GUJARAT TECHNOLOGICAL UNIVERSITY

ELECTRONICS & COMMUNICATION
COGNITIVE RADIO NETWORKS
SUBJECT CODE: 3710513
M.E. 1st SEMESTER

Type of course: Programme Elective-II

Prerequisite: Wireless Communication, Data Communication and Networking

Rationale: Now a day, many receivers are implemented using software and they are called Software Defined Radios. Cognitive radio network is an emerging technology which utilizes available frequency resources in most efficient way and provides reliable communication. Cognitive radio network is an advanced research area in the field of wireless communication and networking. By learning this subject the students will appreciate the recent trends of software defined radios and cognitive radio networking.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Unit 1:** 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	**07**	20
2	Unit 2: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).	**08**	20
3	**Unit 3:**Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.	**07**	10
4	**Unit 4:**Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols	**08**	20
5	**Unit 5:**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).	**07**	15
6	**Unit 6:** Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross- layer design for cognitive radio networks, Cognitive radio for Internet of Things,MIMO Cognitive Radio	**06**	15

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.
- Jeffrey H. Reed ,"Software Radio: A Modern Approach to Radio Engineering By Pearson Education .
- Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
- Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
- Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
- Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009

Course Outcomes:

At the end of this course, students will be able 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 the basic architecture of cognitive radio.
- Study various techniques like spectrum sensing and spectrum analysis.
- 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

List of Open Source Software/learning website:

www.crew-project.eu, GNU Radio , sdrforum.org, ecewp.ece.wpi.edu

GUJARAT TECHNOLOGICAL UNIVERSITY

RTL SIMULATION AND SYNTHESIS WITH PLDs

SUBJECT CODE: 3710512

ME 1st Semester

Type of course: Major Elective - I

Prerequisite: Digital logic design and any programming language.

Rationale: NA

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Top down approach to design, Design of FSMs (Synchronous and asynchronous), Static timinganalysis, Meta-stability, Clock issues, Need and design strategies for multi-clock domain designs.	11	24%
2	Programmable Logic Devices, Introduction to ASIC Design Flow, FPGA, SoC, Floor planning, Placement, Clock tree synthesis, Routing, Physical verification, Power analysis, ESD protection.	12	30%
3	Design for performance, Low power VLSI design techniques. Design for testability.	08	20%
4	IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, Use of external hard IP during prototyping.	07	17%
5	Case studies and Speed issues.	04	09%
		42	100%

Reference Books:

1. Richard S. Sandige, “Modern Digital Design”, MGH, International Editions.
2. Donald D Givone, “Digital principles and Design”, TMH
3. Charles Roth, Jr. and Lizy K John, “Digital System Design using VHDL”, Cengage Learning.
4. Samir Palnitkar, “Verilog HDL, a guide to digital design and synthesis”, Prentice Hall.
5. Doug Amos, Austin Lesea, Rene Richter, “FPGA based prototyping methodology manual”, Xilinx
6. Bob Zeidman, “Designing with FPGAs & CPLDs”, CMP Books.
7. J. Bhasker, “A VHDL PRIMER, 3/E 3rd Edition

Course Outcome:

At the end of the course, students will demonstrate the ability to:
Familiarity of Finite State Machines, RTL design using reconfigurable logic. Design and develop IP cores and Prototypes with performance guarantees. Use EDA tools like Cadence, Mentor Graphics , Altera and Xilinx.

Suggested List of Experiments:

1. (a) Implement 4 bit adder
   (b) Modify 4 bit adder for carry look ahead concept.
2. Implement 4 bit universal counter with up/down counter, synchronous clear and preset, count enable carry in/out
   facility
3. Implement 4 bit shift register with parallel load, serial in, shift left/right control.
4. Design 4 bit comparator with behavioral and structure architecture.
5. Design 4 bit ALU sequence detector.
6. (a) Design 4X4 bit multiplier
   (b) Design 4X4 booth bit multiplier
7. (a) Design the state machine with combinational output decoding.
   (b) Design the state machine with registered output decoding
   (c) Design the state machine with output encoded within the state bit.
8. Design simple memory controller.
9. Using PSPICE obtain characteristics of MOSFET with resistive load.
10. Using PSPICE obtain characteristics of enhancement MOSFET with resistive load.
11. Using PSPICE obtain characteristics of CMOS.
12. Minimum 2 mini project in the group of two students.

Major Equipments:

Kits with Xilinx / Altera FPGA

List of Open Source Software/learning website:

Xilinx ISE/Altera/cadence

GUJARAT TECHNOLOGICAL UNIVERSITY

WIRELESS SENSOR NETWORKS
SUBJECT CODE: 3710511
M.E. 1st SEMESTER

Type of course: Programme Elective-I

Prerequisite: Wireless Communication, Data Communication and Networking

Rationale: Now a day, wireless sensor networks are used in many applications like habitat monitoring or in areas where human interventions is hazardous. Wireless sensor network is an emerging area which utilizes network of sensor nodes which are tiny in size and battery operated. They required to be used very power efficiently so that network lifetime is optimized and provide reliable communication to the base station. By learning this subject the students will appreciate the recent trends of wireless sensor networks, their design constraints and challenges.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Unit 1:** 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.	**07**	20
2	**Unit 2:** Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.	**08**	20
3	**Unit 3:** Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet)	**07**	10
4	**Unit 4:**Overview of sensor network protocols (details of atleast 2 important protocol per layer): 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.	**08**	20
5	**Unit 5:** Data dissemination and processing; differences compared with other database management systems, data storage; query processing.	**07**	15
6	**Unit 6:** Specialized 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**	15

