grammatically correct language

Prerequisite:

Students should have knowledge of MATLAB programming.

Course Content

Experiment No	Description	Hrs
1.	Basic Signal Representation	04
2.	Correlation Auto And Cross	04

3.	Stability Using Hurwitz Routh Criteria	**04**
4.	Sampling FFT of Input Sequence	**04**
5.	Butterworth Low pass And High pass Filter Design	**04**
6.	Chebychev Type I, II Filter	**04**
7.	State Space Matrix from Differential Equation	**04**
8.	Normal Equation Using Levinson Durbin	**04**
9.	Decimation And Interpolation Using Rationale Factors	**04**
10.	Maximally Decimated Analysis DFT Filter	**04**
11.	Cascade Digital IIR Filter Realization	**04**
12.	Inverse Z-Transform and Parallel Realization of IIR filter	**04**

References -

1. J.G.Proakis and D.G.Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
3. Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.
4. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
5. S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
6. D.G.Manolakis, V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

Semester II

Class:- **First Year M.Tech Electronics**	Semester-**II**
Course Code : **SHP515**	Course Name : **Numerical Computation Techniques**

L	T	P	Credits
3	--	--	3

Course Description:

Numerical computational method is a core subject introduced at Semester I of first year M. Tech. Electronics and Telecommunication Engineering. This course intends to build the competency in the students to apply the knowledge of mathematics to the solution of engineering problems and to analyze it.

Course Learning Outcomes:

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

1. Estimate the error.
2. Apply the relevant numerical method for interpolating the polynomial
3. Develop the equation to be fitted and fit the curve for given data
4. Estimate numerically the solution of given algebraic equation.

Prerequisite:

Undergraduate Engineering Mathematics

Course Content

Unit No	Description	Hrs
1.	**Error Analysis and Estimation:** Error and their analysis, A general error formula, Error in numerical computations, Error in series approximation.	06
2.	**Interpolations:** Introduction, Finite differences, Relation between operators, Differences of a polynomial, Factorial notation, Missing term technique, Laplace-Everett's formula, Lagrange's interpolation formula, Newton's Divided difference formula.	06

3.	**Curve Fitting:** Method of least squares, Fitting a straight line, Fitting of an exponential curve $y = ae^{bx}$, Fitting of the curve $y = ax^b$, Fitting of the curve $y = ab^x$, Fitting of the curve of the type $xy = b + ax$, Fitting of the curve $y = ax + bx^2$. Most plausible solution of a system of a linear equations.	**06**
4.	**Solution of Nonlinear Algebraic and Transcendental Equations:** Muller's Method, Horner's Method, Multiple roots, Lin Bairtow's Method, Graeffe's Squaring Method.	**06**
5.	**Elements of Matrix Algebra**: Gaussian Elimination method, Gauss Jordan method, LU- decomposition from Gaussian Elimination method, Solution of Tridiagonal Systems, Eigen Value problems.	**06**
6.	**Fuzzy Logic Theory and Applications:** Classical logic theory, Logical functions of the Two Valued logic, Boolean algebra. Multi valued logic, Fuzzy logic and approximate reasoning, Fuzzy relations, Applications of fuzzy logic for product quality evaluation, Decision making for investment.	**06**

References -

1. An Introduction to Numerical Analysis, Atkinson K. E., J. Wiley and Sons, 1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.
3. Introductory Methods of Numerical Analysis, Sastry S. S, Prentice Hall of India, 1998.
4. Fuzzy Mathematics, M. S Bapat, Shivaji Univesrsity, Kolhapur, 2015.
5. Introduction to Fuzzy Systems, Guanrong Chen, Trung Tat Pham, Chapman and Hall/ CRC Taylor and Francis Group.

Class:- **First Year M. Tech Electronics**	Semester-**II**
Course Code : **ECS2014**	Course Name : **Antennas and Radiating Systems**

L	T	P	Credits
3	--	--	3

Course Description:

Antennas and Radiating Systems course is offered as the core course at the second semester of Electronics Engineering post-graduate programme; consist of two modules. The first module constitutes the study of basics of antennas, Linear and array antennas. The second module covers the study and analysis of aperture, microstrip and reflector antennas.

Course Learning Outcomes:

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

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

Prerequisite:

Basic Knowledge of Electromagnetic Engineering.

Course Content

Unit No	Description	Hrs
1.	**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,	06

	Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.	
2.	**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.	**06**
3.	**Linear Arrays:** Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.	**06**
4.	**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.	**06**
5.	**Micro strip Antennas:** Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.	**06**
6.	**Reflector Antennas:** Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.	**06**

Text Books:

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.

Reference Books:

1. R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984.
2. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980.

