DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

MASTER OF TECHNOLOGY (M.Tech.)

IN

ELECTRONICS & COMMUNICATION ENGINEERING

DETAILED SYLLABUS

(Effective from Academic Session – 2026–2027)

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

Waknaghat, Solan – 173234

PROPOSED COURSE STRUCTURE

SEMESTER - I								
S.No.	**Course Code**	**Name of the Subjects**		**Course Hours**			**Total**	**Credits**
			C/ E/ A	**L**	**T**	**P**		
1	26M**EC***	Advanced Digital Signal Processing	C	3	0	0	3	3
2	26M**EC***	Advanced Wireless and Mobile Communication	C	3	0	0	3	3
3		**Prog. Specific Elective-1**	**E**	**3**	**0**	**0**	**3**	**3**
	**	*Wireless Sensor Networks*						
PSE-1	**	*Embedded Systems and Applications*						
	**	*Sensor and Smart Instrumentation*						
4		**Prog. Specific Elective-2**	**E**	**3**	**0**	**0**	**3**	**3**
	**	*Cognitive Radio*						
PSE-2	**	*RF and Microwave Circuit Design*						
	**	*DSP Architecture*						
5	26M**EC***	Research Methodology and IPR	C	2	0	0	2	2
6	26M**EC***	Advanced Digital Signal Processing Lab	C	0	0	4	4	2
7	26M**EC***	Advanced Wireless and Mobile Communication Lab	C	0	0	4	4	2
8	26M**EC***	Audit Course-1/Swayam Certification-1	A	2	0	0	2	0
Total							**24**	**18**
SEMESTER - II								
S.No.	**Course Code**	**Name of the Subjects**		**Course Hours**			**Total**	**Credits**
			C/ E/ A	**L**	**T**	**P**		
1	26M**EC***	Modern Microelectronic Devices & Sensors	C	3	0	0	3	3
2	26M**EC***	Antenna and Radiating Systems	C	3	0	0	3	3
3		**Prog.Specific Elective-3**	**E**	**3**	**0**	**0**	**3**	**3**
	**	*Satellite Communication)*						
PSE-3	**	*Internet of Things*						
		Voice and data networks						
4		**Prog.Specific Elective-4**	**E**	**3**	**0**	**0**	**3**	**3**
	**	*Markov Chain and Queuing System*						
PSE-4	**	*MIMO System*						
		Programmable Networks –						

		SDN, NFV						
5	**26M**EC*** **	**Mini Project**	**C**	**0**	**0**	**4**	**4**	**2**
6		Modern Microelectronic Devices & Sensors Lab	C	0	0	4	4	2
7		Antenna and Radiating Systems Lab	C	0	0	4	4	2
8	Aud-2	Audit Course-2/Swayam Certification-2	A	2	0	0	0	0
Total							**24**	**18**
SEMESTER - III								
S.No.	**Course Code**	**Name of the Subjects**		**Course Hours**			**Total**	**Credits**
			C/E	**L**	**T**	**P**		
1		**Prog.Specific Elective-5**	**E**	**3**	**0**	**0**	**3**	**3**
PSE-5	**	*High Performance Networks*						
	**	*Pattern Recognition and Machine learning*						
		Remote Sensing						
2		**Open Elective-1**	**E**	**3**	**0**	**0**	**3**	**3**
OE-1	**	*Business Analytics*						
	**	*Operations Research*						
	**	*Waste to Energy*						
3	26M**EC***	Dessertation-1	C	0	0	20	20	10
Total							**26**	**16**
SEMESTER - IV								
S.No.	**Course Code**	**Name of the Subjects**		**Course Hours**			**Total**	**Credits**
			C/E	**L**	**T**	**P**		
1	26M**EC***	Dessertation-2	C	0	0	32	32	16
Total							**32**	**16**
Overall Credits in 1st(18), 2nd(18), 3rd(16) and 4th(16) Semestrs								**68**

List of Audit courses 1 & 2

- English for Research Paper Writing
- Disaster Management
- Sanskrit for Technical Knowledge
- Value Education
- Constitution of India
- Pedagogy Studies
- Stress Management by Yoga
- Personality Development through Life Enlightenment Skills.

DETAILED SYLLABUS

(Semester-1)

Advanced Digital Signal Processing

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: CORE
L-T-P: 3-0-0

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

1. To understand theory of different filters and algorithms
2. To understand theory of multirate DSP, solve numerical problems and write algorithms
3. To understand theory of prediction and solution of normal equations
4. To know applications of DSP at block level.

Course Contents:

Unit	Contents
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
2	Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.
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.
4	Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm
5	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.

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

References:

1. J. G. Proakis and D. G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, *Multirate Digital Signal Processing: Multirate Systems – Filter Banks – Wavelets*, John Wiley & Sons, 1999.
3. Bruce W. Suter, *Multirate and Wavelet Signal Processing*, Academic Press, 1997.
4. M. H. Hayes, *Statistical Digital Signal Processing and Modeling*, Wiley, 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.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Wireless and Mobile Communication

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: CORE
L-T-P: 3-0-0

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

Course Contents:

Unit	Contents
1	Cellular Communication Fundamentals: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.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).
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.
4	Equalization, Diversity: Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.
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.
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.