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.
- YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

Course Outcomes:

At the end of this course, students will be able 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\
- Study / Implementation of

1. Wireless test bed for lab usage monitoring
2. A wireless sensor network for monitoring class room occupancy
3. Wireless Sensor network for habitat monitoring
4. Protocol Architectures for Cognitive Networks
    - Study of Mica2/MicaZ and associated interface board

List of Open Source Software/learning website:

sensors.cs.umass.edu/

GUJARAT TECHNOLOGICAL UNIVERSITY

Statistical Information Processing
SUBJECT CODE: 3710510
ME 1st Semester

Type of course: Program Elective - I

Prerequisite: Higher Engineering Mathematics, Fundamental knowledge of signals and systems along with types, Probability and elementary enumerating principles, Linear Algebra, and Calculus

Rationale:
PG Students of EC Engineering need to possess good understanding of the fundamentals Algebra and random variable. They are expected to be able to understand sequence of random variable, conditional expectation and statistical independence and perform matlab implementation of stochastic processes like wide sense stationary processes, orthogonal increment processes. They are expected to be able to design efficient error correcting codes. Theory concepts of source coding, error detecting and correcting schemes, their encoding and decoding process will be verified through implementation in MATLAB and Simulink

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
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.	6	10
2	**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.	6	15
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.	9	20
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.	6	10

5	**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.	9	15
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.	9	20
Total		**45**	**100**

References Books:

- 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 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.

Course Outcome:

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

Suggested List of Experiments:

1. Decoding the messages for a system with a given cyclic polynomial code and verifying through simulation.
2. Understanding the concept of loss less data compression technique using Huffman coding.
3. Write a MATLAB program to perform BCH encoding and decoding.
4. Write a MATLAB program to perform RS encoding and decoding.
5. Encoding the data bits using a Binary Cyclic block encoder in Simulink.
6. Decoding the code words using a Binary Cyclic block decoder in Simulink.
7. Write a MATLAB program to find the joint distribution of time samples.
8. Write a MATLAB program for derivatives of random process.
9. Write a MATLAB program for integration of random process.
10. Write a MATLAB program for joint densities function of random variables.

11. Write a MATLAB program for marginal densities function of random variables.

List of Software/learning website:

1. MATLAB
2. http://nptel.ac.in
3. www.youtube.com

GUJARAT TECHNOLOGICAL UNIVERSITY

OPTICAL NETWORKS
SUBJECT CODE: 3710509
M. E. Semester – I

Type of course: Elective

Prerequisite: Fundamental knowledge of Optical Communication System is necessary,

Rationale: The course provides good knowledge of different optical networks and the mechanism to obtain the same. The course also describes present optical fiber to carry out more messages, handle a wide variety of transmission types and provide improved reliabilities and ease of use.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Introduction:** Introduction to Optical Networks: Telecommunications Networks Architecture, Services, Circuit Switching and Packet switching, Optical Networks, Optical Packet Switching, Transmission Basics, Components: Multiplexers and Filter Switches, Wavelength Converters.	3	15
2	Client layers of the optical layer: SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.	7	15
3	WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.	6	15
4	Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.	6	15
5	Network Survivability: ,protection in SONET/SDH & client layer, optical layer protection schemes	7	15
6	WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.	6	15
7	Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON	7	10

Reference Books:

1. Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3 rd edition, 2010.
2. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001.
3. Optical WDM Networks by Biswanath Mukherjee, Springer

Course Outcome:

After learning the course the students should be able to:

1. understand the concept of WDM thoroughly and international telecom standards.
2. Gain understanding the functions of network elements and network design.
3. wide knowledge of Optical Network applications.
4. understand the routing in optical networks.
5. implement simple optical network and understand further technology developments for future enhanced network.

Practicals /Tutorials

Experiments /Simulations based on syllabus topics and advanced topics in the present scenario with reference to the subject.

Major Equipment :

Simulation Software

GUJARAT TECHNOLOGICAL UNIVERSITY

WIRELESS & MOBILE COMMUNICATION
SUBJECT CODE: 3710508
ME 1st Semester

Type of course: Core Subject

Prerequisite:

- Higher Engineering Mathematics,
- Fundamental knowledge of Signals and Systems
- Antenna and Wave Propagation
- Digital Communication theory
- Probability and random processes
- Programming skills in Simulation Exercises

Rationale:

The purpose of this course is to provide an understanding of modern digital mobile and wireless communication systems. Topics include: overview of cellular concept; interference and traffic analysis for cellular networks; wireless fading channel modeling and characterization; modulation and detection performance over fading channels; multi-carrier systems; receiver and transmitter diversity techniques; information theory of wireless channels; OFDM, MIMO, Massive MIMO and space-time communications; and cooperative communications; Mobile ad-hoc networks; 2G standards (e.g. GSM, CDMA), 3G standards and introduction to 4G and 5G standards.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Sr. No.	Content	Total Hrs	%Weight
1	**The Cellular Concept-System Design Fundamentals:** Cellular structure, Frequency Reuse, Frequency management, Channel Assignment Strategies, Handoff Strategies- Interference and system capacity, Co channel Interference Co-channel Interference reduction and system capacity, Adjacent Channel interference , Channel planning for Wireless Systems, , Power Control for Reducing interference, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring, Mobile Antennas, Antennas at cell site and Cellular System Design Considerations, GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM. Wireless Network planning, Link budget and power spectrum calculations.	7	17%
2	**Mobile Radio Propagation Model, Small Scale Fading:** Large scale path	7	17%