Class:- **First Year M.Tech Electronics**	Semester- **II**
Course Code : **ECS2024**	Course Name : **Wireless and Mobile Communication**

L	T	P	Credits
3	--	--	3

Course Description:

This course will provide an introduction and history of cellular communication systems that have changed our lives during the recent four decades and will become an essential and inseparable part of human life. The principles of wireless communication theory are covered with emphasis on the essential concept delivery to non-major learners in the easiest way. Then, it will be covered how such principles are realized and how multimedia services can be delivered in practical LTE cellular systems by which learners are connected and enjoys together in their lives.

Course Learning Outcomes:

At the end of this course, students will be able to

1. Design appropriate mobile communication systems.
2. Apply frequency-reuse concept in mobile communications.
3. Distinguish various multiple-access techniques for mobile communications .
4. Analyze CDMA system functioning
5. Evaluate 3G, 4G technologies .

Prerequisite:

Basics of Communication Engineering.

Course Content

Unit No	Description	Hrs
1.	**Cellular Communication Fundamentals:** Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and	06

	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.	
2.	**Spectral efficiency analysis based on calculations for Multiple access technologies**: 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).	**06**
3.	**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.	**06**
4.	**Equalization, Diversity:** Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.	**06**
5.	**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 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and Channels.	**06**

6.	**Higher Generation Cellular Standards:** 3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G.	**06**

References -

1. V. K. Garg, J. E. Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2. V. K. Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
3. T. S. Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.
4. William C. Y. Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
5. Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London, 1997.

Class:- **First Year M.Tech Electronics**	**Semester- II**
Course Code : **ECS2034**	Course Name : **(PE-III) Automotive Electronics**

L	**T**	**P**	**Credits**
3	**--**	**--**	**3**

Course Description:

The course will be helpful to provide overview of automotive electronics used in vehicles. This will be helpful for future generation automobile vehicles as hybrid vehicles and battery operated vehicles which is emerging demand of the world.

Course Learning Outcomes:

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

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

1. Describe components of automotive electronics and its evolution and trends.
2. Develop automotive grade microcontroller based system.
3. Design and model various automotive control systems.
4. Describe safety standards and advances towards autonomous vehicles.

Prerequisite:

Knowledge of instrumentation, control systems and linear algebra

Course Content

Unit No	**Description**	**Hrs**
1.	**Automotive System:** Role of technology in Automotive Electronics and interdisciplinary design tools and processes. Introduction to modern automotive systems and need for electronics in automobiles and application areas of electronic systems in modern automobiles, Overview of Hybrid Vehicles.	**06**

2.	**Automotive Sensors and Actuators:** Systems approach to control and instrumentation: Concept of a system, Analog and Digital systems, Basic measurements systems- Automotive Sensors, Sensor characteristics, Sensor response, Sensor error, Redundancy of sensors in ECUs, Avoiding redundancy, Sensor modeling , Smart Nodes, Examples of sensors in automotive. Actuators – Examples of actuators in automotive- solenoid and motor based	**06**
3.	**Microcontrollers/Microprocessors in Automotive domain, Communication protocols:** Microcontrollers/Microprocessors in Automotive domain: Review of microprocessor, microcontroller and digital signal processor development, Criteria to choose the right microcontroller/processor for automotive applications, Automotive grade processors. Communication Protocols: Overview of Automotive communication protocols: CAN, LIN, Flex Ray, MOST, Ethernet, D2B and DSI.	**06**
4.	**Automotive Control Systems** Control system approach in Automotive (State variables approach only):Analog and Digital control methods, modeling of linear systems, System responses. Modeling of Automotive Systems simple examples (PID tuning by Zeigler-Nichols Method).	**06**
5.	**Model based Development:** Model-Based Design for a small system, Explore the system response using different control methods, Study of system modeling of any one of the Automotive systems.	**06**
6.	**Safety Systems in Automobiles and Diagnostic Systems:** Active Safety Systems: ABS, TCS, ESP, Brake assist etc Passive Safety Systems: Airbag systems, Advanced Driver Assistance Systems (ADAS), Examples of assistance applications. Functional Safety: Need for safety systems, safety concept, safety process for product life cycle, Safety by design, Validation. Diagnostics: On board and off board diagnostics in Automobiles, Diagnostic tools, Diagnostic protocols	**06**

Text Books:

1. William B. Ribbens, "Understanding Automotive Electronics", 6thEdition, Newness Publication, An imprint of Elsevier Science, 2003and onwards.
2. Ronald K Jurgen, "Automotive Electronics Handbook, 2ndEdition, McGraw-Hill, 1999and onwards.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 5th Edition and onwards.