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.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Wireless Sensor Networks

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

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

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

Course Contents:

Unit	Contents
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.
2	Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.
3	Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet).
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.

5	Data dissemination and processing; differences compared with other database management systems, data storage; query processing.
6	Specialized features: Energy preservation and efficiency; security challenges; faulttolerance, 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.

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.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Embedded Systems and Applications

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

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

1. Understand various components of embedded system, design challenges.
2. Comprehend RISC architecture, programming of ARM and PIC microcontrollers.
3. Know about embedded system design and development methodology, tools and languages used for embedded system design.
4. Learn about Devices and Communication interface used in embedded system.
5. Learn about Real Time Operating System used for embedded system application.

Course Contents:

Unit	Contents
1	Introduction: Characteristics of Embedded System Computing, Concept of Real time Systems, Classification, Application areas, Design challenges – real-time execution, physical size, power consumption, multirate operation.
2	Embedded system processors: ARM Processor Fundamentals and Architectures, ARM Instruction Set, PIC Microcontroller and its Architecture, Instruction Set.
3	Embedded hardware units and devices in a System, Embedded software in a system, Embedded system-on-chip (SOC), Embedded system-on-module (SOM).
4	Devices and Communication interface: Serial communication devices, Parallel communication, Wireless Devices, Timer and Counting Devices, Watchdog timer, Real time clock, Parallel communication network using ISA, PCI, Serial bus communication protocols, SCI, CAN, I2C, USB.

5	Real Time Operating System: Real-time Kernels, Polled Loops System, Coroutines, Interrupt-driven System, Multi-rate System, Processes and Thread Context Switching, Scheduling, Inter-process Communication, Real-time Memory Management, I/O, VxWorks, RT-Linux.
6	Case Study: ARM Cortex-A5 Processor-based SOM, ATSAMA5D27-SOM1, Use of SAMA5D2 GPIO under Linux.

References:

1. Frank Vahid and Tony Givargis, "Embedded system design: A unified Hardware/Software introduction,"3rd Ed., Wiley 2014.
2. Shibu K. V, "Introduction to Embedded Systems," 2nd Ed., McGraw Hill 2017.
3. Embedded System: Architecture, Programming and Design by Rajkamal,2nd Ed., 2010, Tata McGraw Hill gle, and S. M. Kogon, *Statistical and Adaptive Signal Processing*, McGraw Hill, 2000.
4. Steve Furber, "ARM System-on-Chip Architecture," 2nd Ed., Pearson, 2012
5. Tim Wilmshurst, "Designing Embedded Systems with PIC Microcontrollers: Principles and Applications," 2nd Ed., Newnes, 2009.
6. Steven F Barrett and Daniel J Pack, "Embedded Systems Design and Applications with the 68HC12 and HCS12," 1st Ed., Pearson 2012.
7. Kenneth Ayala, "The 8051 microcontroller," 3rd Ed., Thomson, 2005.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Sensors and Smart Instrumentation

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

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

1. Knowledge of characteristics of sensors and measurement system, criteria for transducer selection.
2. Learn about data acquisition systems, signal conditioners and signal converters.
3. Knowledge about different basic sensors and transducers used for measurement of physical quantities.
4. Knowledge about different measurement systems used in industry.
5. Learn about characteristics and working of smart sensors and instruments.

Course Contents:

Unit	Contents
1	Introduction: Basics of measurement systems, sensors and transducers, General transducers characteristics, static and dynamic characteristics, Criteria for transducer selection, Calibration techniques, Classification of errors.
2	Data acquisition system and its uses in intelligent Instrumentation systems, Signal conditioners, signal converters, sample and hold. Instrumentation amplifiers, Interference, grounding and shielding.
3	Resistive Transducers: Potentiometers, strain gauges, Resistance Thermometer, Thermistors. Inductive Transducers, Capacitive Transducers: Principles of operation, construction, Piezoelectric transducer, fibre optic transducers for the measurement of force, temperature, flow and pressure, Elastic Transducers: Spring bellows, diaphragm, bourdon tube.
4	Pressure sensor, temperature measurement, flow measurement, level measurement, displacement, force, velocity, acceleration and torque measurement. Telemetry, multiplexing, modulation of data, transmission channels.

5	Smart instruments - comparison with conventional transducers - self diagnosis and remote calibration features - smart transmitter with HART communicator - Micro Electro Mechanical Systems - sensors, actuators - principles and applications, nonlinearity compensation. Cogent sensors, Soft sensors, self-validating sensors, temperature-compensating sensors, ANN-based sensors, ANN techniques for fault detection, linearization, and calibration.

References:

1. Doebelin EO, "Measurement Systems: Application and Design," Tata McGraw Hill, 7th Ed., 2019.
2. Patranabis D, "Sensors and Transducers," Prentice Hall of India, 2nd Ed., 2003.
3. Manabendra Bhuyan, "Intelligent Instrumentation: Principles and Applications", CRC Press, 2017.
4. Subhas Chandra Mukhopadhyay, "Intelligent Sensing, Instrumentation and Measurements (Smart Sensors, Measurement and Instrumentation Book 5)," Springer, 2013.
5. Bela G. Liptak, "Instrument Engineers' Handbook, Volume One: Process Measurement and Analysis," 4th Ed., CRC Press, 2003.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Cognitive Radio

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

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

1. Understand the fundamental concepts of cognitive radio networks.
2. Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
3. Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
4. 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.