	loss:-Free Space Propagation loss equation, Path-loss of NLOS and LOS Systems Reflection, 2-Ray Ground reflection Model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread, Feher's delay spread upper bound Small scale, Multipath Measurement parameters of multipath channels, Types of small scale Fading, Rayleigh and Rician distribution, Statistical for models multipath fading channels		
3	**Equalization & Diversity:** Equalizers in communication receiver, Algorithms for adaptive equalization, Diversity Techniques: Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Considerations, Frequency Diversity, and Time Diversity, RAKE Receiver, Interleaving	**6**	**14%**
4	**OFDM and MIMO:** Introduction to OFDM, Multicarrier Generation of sub-carriers using the IFFT OFDM signal processing and Trans-receiver blocks; Peak Power Problem: PAP reduction schemes, SNR performance, Introduction to MIMO, MIMO Spatial Multiplexing, MIMO Channel Capacity, MIMO applications, and Massive MIMO.	**8**	**19%**
5	**Mobile Ad-hoc Networks:** Ad-hoc wireless network-features and Challenges, MAC protocols in Ad-hoc Wireless networks (MACAW) Internet-based mobile ad-hoc networking communication strategies, Routing algorithms – Proactive, Reactive and Hybrid Routing Protocols, Energy management in ad-hoc wireless networks, Security issues and QoS in wireless networks, Vehicular to Vehicular Communication, Introduction to wireless sensor networks.	**8**	**19%**
6	**Recent Wireless Technology:** Overview of WCDMA, and Wi-MAX, Higher Generation Cellular Standards: 4G , enhanced 4G and 5G standards, Cognitive Radio, NOMA, Massive IoT	**6**	**14%**

Reference Books:

1. Wireless Communications: Principles and Practice, 2nd Edition, By Theodore S. Rappaport
2. Wireless Communication, By Molisch-Wiley India
3. Advanced Wireless Networks (Technology and Business Models): By Savo Glisic-Wiley
4. Wireless Communications ,Andrea Goldsmith Cambridge University Press, 2007
5. Mobile Cellular Telecommunications (Analog and Digital Systems), 2nd Edition, By William C.Y. Lee-McGraw Hill
6. David Tse and Pramod Viswanath Fundamentals of Wireless Communication ,Cambridge University Press 2005
7. Wireless Communication Systems: By Ke-Lin DU and M.N.S. Swamy
8. MIMO Wireless Communications – Ezio Biglieri – Cambridge University Press.
9. Principle and Application of GSM", V.K.Garg, J.E.Wilkes Pearson Education.
10. "A GSM system Engineering" Asha Mehrotra, Artech House Publishers
11. Richard Van Nee & Ramjee Prasad., 'OFDM for Multimedia Communications' Artech House Publication, 2001.

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Reference Papers:

1. Vaduvur Bharghavan, A. Demers, S. Shenker, and L. Zhang, "MACAW: A Medium Access Protocol for Wireless LAN's". In the Proc. ACM SIGCOMM Conference (SIGCOMM '94), August 1994, pages 212-225
2. C. Perkins C., and P. Bhagwat, "Highly Dynamic Destination-Sequence Distance Vector Routing (DSDV) for Mobile Computers," ACM SIGCOMM Computer Communication Review, Vol. 24, No. 4, October 1994, pp. 234-244.
3. "Charles E. Perkins and Elizabeth M. Royer "Ad hoc On-Demand Distance Vector Routing." Proceedings of the 2nd IEEE Workshop on Mobile Computing Systems and Applications, New Orleans, LA, February 1999, pp. 90-100.
4. "David B. Johnson, David A. Maltz, and Josh Broch, "DSR: The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad-Hoc Networks", in Ad-Hoc Networking, edited by Charles E."Perkins, Chapter"5, pp."139-172, Addison-Wesley, 2001. Invited paper.
5. "Samir R. Das, Charles E. Perkins, and Elizabeth M. Royer "Performance comparison of two on-demand routing protocols for ad-hoc networks," Proceedings of the IEEE Conference on Computer Communications (INFOCOM), Tel Aviv, Israel, March 2000, p. 3-12.
6. A.J Paulraj, Gore, Nabar and Bolcskei, "An Overview of MIMO Communications – A Key to Gigabit Wireless", IEEE Trans Comm, 2003
7. Simon Haykin: Cognitive Radio: Brain Empowered Wireless Communications, IEEE Journal on selected areas in communication Vol. 23 No.2 Feb-2005
8. Simon Haykin, David J. Thomson, Jefery H. Reed: Spectrum Sensing for Cognitive Radio, Proceedings of IEEE Vol. 97 No.5 May-2009.
9. MIMO-OFDM Systems for High Data Rate Wireless Networks", Whu

Course Outcome:

By the end of this course, the student will be able to:

1. Design a mobile cellular network
2. Optimize a radio channel system
3. Select the apt diversity scheme for a given wireless system to improve the performance.
4. Perform efficient spectral allocation using multiple access techniques such as CDMA, and OFDM.
5. Select the correct MAC protocol and routing algorithm for mobile ad-hoc networks.
6. Optimize the mobile ad-hoc network-MAC protocols and routing algorithms as per application.
7. Gain knowledge of underlying mobile standards and the future mobile technologies such as WCDMA, Wi-Max; and also the coming 4G and 5G mobile standards

Course Outcomes:

At the end of this course, students will be able 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 OFDM and MIMO system functioning, advantages and disadvantages of the technology.
- Understand upcoming Mobile technologies like Massive MIMO, Massive IoT, NOMA
- Understand upcoming Mobile technologies like enhanced 4G and 5G etc.