Reference Books:

3. Tom Denton, "Advanced Automotive Diagnosis, 2ndEdition, Elsevier, 2006and onwards.
4. Allan Bonnick, "Automotive Computer Controlled Systems: Diagnostic Tools and Techniques Elsevier Science, 2001 and onwards

Class:- **First Year M.Tech Electronics**	Semester- **II**
Course Code : **ECS2044**	Course Name : **(PE-III) Internet of Things**

L	T	P	Credits
3	--	--	3

Course Description: The Internet of Things (IoT) is expanding at a rapid rate, and it is becoming increasingly important for professionals to understand what it is, how it works, and how to harness its power to improve business. This course will enable learners to leverage technical knowledge across IoT-related functions in the workplace.In the course; we will examine the concept of IoT. We will look at the 'things' that make up the Internet of Things, including how those components are connected together, how they communicate, and how they value add to the data generated. We will also examine cyber security and privacy issues, and highlight how IoT can optimize processes and improve efficiencies in your business.

Course Learning Outcomes:

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

1. Identify IoT technologies in certain scenarios.
2. Describe technologies which are available for IoT solutions.
3. Apply technologies for IoT applications

Prerequisite:

Basic knowledge of WSN

Course Content

Unit No	Description	Hrs
1.	Smart cities and IoT revolution, Fractal cities, From IT to IoT, M2M and peer networking concepts, Ipv4 and IPV6	06
2.	Software Defined Networks SDN, From Cloud to Fog and MIST	06

	networking for IoT communications, Principles of Edge/P2P networking, Protocols to support IoT communications, modular design and abstraction, security and privacy in fog. pipelining, VLIW (Very Long Instruction Word) processor.	
3.	Wireless sensor networks: introduction, IOT networks (PAN, LAN and WAN), Edge resource pooling and caching, client side control and configuration.	**06**
4.	Smart objects as building blocks for IoT, Open source hardware and Embedded systems platforms for IoT, Edge/gateway, IO drivers, C Programming, multithreading concepts.	**06**
5.	Operating systems requirement of IoT environment, study of mbed, RIoT, and Contiki operating systems, Introductory concepts of big data for IoT applications	**06**
6.	Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT, Security and legal considerations, IT Act 2000 and scope for IoT legislation.	**06**

References -

1. A Bahaga, V. Madisetti, "Internet of Things- Hands on approach", VPT publisher, 2014.
2. A. McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
3. CunoP fister, "Getting started with Internet of Things", Maker Media, 1st edition, 2011.
4. Samuel Greenguard, "Internet of things", MIT Press, 2015.

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/

Class:- **First Year M.Tech Electronics**	Semester- **II**
Course Code : **ECS2054**	Course Name : **(PE-III) Voice and Data Networks**

L	T	P	Credits
3	-	--	3

Course Description:

Understanding Voice and Data Networks is intended as an introduction to the communications technologies used in transporting voice and data. It provides a broad base of knowledge into communication networks but doesn't require prior technical background or experience in the field. Topics include: basis of voice, video and data communication, network terminologies, architecture, switching techniques, network design, basic queuing analysis, protocols, Transmission Control Protocol (TCP), Internet Protocol (IP), Routing Techniques and Performance Analysis.

Course Learning Outcomes:

At the end of this course, students will be able to

1. Describe Protocol, algorithms, trade-offs rationale for voice and data network.
2. Apply Routing and transport protocols .
3. Identify congestion algorithms .

Prerequisite:

Knowledge of Mobile Communication

Course Content

Unit No	Description	Hrs
1.	**Network Design Issues:** Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of voice and data networks.	06
2.	**Layered and Layer less Communication**: Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit	06

	Switching and Packet Switching, Statistical Multiplexing.	
3.	**Data Networks and their Design** : Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.	**06**
4.	**Queuing Models of Networks**:, Traffic Models , Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols , Aloha System , Carrier Sensing , Examples of Local area networks.	**06**
5.	**Inter-networking** : Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup, Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery.	**06**
6.	**Congestion avoidance** : RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.	**06**

References -

1. D. Bertsekas and R. Gallager, "Data Networks", 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, "Computer Networks: A Systems Approach",5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, "Communication Networking: An analytical approach", 1st Edition, Morgan Kaufman, 2004.
4. Walrand, "Communications Network: A First Course", 2nd Edition, McGraw Hill, 2002.
5. Leonard Kleinrock, "Queueing Systems, Volume I: Theory", 1st Edition, John Wiley and Sons, 1975.
6. Aaron Kershenbaum, "Telecommunication Network Design Algorithms", McGraw Hill, 1993.
7. Vijay Ahuja, "Design and Analysis of Computer Communication Networks", McGraw Hill, 1987.

Class:- **First Year** **M.Tech Electronics**	Semester- **II**
Course Code : **ECS2064**	Course Name : **(PE-IV) Soft Computing**

L	T	P	Credits
3	--	--	3

Course Description:

This course provides an introduction to the basic concepts of Soft Computing methodology and covers three main components – Neural Networks, Fuzzy Logic and genetic algorithm. The course combines theoretical foundations with practical applications using different tools and techniques.