List of Experiments:

Sr. No.	Experiment Name
1	To study different mobile communication standards.
2	To study and perform channelization scheme and measure adjacent and co-channel interference in cellular system
3	To study different diversity schemes and measure RF signal strength.
4	To study and measure path loss exponent for different environment.
5	To study and perform GSM AT commands
6	To study Trunking theory and generate ERLANG table.
7	To study and generate PN sequence using matlab.
8	To study the phase linearity of GMSK.
9	Implement Rayleigh fading channel in Simulink.
10	Implement OFDM IEEE 802.11a in Simulink.
11	Implementing Wi-Max 2004 in Simulink.

List of Assignments:

1. May 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.
2. May study and analyze different modulation techniques in time and frequency domain using SDRkit.

Design based Problems (DP)/Open Ended Problem:

1. Show that if n=4, a cell can be split into four smaller cells, each with half the radius and 1/16 of the transmitter power of the original cell. If the extensive measurements show that the path loss exponent is 3, how should the transmitter power be changed in order to split a cell into four smaller cells? What impact will this have on the cellular geometry? Explain your answer and provide drawings that show how the new cells would fit within the original macrocells.
2. Assume that a cell named Radio Knob has 57 channels, each with an effective radiated power of 32 W and a cell radius of 10 km. The path loss is 40 dB/ decade. The grade of service is established to be a probability of blocking of 5%. Assume the average call length is 2 minutes, and each user averages two calls per hour. Further, assume the cell has just reached its maximum capacity in the same area.
    a. What is the current capacity of Radio Knob cell?
    b. What is the radius and transmit power of the new cells?
    c. How many channels are needed in each of the new cells to maintain the frequency reuse stability in the system?
    d. If the traffic is uniformly distributed, what is the new traffic carried by each new cell?
    e. Will the probability of blocking in these new cells be below 0.1 % after the split?

    Assume 57 channels are used at the original BS and the split cells.
3. In a two-ray ground reflection model, assume that θ_Δ must be kept below 6.261 radians for phase cancellation reasons. Assuming a receiver height of 2m, and given a requirement that θ_i be less than 5^O, what are the minimum allowable values for the T-R separation distance and the height of the transmitter antenna? The carrier frequency is 900 MHz
4. Using computer simulation, create a Rayleigh fading simulator that has three independent Rayleigh fading multipath components, each having variable multipath time delay and average power. Then convolve a random binary bit stream through your simulator and observe the time waveforms of the output stream. Observe the effects of multipath spread as you vary the bit period and time delay of the channel.
5. Analyze any wireless network of your choice using different routing algorithms covered in syllabus using NS-2

C. List of Software:

Matlab, NS-2

Learning website:

www.nptel, ocw.mit.edu (MIT Open-Course Ware)

Review Presentation (RP): The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.

GUJARAT TECHNOLOGICAL UNIVERSITY

Advance Image Processing
SUBJECT CODE: 3710506
Semester I

Type of course: Major Elective -II

Prerequisite: Higher Engineering Mathematics, Fundamental knowledge of signals and systems along with types, Mathematical representation of signals and system modeling in time as well as frequency domain. Fourier Transforms, Basic analysis and synthesis procedure

Rationale: PG Students of EC Engineering need to possess good understanding of the fundamentals and applications of Image Processing specially in image feature extraction, including basic image processing operations, Low-level feature extraction (including edge detection), Feature extraction by shape matching, Flexible shape extraction (snakes and other techniques), Object description, Introduction to texture description, segmentation and classification and 3-D image processing. They are expected to be able to design algorithms in MATLAB software running on PC,digital ,this includes both the analysis and synthesis

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	**Basic image processing operations** Overview, Histograms, Point Operators,Group operators, Other statistical Operators, Mathematical morphology	2
2	**Low- level feature extraction (including edge detection)** Overview, First-order edge detection operators , Second- order edge detection operators, Other edge detection operators, Comparison of edge detection operators , Phase Congruency, Localized feature extraction, Detecting image curvature ,Describing image motion	4
3	**Feature extraction by shape matching** Overview, Thresholding and subtraction, Template matching,Hough transform (HT), Generalized Hough transform (GHT),Other extensions to the HT	4
4	**Flexible shape extraction (snakes and other techniques)** Overview, Deformable templates, Active contours (snakes), Shape skeletonization, Flexible shape models: active shape and active appearance	4
5	**Object description** Overview, Boundary descriptions(Boundary and region, Chain codes, Fourier descriptors), Region descriptors(Basic region descriptors, Moments)	6

6	**Introduction to texture description, segmentation and classification** Overview , What is texture, Texture description(Performance requirements, Structural approaches, Statistical approaches, Combination approaches), Classification(The k-nearest neighbor rule, Other classification approaches), Segmentation	**7**
7	**3D Image Acquisition** Volume imaging vs. sections, Basics of reconstruction, Algebraic reconstruction methods, Maximum entropy, Defects in reconstructed images, Imaging geometries, Three-dimensional tomography, High resolution tomography	**6**
8	**3D Image Visualization** Sources of 3D data, Serial sections, Optical sectioning Sequential removal Stereo, 3D data sets, Slicing the data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Special display hardware, Ray tracing, Reflection, Surfaces, Multiply connected surfaces, Image processing in 3D,Measurements on 3D images	**7**
	Total	**40**

Reference Books:

1. Feature Extraction and Image Processing, Mark S. Nixon and Alberto S. Aguado, Elsevier Publication,Second Edition,2008
2. Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Third Edition,Pearson Education
3. Fundamentals of Digital Image Processing:Practical Approach with examples in MATLAB, Chris Solomon and Toby Breckon,Wiley-Blackwell.
4. Digital Image Processing Using MATLAB, Rafael C. Gonzalez, Richard E. Woods,and Steven L. Eddins, Second Edition, Tata McGraw Hill Publication
5. Digital Image Processing, S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill Publication
6. Digital Image Processing, S Sridhar, Oxford University Press
7. The Image Processing Handbook, Third Edition *by John C. Russ* CRC Press, CRC Press 1998

Course Outcome:

After learning the course the students should be able to:

1. Understanding of digital image processing fundamentals to enhance image and reduce noise from image.
2. Analyze and implement different image processing algorithms for 2-D and 3-D images.
3. Ability to write image processing programs in MATLAB.

List of Experiments:

1. Image Enhancement : Point Processing Techniques
2. Image Enhancement : Histogram Equalization
3. Image Enhancement : Low pass Filtering
4. Image Enhancement : Sharpening Filter
5. Image Enhancement : Erosion & Dilation of image
6. Image Segmentation : First order Edge Detection operators: Roberts, Prewitts, sobel operators, Canny operator
7. Image Segmentation : Second order Edge Detection operators: laplacian, Marr–Hildreth operator
8. Morphological Processing: Boundary Extraction
9. Morphological Processing: Object Identification
10. Feature Extraction: Texture filters
11. Segmentation: Split and Merge Algorithms

List of Software:

1. MATLAB
2. Scilab

GUJARAT TECHNOLOGICAL UNIVERSITY

Advanced Digital Signal Processing
SUBJECT CODE: 3710501
ME 1st Semester

Type of course: Advanced Statistical ,Adaptive and Multirate Signal Processing

Prerequisite: Higher Engineering Mathematics, Digital Filter Structure and Design, Estimation and Linear Prediction, Estimation of spectra from finite duration signals, Periodogram, Nonparametric and Parametric methods and model based spectral estimation**.**

Rationale: PG Students of EC Engineering need to possess good understanding of the fundamentals and applications of Digital filters, predictive filters,Adaptive systems and multirate DSP including estimation theory and random variables for implementing changing real world into DSP system. They are expected to be able to design Adaptive Digital filters and process real world signals as per desired communication applications. They will be guided in designing Adaptive Filters using various Algorithms using MATLAB/Scilab/CCS software.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr.No.	Course Content	Teaching hours	Module weightage
1	**Overview of DSP**:Characterization in time and frequency **Digital filter design and structures**: Basic, Cascaded, lattice FIR/IIR filter structures, Frequency sampling structures of FIR systems ,lattice-ladder structures, parallel realization of IIR systems. design techniques of FIR filters,Design of IIR filters from analog filters by approximations of derivatives ,impulse invariance, bilinear transformation methods	**09**	**20%**
2	**RandomSignals :**Random Processes- Stationary Random processes, discrete time random signals,Estimation,Linear Systems with Stationary Random Inputs, Whitening and Innovations Representation,Special types of Random Processes: AR,MA ,ARMA processes ,Yule-Walker equations	**06**	**05%**
3	**Linear prediction & optimum linear filters:** Linear prediction: Forward and Backward linear prediction, filters,solution of normal equations, Properties of the Linear Prediction error filters,AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction-FIR and IIR Wiener filter ,Noncausal IIR filter, Kalman Filter	**10**	**15%**

4	**Adaptive Filters:** Introduction to Adaptive System, Adaptive Linear Combiner, Properties of Quadratic Performance Surface, Searching the Performance Surface, Gradient Estimation and its Effect on Adaptation, Method of Steepest Descent, LMS Algorithm, RLS Algorithms. Applications of adaptive filters : System Modelling,Channel equalization, Echo Cancellation,Narrowband interference,Adaptive Array	**10**	**30%**
5	**Multi rate DSP** :Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, CIC filters,QMF, digital filter banks, Applications in subband coding.	**08**	**20%**
6	**Application of DSP & Multi rate DSP**: Application to Radar, Introduction to wavelets, application to image processing, DSP in speech processing & other applications	**05**	**10%**

Reference Books:

1. J.G.Proakis and D.G.Manolakis"Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007.
2. Stearns, Bernard Widrow and Samuel Stearns, " Adaptive Signal Processing "
3. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 1st Edition, John Wiley and Sons Ltd, 1999.
4. Li Tian,Digital Signal Processing Fundamentals and Applications Elsevier 2nd Edition
5. S.K. Mitra - Digital Signal Processing: A computer based approach, TMH, 2001
6. P.P. Vaidyanathan, Multirate systems and Filter banks, Pearson,1996
7. Bruce W. Suter, "Multirate and Wavelet Signal Processing",1st Edition, Academic Press, 1997.
8. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
9. S.Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
10. D.G.Manolakis,V.K. Ingle and S.M.Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000

Course Outcomes:

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

- Design different digital filters in software
- Apply various transforms in time and frequency
- Perform decimation and interpolation To understand theory of different filters and algorithms
- Study Random Variables and random process
- Understand theory of multirate DSP, solve numerical problems and write algorithms
- Understand theory of linear prediction and solution of normal equations
- Use MATLAB and C language for adaptive system Analysis and design
- Study and Design Adaptive System for various applications.
- Analyse the applications of DSP at block level.