Course Learning Outcomes:

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

1. Identify soft computing techniques and their roles in building intelligent machines
2. Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems
3. Describe genetic algorithms to combinatorial optimization problems
4. Apply neural networks to pattern classification and regression problems

Prerequisite:

Basic knowledge of set theory

Course Content

Unit No	Description	Hrs
1.	**Fuzzy sets and membership,** Universe of discourse, Classical sets operations and properties, Fuzzy sets operations and properties, mapping, Cartesian product, crisp relations, fuzzy relations, membership functions, Fuzzy arithmetic.	06

2.	**Soft computing:** What is soft computing? Differences between soft computing and hard computing, Soft Computing constituents, Methods in soft computing, Applications of Soft Computing, Concept, biological neural system. Evolution of neural network, McCulloch-Pitts neuron model, activation functions, feed forward networks, feedback networks, learning rules - Hebbian, Delta, Percepron learning and Windrow-Hoff, winner-take-all.	**06**
3.	**Neural Network :** Perceptron learning, single 1 layer/multilayer perceptron, linear separability, hidden layers, back popagation algorithm, Radial Basis Function network; Unsupervised learning, applications of neural networks to pattern recognition systems such as character recognition, face recognition, application of neural networks in image processing.	**06**
4.	**Fuzzy controller**; Fuzzy Rules & Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making; Neuro-fuzzy modeling- Adaptive Neuro-Fuzzy Inference Systems, Coactive Neuro-Fuzzy Modeling, Classification and Regression Trees, Data Clustering Algorithms, Rule base Structure Identification and Neuro-Fuzzy Control , Applications of neuro-fuzzy modeling.	**06**
5.	Introduction to Genetic Algorithms (GA), Representation, Operators in GA, Fitness function, population, building block hypothesis and schema theorem.; Genetic algorithms operators- methods of selection, crossover and mutation, simple GA(SGA), other types of GA, generation gap, steady state GA, Applications of GA.	**06**
6.	**Swarm intelligence:** What is swarm intelligence? Various animal behaviors which have been used as examples, ant colony optimization, swarm intelligence in bees, flocks of birds, ant-based routing and particle swarm optimization.	**06**

Text Books:

1. S.N. Shivanandam, Principle of soft computing, Wiley. ISBN13: 9788126527410(2011)
2. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2003.
3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall,1995.
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson publication., 2003.

Reference Books:

1. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998.
2. David E. Goldberg, Genetic Algorithms in Search, Optimization & Machine Learning, Addison Wesley, 1997.

Class:- **First Year M.Tech Electronics**	Semester-**II**
Course Code : **ECS2074**	Course Name : **(PE-IV) Electric Drives**

L	T	P	Credits
3	--	--	3

Course Description:

An electric drive is offered as elective course for Electronics Engineering postgraduate programme. The contents of the course focus on ac and dc drives, traction drives and energy conservation of drives. This course is useful for developing upcoming areas of autonomous vehicles.

Course Learning Outcomes:

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

1. Describe operation and applications of drives.

2. Design drives for various applications.

3. Illustrate methods of energy conservation in electric drives.

Prerequisite:

Knowledge of power electronics.

Course Content

Unit No	Description	Hrs
1.	**Dynamics of Electric Drives:** Definition, Advantages of electrical drives, Components of Electric drive system, Selection Factors, Types of Electrical Drives (DC & AC). Motor-Load Dynamics, Speed Torque conventions and multi quadrant operation, Equivalent values of drive parameters. Load Torque Components, Nature and classification of Load Torques, Constant Torque and Constant Power operation of a Drive.	06
2.	**Electrical Braking:** Electrical braking methods, characteristics of DC	06

	Motors: Rheostatic, Plugging, and Regenerative. Electrical braking method of three phase induction motor: DC Dynamic Braking, Plugging, Regenerative Braking, AC Rheostatic braking, motor braking methods using static devices. Closed loop control of drives: current limit control, torque control and speed control.	
3.	**Solid State Controlled D.C. Motors:** Single phase and three phases fully controlled converter drives and performance of converter fed separately excited DC Motor for starting and speed control operations. Chopper controlled drives for separately excited and series DC Motor operations. Closed loop speed control of DC motor below and above base speed.	**06**
4.	**Solid State Controlled Induction Motors** Mathematical modeling of ac drives, Induction motor characteristics, control strategies like stator voltage control, v/f control, rotor resistance control, use of CSI for induction motor control, PWM control, controlled slip system, slip power recovery system, close loop control, direct vector control & indirect vector control, breaking of induction motor, soft acceleration and deceleration, various protections.	**06**
5.	**Traction drives:** electric traction services, electric trains, electric buses, trams and trolleys, nature of traction load, main line and suburban train configurations, braking, important feature of traction drives, motors employed in traction, conventional ac and dc traction drives, semiconductor converter controlled drives.	**06**
6.	**Energy conservation in electric drives:** losses in electrical drive system, measures for energy conservation in electrical drives, use of efficient semiconductor converters, use of efficient motors, use of variable speed drives, energy efficient operation of drives, improvement of power factor, improvement of quality of supply.	**06**

Text Books:

1. G. K. Dubey, "Fundamentals of Electric Drives", 2nd Edition, Narosa Publishing House
2. S. K. Pillai, "Analysis of Thyristor Power Conditioned Motors", University Press

Reference Books:

1. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education
2. R. Krishnan, "Electric Motor Drives – Modeling Analysis and Control", PHI India
3. V. Subrahmanyam, "Electric Drives: Concepts & Application", Tata Mc-Graw Hill

Class: - **First Year M.Tech Electronics**	Semester-**II**
Course Code : **ECS2084**	Course Name: **(PE-IV) High Performance Networks**

L	T	P	Credits
3	--	--	3

Course Description:

The course deals with the networks, voice over IP, network security and ecosystem of networks. The high performance networks are discussed in this course with reference to design analysis and implementation of different types of networks.

The modeling, routing algorithms are elaborated in detail.

Course Learning Outcomes:

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

1. Explain the concepts of Networks, VoIP, VPN, Network security and management.
2. Solve numerical based on networks, routing and traffic modeling.
3. Analyze the Network designs, VoIP/ VPN architectures and network security.
4. Evaluate the performance of networks, system architecture and infrastructure.
5. Design and implement networks with suitable architecture, protocols and infrastructure.

Prerequisite:

Knowledge of Mathematics, Digital Communications and computer networks.

Course Content

Unit No	Description	Hrs
1.	**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	06

	mechanism, integrated services, and RSVP-differentiated services.	
2.	**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.	**06**
3.	**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.	**06**
4.	**Traffic Modeling:** Little's theorem, Need for modeling, Poisson modeling, Non-poisson models, Network performance evaluation.	**06**
5.	**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.	**06**
6.	**Infrastructure for network management,** The internet standard management framework –SMI, MIB, SNMP, Security and administration, ASN.1.	**06**

Text Books:

1. Warland J., Varaiya P., "High-Performance Communication Networks", Morgan Kaufmann, 1996.
2. Kershenbaum A., "Telecommunications Network Design Algorithms", Tata McGraw Hill, 1993.
3. Larry Peterson & Bruce David, "Computer Networks: A System Approach", Morgan Kaufmann, 2003.

Reference Books:

1. Douskalis B., "IP Telephony: The Integration of Robust VoIP Services", Pearson Ed. Asia, 2000.
2. Stallings W., "High-Speed Networks: TCP/IP and ATM Design Principles", Prentice Hall, 1998.
3. Leon Garcia, Widjaja, "Communication networks", TMH 7threprint 2002.

Class:- **First Year M. Tech Electronics**	Semester- **II**
Course Code : **SHP551**	Course Name : **Technical Communication**

L	T	P	Credits
2	0	0	0

Course Learning Outcomes:

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

1. Acquire skills required for good oral and written communication
2. Demonstrate improved writing and reading skills

Prerequisite: --

Course Content

Unit No	Description	Hrs
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	04
2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism	04
3.	Sections of a Paper, Abstracts, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	04
4.	Key skills needed when writing a Title, key skills needed when writing an Abstract, key skills needed when writing an Introduction, skills needed when writing a Review of the Literature	04
5.	Key skills needed when writing the Methods, skills needed when writing the Results, skills needed when writing the Discussion, skills needed when writing the Conclusions, useful phrases, how to ensure good quality	04

	of the paper at the time of submission	
6.	Professional skills: Resume Writing, e-Mails, Interview skills , Dos and Don'ts while Answering, FAQs, GROUP DISCUSSION: Structured and Unstructured GD, Opening and Closure, Showing Agreement and Disagreement	**04**

References -

1. Goldbort R ,Writing for Science, Yale University Press (available on Google Books), 2006
2. Day R , How to Write and Publish a Scientific Paper, Cambridge University Press, 2006
3. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book, 1998 .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
5. John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
6. Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
7. Jeff Butterfield, Soft Skills for Everyone, Cengage Learning India Private Limited, 2010

Class:- **First Year M.Tech Electronics**	Semester-**II**
Course Code : **ECS2094**	Course Name : **Antennas and Radiating Systems Lab**

L	T	P	Credits
0	0	4	2

Course Description:

Antennas and Radiating Systems Lab constitute of design and test of basics of antennas, Linear and array antennas. It covers the study and analysis of aperture, microstrip and reflector antennas.

Course Learning Outcomes:

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

1. Determine specifications, design, construct and test antenna.
2. Explore and use tools for designing, analyzing and testing antennas.