Tutorials/Teacher Guided Student Activity:

- As a part of this activity students can perform following activities.

- Refer scholarly articles from well known journal/conferences such as IEEE, ELSEVIER, and SPRINGER etc
- Student can be assigned topics for seminars on some research topics.
- Perform practicals using MATLAB/SCILAB

- Basic Signal Representation
- Correlation Auto And Cross
- Determine Mean, Mean Square, variance of a random process
- Sampling FFT Of Input Sequence
- Butterworth Low pass And High pass Filter Design
- Chebychev Type I,II Filter
- FIR filter design
- State Space Matrix from Differential Equation
- Implement system function of forward and backward prediction filters.
- Normal Equation Using Levinson Durbin
- Implement lattice structure and system function for AR, MA, ARMA process.
- Write a MATLAB program for Wiener-Hopf equation.
- Implement comb filter and CIC filter.
- Implement LMS and RLS algorithm.
- Decimation And Interpolation Using Rationale Factors
- Maximally Decimated Analysis DFT Filter
- Cascade Digital IIR Filter Realization
- Convolution And M Fold Decimation &PSD Estimator
- Estimation Of PSD
- Separation (Decomposition) Of System Function
- Parallel Realization of IIR filter

Major Equipments: PC with MATLAB and CCS, Digital Storage Oscilloscope, DSP Processor Kit TMS X 6713

List of Open Source Software/ Learning website:

1. Scilab (software)
2. www.nptel.ac.in

GUJARAT TECHNOLOGICAL UNIVERSITY

RESEARCH AND IPR

M.E. SEMESTER: I

Rationale:

To the Student:

The purpose of this subject is to orient the students to the scientific methodology of research and presenting their thesis. Research constitutes primarily of literature review, giving critical comments on the literature reviewed and identifying the gap, problem formulation, modeling in either an analytical or experimental set up, validating the model and solving the problem you set for yourself.

At the end, student should be able to present and defend the solution he/she has found, in a simple and easy manner. Communicating the research outcomes, is an art wherein, you do not want to either undermine or over emphasise the content, within the short time limit given for such presentations. The balance of critical technicality and overall outcomes is the key to an effective presentation. The language, content and articulation should be such as to convey in a unified manner, the gist of your work.

To the Teacher:

It is envisaged that the teacher will discuss actual case studies to make the student understand the concepts of demonstration of examples during theory. Theory classes will be used to explain each of the concepts in Module 1 and 2. This syllabus is based on the model AICTE course prescribed in May2018.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
1	0	2	2	0	0	80	20	100

Content:

	Module 1 Starting Research	**Teaching Hrs**
1.1	**Find what is expected of you**	
	Identify specific requirements for evaluation/review and what constitutes completion of your work	
	Find where the source is available	
	Establish proper methods for finding the relevant material from the source.	
1.2	**Analyse the question**	
	Identify key areas in your field	
	Determine the nature and extension of papers that you should read	
1.3	**Identify the gaps**	

	Learn to Critique existing knowledge and how to find the gap	
1.4	**Formulate the Problem Statement**	
	Understand what should be the key aspects of your problem statement	
	Examples of effective and ineffective Titles	
1.5	**Validation**	
	Identify problem and experimental/theoretical data for comparison with your model	
	Learn how to extrapolate/scale data for validation	
	Find what is acceptable level of error and justification thereof	
	Module 2 Finding Good Literature	
2.1	**Decide which sources you will need**	
	Differentiate between journals, conferences, books, magazines and their quality	
	Understand how to establish their quality and authenticity	
2.2	**Finding Information**	
	How to conduct effective searches	
	How to find relevant papers related to your area of research	
	How to capture critical information	
2.3	**Identify main ideas in scholarly literature**	
	Understand and identify the bias, theoretical position and evidence produced	
2.4	**Write notes to organize your ideas**	
	Compare ideas and concepts from different papers	
	Module 3 Writing and Presenting your Work	
3.1	**Effective technical writing**	
	How to write Report, Paper, Developing a Research Proposal, Format of research proposal	
3.2	**Build your argument**	
	Recognise the importance of emphasizing your point	
	Distinguish between your point and the evidence available	
	Acknowledge the evidence	
3.3	**Review and finalize your work**	
	Know and follow the Process of reviewing and proof reading your work	
	Use feedback to improve your work	
3.4	**Check the logistics of your presentation**	
	Identify the key message of your presentation	
	Understand the expectations and what will be the key review points	
3.5	**Develop the structure of your presentation**	
	Understand the key components of an oral presentation	
	Know the usual structure of a good presentation	
3.6	**Prepare for delivery of your Oral presentation**	
	Rehearse and time your presentation	
	Prepare to answer questions from the audience: Fundamental concepts should be spoken from memory as reviewer will be looking for evidence of your thorough understanding.	
	Read more than the content you are presenting; keep sources ready on hand for reference;	
	Module 4 Intellectual Property	
4.1	**Patents, Designs, Trade and Copyright.,**	
	Process of Patenting and Development: Technological research innovation, patenting, development.	

4.2	**International Scenario:**	
	International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	
4.3	**Patent Rights**	
	Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	
4.4	**New Developments in IPR**	
	Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies	

Reference Books:

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

Course Outcome:

At the end of the course the students should be able to:

1. Conduct a quality literature review and find the research gap.
2. Identify an original and relevant problem and identify methods to find its solution
3. Validate the model
4. Present and defend the solution obtained in an effective manner in written or spoken form.
5. Follow research ethics
6. Understand IPR protection for further research and better products

GUJARAT TECHNOLOGICAL UNIVERSITY

Constitution of India
SUBJECT CODE: 3700005
SEMESTER: I/II

Type of course: Audit course

Prerequisite: -

Rationale: -

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
2	0	0	0	50	0	0	0	50

Content

Sl. No.	Topic	Teaching Hours	Module Weightage (%)
1.	**History of Making of the Indian Constitution** History Drafting Committee, (Composition & Working)	4	17
2.	**Philosophy of the Indian Constitution:** Preamble Salient Features	4	17
3.	**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality Right to Freedom Right against Exploitation Right to Freedom of Religion Cultural and Educational Rights Right to Constitutional Remedies Directive Principles of State Policy Fundamental Duties.	4	17
4.	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4	17

5.	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	4	16
6	**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	4	16

Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.

Course Outcome:

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

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
2. To address the growth of Indian opinion regarding modern Indian intellectuals constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

GUJARAT TECHNOLOGICAL UNIVERSITY

English for Research Paper Writing
SUBJECT CODE: 3700001
SEMESTER: I/II

Type of course: Audit course

Prerequisite: -

Rationale: -

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
2	0	0	0	50	0	0	0	50

Content

Sl. No.	Topic	Teaching Hours	Module Weightage (%)
1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4	17
2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4	17
3.	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	4	17
4.	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	4	17
5.	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4	16
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4	16

Reference Books:

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

Course Outcome:

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

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

GUJARAT TECHNOLOGICAL UNIVERSITY

DSP ARCHITECTURE
SUBJECT CODE: 3710515
ME 1st Semester

Type of course: Advanced Processor Architecture and Programming

Prerequisite: Students should have an understanding of Microcontroller architecture as well as basic C and assembly language programming skills and basic understanding of discrete time signals and systems

Rationale: Students of ME in Signal Processing must acquire fundamental concepts of Digital Signal Processing and implementation of various applications on Advanced Processor. Students also must understand architecture of advanced Digital Signal Processor and how to program it for signal processing applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	**Programmable DSP Hardware:** • Processing Architectures (von Neumann, Harvard) • DSP core algorithms (FIR, IIR, Convolution, Correlation, FFT) • IEEE standard for Fixed and Floating Point Computations • Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters) • On-Chip peripherals • DSP benchmarking	6	14%
2	**Structural and Architectural Considerations:** • Parallelism in DSP processing • Texas Instruments TMS320 Digital Signal Processor Families • Fixed Point TI DSP Processors:TMS320C1X and TMS320C2X Family • TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing) • Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields • TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices • Illustrative Examples for assembly codingation (EMIF)	22	52%
3	**VLIW Architecture:** • Current DSP Architectures • GPUs as an alternative to DSP Processors • TMS320C6X Family, Addressing Modes • Replacement of MAC unit by ILP	7	17%

	• Detailed study of ISA • Assembly Language Programming, Code Composer Studio, Mixed C and Assembly Language programming • Simple applications developments as an embedded environment		
4	**FPGA based DSP Systems:** • Limitations of P-DSPs • Requirements of Signal processing for Cognitive Radio (SDR) • FPGA based signal processing design-case study of a complete design of DSP processor	7	17%
Total		42	100 %

Reference Books:

1. M. Sasikumar, D. Shikhare, Ravi Prakash, "Introduction to Parallel Processing", 1st Edition, PHI, 2006.
2. Fayez Gebali, "Algorithms and Parallel Computing",1st Edition, John Wiley & Sons, 2011
3. Rohit Chandra, Ramesh Menon, Leo Dagum, David Kohr, DrorMaydan, Jeff McDonald,"Parallel Programming in OpenMP", 1st Edition, Morgan Kaufman,2000.
4. Ann Melnichuk,Long Talk, "Multicore Embedded systems", 1st Edition, CRC Press,2010.
5. Wayne Wolf, "High Performance Embedded Computing: Architectures, Applications and Methodologies", 1st Edition, Morgan Kaufman, 2006.
6. E.S.Gopi, "Algorithmic Collections for Digital Signal Processing Applications Using MATLAB", 1st Edition, Springer Netherlands,2007
7. Rulph Chassaing ,Donald Reay , Digital Signal Processing and Application with theTMS320C6713 and TMS320C6416 DSK, 2nd edition, wiley Publication.
8. B Venkataramani, M Bhaskar, Digital Signal Processors, Architecture, Programming and Applications, 2nd edition, TMH, New Delhi
9. User guide - Texas Instrumentation

Course Outcome:

After successfully completion of this course, students should able to –

1. Write, Debug and simulate assembly as well as C code for Digital Signal Processor on Code Composer Studio environment.
2. Describe the architecture and basic operation of fixed-point and floating-point DSPs.
3. Explain the importance of on-chip Hardware modules of DSPs.
4. Develop and realize computationally efficient algorithms on the DSP platform (e.g. FFT, convolution- correlation etc.).
5. Optimize DSP code (e.g. software pipelining).
6. Describe recent application on DSP platform.