Prerequisite: --

Course Content

Experiment No	Description	Hrs
1.	Simulation of half wave dipole antenna.	04
2.	Simulation of change of the radius of dipole wire on frequency of resonance of antenna.	04
3.	Simulation of change of the length of dipole wire on frequency of resonance of antenna.	04
4.	Simulation of full wave antenna and comparison of their parameters	04
5.	Simulation of quarter wave antenna and comparison of their parameters	04
6.	Simulation of monopole antenna without ground plane	04
7.	Simulation of monopole antenna with ground plane	04
8.	Study the effect of the height of the monopole antenna on the radiation characteristics of the antenna.	04

9.	Study the effect of the height of the microstrip antenna on the radiation characteristics of the antenna.	**04**
10.	Study the effect of change in distance between elements of array on radiation pattern of dipole array.	**04**
11.	Develop rectangular patch antenna.	**04**
12.	Develop circular patch antenna.	**04**

Class:- **First Year M.Tech Electronics**	Semester-**II**
Course Code : **ECS2104**	Course Name : **Wireless & Mobile Communication Lab**

L	T	P	Credits
--	--	4	2

Course Description:
A laboratory course that covers the following topics: basics of wireless and mobile communication, radio network planning for the GSM cellular system, CDMA, SDR, analyze different modulation techniques. The lab course represents a novel initiative to increase interactive learning by integrating communications theory fundamental knowledge with state-of-the-art wireless communications software tools. The experiments are carefully designed to enhance the analytical skills and to advance the academic and practical knowledge of the students.

Course Learning Outcomes:
After successful completion of the course, students will be able to,

1. Illustrate Cellular concepts, GSM and CDMA networks.
2. Outline GSM handset by experimentation and fault insertion techniques.
3. Interpret CDMA concept using DSSS .
4. Develop concepts of Software Radio in real time environment.

Prerequisite:
Knowledge of GSM ,CDMA Network

Course Content

Experiment No	Description	Hrs
1.	Understanding Cellular fundamentals like Frequency Reuse, Interface, cell splitting, multi path environment, Coverage and Capacity issues using communication software.	04
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.	04
3.	Study of GSM handset for various signaling and fault insertion	04

	techniques (Major GSM handset sections: clock, SIM card, charging, LCD module, Keyboards, User Interface).	
4.	To study transmitters and receiver section in mobile and measure frequency band signal and GMSK modulating signal.	**04**
5.	To study various GSM At commands their use and developing new application using it.	**04**
6.	Understanding 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.	**04**
7.	Study of DSSS technique for CDMA, observe effect of types of PN codes, chip rate, spreading factor, processing gain on performance.	**04**
8.	To learn and develop concepts of Software Radio in real time environment by studying the building blocks.	**04**
9.	To learn and develop concepts of Software Radio in real time environment by convolution encoder,	**04**
10.	To study SDR using Interweaver and De Interweaver	**04**
11.	To study and analyze different modulation techniques in time and frequency domain using SDR kit.	**04**
12.	Demonstration of 4G and 5G	**04**

References -

1. V. K. Garg, J. E. Wilkes, "Principle and Application of GSM", Pearson Education, 5th edition, 2008.
2. V. K. Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th edition, 2009.
3. T. S. Rappaport, "Wireless Communications Principles and Practice", 2nd edition, PHI, 2002.
4. William C. Y. Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd edition, TMH, 1995.
5. Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London, 1997.

Class:- **First Year M.Tech Electronics**	Semester- **II**
Course Code : **ECS2124**	Course Name : **Mini Project**

L	T	P	Credits
0	0	4	2

Course Description:

There will be one mini project implemented during the course of the semester. Mini project is composed of the following four parts:

- Problem Analysis
- Solution Design
- Build and Test (software /hardware)
- Demonstrate and Report

It is expected to demonstrate a working design to meet the specifications of the assigned project

Course Learning Outcomes:
After successful completion of the course, students will be able to,

- Select title of mini project identifying gap from literature survey and formulate its objectives.
- Develop, simulate and implement the system by complying with desired technical specifications.
- Analyze obtained results in theoretical and practical contextCO4: Analyze obtained results in theoretical and practical context.
- Present findings in logical order.
- Write a report to document his/her findings.

Department: Electronics & Telecommunication Engineering
Class: S. Y. M. Tech. Electronics **Semester:** III

Course Code	Course	Teaching Scheme				Evaluation Scheme				
							Theory		Practical	
		L	T	P	Credits	Scheme	Max Marks	Min % for Passing	Max Marks	Min % for Passing
ECS 3014	Industry Internship	-	-	2	Audit	ISE	--	--	P/NP	
ECS 3024	MOOC Course	-	-	-	3	ESE*	-	-	50	50
ECS 3034	Dissertation Phase-I	-	-	8	4	ISE	-	-	100	50
ECS 3044	Dissertation Phase-II	-	-	12	6	ISE	-	-	100	50
						ESE			100	50
	TOTAL	-	-	22	13	-	-	-	-	-

Total Contact Hours/week : 22
Total Credits : 13

* Indicates that, student needs to complete Online/Certification course approved by DPGC and produce certificate of online or certification course at the time of ESE. If student fails to produce this certificate, he or she will not be eligible to give ESE of Online/certification course.

Class:- **Second Year M.Tech Electronics**	Semester-**III**
Course Code : **ECS3014**	Course Name : **Industry Internship**

L	T	P	Credits
0	0	2	Audit

Course Description:

In the industry internship / field training work, student is expected to get training in the industry, related to subject specialization for duration of 15 days (minimum) for at least 6 hours per day.

The students who are doing course on MOOC/NPTEL/Coursera/Courses suggested by BOS should

- Select the course in consultation with supervisor and submit the details to Head of Program
- The course should be minimum 25 hours duration and should have certification facility.
- Student should complete course and get certificate the certificate copy should be submitted to head of program with supervisor signature.

In case student opted for industrial training he/she should write a report and submit the same for evaluation to head of program.

Course Learning Outcomes:

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

1. Apply engineering knowledge learned during the program
2. Apply his/her technical skills to industrial problem
3. Develop creative and innovative solution to the given problem.
4. Support in multi-disciplinary environment.
5. Show concern for society, environment and other social concerns
6. Demonstrate given task according to the industrial needs with full integrity and responsibility

Class:- **Second Year M.Tech Electronics**	Semester-**III**
Course Code : **ECS3024**	Course Name : **MOOC Course**

L	T	P	Credits
--	--	--	3

- *Students should complete the certificate course in online MOOC mode based on suggestion given by Supervisor. The supervisor should conduct ESE for the course and submit course completion certificate with ESE marks to COE. The course should be selected in inter disciplinary area.

Class:- Second Year M.Tech Electronics	Semester-III
Course Code : ECS3034	Course Name : Dissertation Phase-I

L	T	P	Credits
--	--	8	4

COURSEOUTCOMES:

After completion of this course students will be able to:

- Identify research opportunities in the domain or multidisciplinary domains
- Formulate the problem statement and its objectives.
- Apply the principles of project management.
- Present synopsis in logical order.
- Write synopsis of the proposed system.

DISSERTATION PHASE-I

It consists of Synopsis Preparation and Synopsis approval by DPGC committee

SYNOPSIS PREPARATION

Postgraduate student should decide on the dissertation topic in consultation with its supervisor and come out with a synopsis of dissertation work, in July/August of an academic year. The Synopsis shall consist of three chapters - Introduction, Literature Review and Methodology with expected deliverables.

It is expected that student should have in-depth understanding of the selected problem, knowledge of probable solutions to the same problem and expected outcomes from the dissertation work.

The synopsis shall consist of following points

- Title
- Introduction
- Literature Survey
- Objectives

- Methodology
- Activity chart
- References

The title should be brief, accurate, descriptive, and comprehensive and clearly indicate the subject for the investigation.

The introduction part should include

- Area of the work
- Importance of the work

Literature review should

- Examine the most current studies on the topic and presenting the significant aspects of these studies.
- Compare different authors' views about the issue
- Summarize the literature in terms of a knowledge gap identification e.g. performance improvement of the existing system, functionality improvement of the existing, proposing an entirely new approach, etc.

It should be followed by the Problem statement formulated based on identified gap and objectives of the study

Methodology shall include information such as techniques, sample size, target populations, equipment, data analysis, etc. and explain why proposed methodology is most suitable to solve the undertaken problem.

It should be followed by activity chart mentioning probable duration for completion of various activities to be undertaken during dissertation work and appropriate list of references. The references should be from reputed journals such IEEE, Science direct, Elsevier etc.

SYNOPSIS APPROVAL AND EVALUATION BY DPGC COMMITTEE

The student should submit the synopsis duly signed by supervisor in the prescribed format to the department office. The DPGC committee is advised to conduct the Synopsis Presentation for the students of the program within the stipulated period and give approval to the synopsis with the evaluation score. The committee is advised to find

the enough complexity in the dissertation work, and all committee members should remain present at the time of the presentation.

The objective of the presentation is to find quality of work undertaken by the student, student's understanding about basic concepts required to carry out the work, scope of the work, correctness of the methodology, consistency of proposed work with dissertations works of other students and student's ability to communicate his or her ideas and work. The committee can suggest modifications in the synopsis if it does not fulfill above-mentioned requirements. The student should prepare a modified synopsis by incorporating suggestions given by members and give presentation again.
The supervisor must ensure that student have incorporated all suggestions.

Class:- Second Year M.Tech Electronics	Semester-III
Course Code : ECS3044	Course Name : Dissertation Phase-II

L	T	P	Credits
--	--	12	6

COURSEOUTCOMES:

After completion of this course students will be able to:

- Hypothesize research problem in the domain
- Simulate the problem statement and its objectives.
- Develop the system with desired technical specifications and principles of project management.
- Analyze obtained results in theoretical and practical context.
- Present report in logical order.
- Write report of the dissertation work.