List of Experiments:

1. To study the architecture of DSP chips – TMS 320 6713 a 32-bit floating point processor
2. Introduction of Code Composer Studio.
3. To write and verify assembly language program using C67x processor for data transfer operation.
4. To write and verify assembly language program using C67x processor for arithmetic operation.
5. To write and verify assembly language program using C67x processor for logical operation

6. To write and verify assembly language program using C67x processor which calls assembly language program for various operation.
7. To write and verify 'C' language program using C67x processor for various operation.
8. To write and verify 'C' callable assembly language program using C67x processor for various operation.
9. To write and verify linear assembly language program using C67x processor for various operation.
10. To study the working of TMS 320C 6713 DSP development kit.
11. To write 'C' program using C67x processor for various operation and verify it on DSP Kit.
12. Write a 'C' program using C67x processor to generate Harmonics of a Sinusoidal signal.
13. Write assembly language program using C67x processor to find convolution of two sequences.
14. Write a 'C' program using C67x processor to find convolution of two sequences.
15. Write a 'C' program using C67x processor to find correlation of two sequences.
16. Write a 'C' program using C67x processor to compute 8-point DFT.

Major Equipments:

1. TMS 320C 6713 DSP development kit.

List of Open Source Software:

Code composer studio environment or equivalent,

Learning website:

www.nptel.ac.in, www.ti.com

GUJARAT TECHNOLOGICAL UNIVERSITY

RF AND MICROWAVES
SUBJECT CODE: 3710514
ME 1st Semester

Type of course: Major Elective - I

Prerequisite: Higher Engineering Mathematics, basic knowledge of Electromagnetic Field theory foundation level courses in Electronics Network Theory, Signals and Systems and Communication Systems Antenna theory and wave propagation, Fundaments of semiconductor devices.

Rationale: PG Students of EC Engineering need to possess good understanding of the fundamentals and applications of RF signals and Microwave engineering in wireless communication, microwave frequency operated devices and appliances .They can identify role of microwave semiconductors, solid state devices and MMIC fabrication technology in microwave design. They are expected to be able to design RF frequency/microwave transmission line, coupler, power divider, amplifiers, Resonators, Mixer, oscillators and matching networks. They will be practiced in high frequency analysis and synthesis using S-parameter and microwave measurements. They will be able to design microwave communication system.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Transmission Line & Waveguides:** Lumped element circuit model for transmission line, field analysis, quarter wave transformer, generator and load mismatch, Smith chart: fundamentals and problem solution, impedance matching, and tuning. Microstripline, Waveguides: Rectangular & Circular.	6	15
2	**Microwave Network Analysis:** Impedance and equivalent voltage and current, Impedance and admittance matrix, High frequency parameters, Formulation of S parameters, Properties of S parameters, scattering matrix, transmission matrix, Reciprocal and Lossless networks, Signal flow graph.	6	15
3	**RF MATCHING NETWORKS & RF CIRCUIT DESIGN:** Introduction to component basics, wire, resistor, capacitor and inductor, Applications of RF. Impedance matching networks, Frequency response, T and Π matching networks, Micro-stripline matching networks. Amplifier power relation, Stability considerations, Single stage transistor amplifier Design, Low noise amplifier design, Broadband transistor amplifier design. Oscillators, Mixers and filter design.	15	30
4	**Microwave Semiconductor Devices And Modeling:** PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and	9	20

	power GaAs FETs, MESFET, MOSFET, HEMT		
5	**Microwave Components:** Microwave resonators: Rectangular Cavity Resonator, Cylindrical Cavity Resonator, Power dividers: T Junction Power divider, Wilkinson Power Divider and directional couplers: Waveguide Directional Coupler, Lange Coupler, Ring Hybrid Coupler.	9	20
Total		**45**	

References:

- D.M.Pozar, " Microwave engineering" ,Wiley, 4th edition, 2011.
- Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", AuthorHouse, 2009.
- R.Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc, 2009.
- 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, 2004.

Course Outcome:

By the end of this course, the student should be able to do the followings

1. To identify role of RF/Microwave engineering in communication and other field.
2. To analyse high frequency parameters of two port RF Networks and represent in circuit form.
3. To design RF transistor amplifiers and matching networks.
4. To formulate S-matrix for n-port junction, microwave components and cylindrical cavity resonators.
5. To design and operate microwave amplifiers, filters and oscillators.
6. To identify high frequency limitations to design microwave devices.

Suggested List of Experiments:

1. To study V-I characteristics of Gunn Diode.
2. To determine the frequency and wavelength in a rectangular waveguide working on TE10mode.
3. To determine the standing wave ratio.
4. To measure input and output power for H-palne, E-plane and Magic tee.
5. To design and simulation of short circuited Ideal Transmission line using ADS
6. To design and simulation of open circuited ideal transmission line using ADS
7. To design and simulation of short circuited microstrip Transmission line using ADS
8. Design and simulation of Band Pass Filter using ADS.
9. Design and simulation of Low pass Filter Using ADS.
10. Design and simulation of directional coupler using ADS.
11. Design and simulation of power divider using ADS.
12. Design a GaAs FET amplifier for maximum gain at 4.0 GHZ.
13. Design a GaAs FET amplifier having a 2.0 dB noise figure with the maximum gain that is compatible with noise figure.
14. Design an impedance transforming network using two element L matching circuit that matches a generator resistance of 400 Ω to a load resistance is 20 Ω. The centre frequency for the circuit is 6MHz.
15. Design a transistor oscillator at 4 GHz using a GaAs FET. Choose a terminating network to match to a 50Ω load, and appropriate tuning network.

16. A wireless local area network application require a local oscillator operating at 2.4 GHz. Design a dielectric resonator oscillator using bipolar transistor. It should include matching network for output termination.
17. Design matching network to match broader load variable range with minimum reflection co-efficient value.
18. Design optimum resonator with best values of operating frequency and quality factor.

List of Software/learning website:

1. ADS
2. http://nptel.ac.in
3. www.youtube.com