DISSERTATION PHASE-II

After synopsis approval, it is expected that student should start working on the selected problem as per activity chart given in the synopsis. It is expected that at least 40% dissertation work should be completed by a student in this phase.

EVALUATION OF DISSERTATION PHASE-II

Evaluation (ISE) of Dissertation Phase-II shall be carried before the end of the semester-III and shall be jointly evaluated by Supervisor and Internal-examiner appointed by DPGC committee.

The student should give presentation / demonstration of the work done. The examiners shall look at student's progress and quality of the work done. The suggestions shall be given to the student, if required. The student should keep a record of these suggestions

and incorporate them in his or her work. The supervisor should ensure that suggestions given are incorporated by the student.

The End –semester examination (ESE) of Dissertation Phase-II shall be carried out by Controller-of-Examinations after the end of Semester-III. The student should give presentation and/or demonstration of completed work in front of supervisor and external examiner appointed by COE.

Class:- Second Year M.Tech Electronics	Semester-IV	L	T	P	Credits
Course Code : ECS4014	Course Name: Dissertation Phase-III	--	--	12	6

COURSEOUTCOMES:

After completion of this course students will be able to:

- Modify system as per previous results.
- Simulate the problem statement and its objectives.
- Develop the system by complying with desired technical specifications and principles of project management.
- Analyze obtained results in theoretical and practical context.
- Present report in logical order.
- Write report of the dissertation work.

DISSERTATION PHASE-III

In Dissertation Phase-III, it is expected that student should complete at least 70% of the dissertation work and prepare a draft of the paper for publication.

EVALUATION OF DISSERTATION PHASE-III

The evaluation (ISE) of Dissertation Phase-III shall be carried out in March of the academic year by Supervisor and Internal examiner appointed by DPGC. The appointed members shall look at student's progress and quality of the work done. The suggestions shall be given to the student, if required. The student should keep a record of these suggestions and incorporate them. The supervisor should ensure that suggestions given are incorporated by the student.

If student's progress is not as per expectation, the committee member shall issue a written notice to the student about probable extension.

Class:- **Second Year M.Tech Electronics**	Semester-IV
Course Code : **ECS4024**	Course Name **Dissertation Viva Voce**

L	T	P	Credits
--	--	20	10

COURSEOUTCOMES:

After completion of this course students will be able to:

- Modify system as per previous results.
- Simulate the problem statement and its objectives.
- Develop the system by complying with desired technical specifications.
- Analyze obtained results in theoretical and practical context.
- Present report in logical order.
- Write report of the dissertation work.

DISSERTATION PHASE-IV

In Dissertation Phase-IV, it is expected that student should complete

- 100% implementation of the proposed system
- Simulation/ experimentation work on the proposed system
- Performance evaluation of the proposed system
- Comparison of the proposed system with existing systems
- Writing of the conclusion
- Preparation of a draft-copy of the dissertation report with Plagiarism report

EVALUATION OF DISSERTATION PHASE-IV

The DPGC committee is advised to evaluate the dissertation pre-submission presentation and/or system demonstration given by the students at the end of semester –IV within the stipulated period and give approval/modifications to the work done by the student along with the evaluation score.

The committee is advised to verify work completion as per the synopsis, and all committee members should remain present for the presentation. The objective of the presentation/ demonstration is to understand techniques implemented by the student, student's own contribution in the development process, obtained results, comparison of results with existing systems, and deliverables of the dissertation work.

The committee can suggest modifications if it does not fulfill above-mentioned requirements in the system/ draft copy of the report. In this case, the student should modify the system in a given time span based on suggestions given by the members and give presentation again in front of committee members. The members should ensure that student has incorporated all suggestions and gives him/her approval to submit the dissertation work for final evaluation.

FINAL EVALUATION OF DISSERTATION WORK:

The final evaluation of the dissertation work shall be carried out by a three-member committee, comprising of Chairman, External Examiner and concerned supervisor. This committee should be appointed by Controller of Examinations.

The student should give presentation and demonstration of work carried out in front of committee members. The external examiner and supervisor should evaluate student's performance based on following points.

1. Justification and clarity of the problem statement and project objectives
2. Use of appropriate, applicable and justifiable methodology to solve problem undertaken

3. Reliability and validity of data collection instruments /resources used, critical data analysis and interpretation
4. Overall system design
5. Experimental Results and their comparison with existing systems
6. Critical analysis of obtained results and their interpretation and correlation with project deliverables
7. Scientific justification of conclusions
8. self-contribution of the candidate in project development irrespective of use of readymade hardware/software
9. Presentation skills

The chairman shall ensure smooth conduct of the examination.