Course Contents:

Unit	Contents
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.
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).
3	Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

4	Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.
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).
6	Research Challenges in Cognitive Radio: Network layer and transport layer issues, crosslayer design for cognitive radio networks.

References:

1. Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
2. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
3. Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
4. Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
5. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
6. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

Evaluation Scheme:

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1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

RF and Microwave Circuit

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

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

1. Understand the behaviour 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. Contribute in the areas of RF circuit design.

Course Contents:

Unit	Contents
1	Transmission Line Theory:Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.
2	Microwave Network Analysis:Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.
3	Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.
4	Nonlinearity And Time VarianceInter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.
5	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 power GaAs FETs, MESFET, MOSFET, HEMT.

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

References:

1. Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", AuthorHouse, 2009.
2. D.M.Pozar, " Microwave engineering" ,Wiley, 4th edition, 2011.
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.
6. Radmanesh, "RF and Microwave Electronics Illustrated" , Pearson Education, 2004.

Evaluation Scheme:

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2	T-2	25	1.5 Hours	Syllabus covered up to T-2
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4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

DSP Architecture

COURSE CODE:
COURSE CREDITS: 3
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 3-0-0

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

1. Identify and formalize architectural level characterization of P-DSP hardware.
2. Ability to design, programming (assembly and C), and testing code using Code Composer Studio environment.
3. Deployment of DSP hardware for Control, Audio and Video Signal processing applications.
4. Understanding of major areas and challenges in DSP based embedded systems.

Course Contents:

Unit	Contents
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.
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 coding.

3	VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors, TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study of ISA, Assembly Language Programming, Code Composer Studio, Mixed Cand Assembly Language programming, On-chip peripherals, Simple applications developments as an embedded environment.
4	Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware, Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous and homogenous multi-core systems, Shared Memory parallel programming –OpenMP approach of parallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop, sections, TI TMS320C6678 (Eight Core subsystem).
5	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.
6	High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

References:

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.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1

2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus
4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Research Methodology and IPR

COURSE CODE:
COURSE CREDITS: 2
CORE/ELECTIVE/AUDIT/MOOCs: ELECTIVE
L-T-P: 2-0-0

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

1. Understand research problem formulation.
2. Analyze research related information.
3. Follow research ethics.
4. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Contents:

Unit	Contents
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations
2	Effective literature studies approaches, analysis Plagiarism , Research ethics.

3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.
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.
5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.
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.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students".
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction".
3. Ranjit Kumar, 2nd Edition , "Research Methodology: A Step by Step Guide for beginners".
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", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

Evaluation Scheme:

S. No	Exam	Marks	Duration	Coverage / Scope of Examination
1	T-1	15	1 Hour.	Syllabus covered up to T-1
2	T-2	25	1.5 Hours	Syllabus covered up to T-2
3.	T-3	35	2 Hours	Entire Syllabus

4.	Teaching Assessment	25	Entire Semester	**Class Performance** (Assignments, Homework, Tutorials, Presentations etc.)- 8-10Marks **Quizzes**- 10-12Marks **Attendance** – 5 Marks

Advanced Digital Signal Processing Lab

COURSE CODE:
COURSE CREDITS: 2
CORE/ELECTIVE/AUDIT/MOOCs: CORE
L-T-P: 0-0-4

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

1. Design different digital filters in software.
2. Apply various transforms in time and frequency.
3. Perform decimation and interpolation.

List of Assignments:

1. Basic Signal Representation
2. Correlation Auto And Cross
3. Stability Using Hurwitz Routh Criteria
4. Sampling FFT Of Input Sequence
5. Butterworth Low pass And High pass Filter Design
6. Chebychev Type I,II Filter
7. State Space Matrix from Differential Equation
8. Normal Equation Using Levinson Durbin
9. Decimation And Interpolation Using Rationale Factors
10. Maximally Decimated Analysis DFT Filter
11. Cascade Digital IIR Filter Realization
12. Convolution And M Fold Decimation &PSD Estimator
13. Estimation Of PSD
14. Inverse Z Transform
15. Group Delay Calculation
16. Separation Of T/F
17. Parallel Realization of IIR filter

Suggested Books / Resources:

[1] J. G. Proakis and D. G. Manolakis, *Digital Signal Processing: Principles, Algorithms, and Applications*, 4th ed. Upper Saddle River, NJ, USA: Pearson Education, 2007.

[2] A. V. Oppenheim and R. W. Schafer, *Discrete-Time Signal Processing*, 3rd ed. Upper Saddle River, NJ, USA: Pearson Education, 2010.

[3] V. K. Ingle and J. G. Proakis, *Digital Signal Processing Using MATLAB*, 3rd ed. Stamford, CT, USA: Cengage Learning, 2012.

Evaluation Scheme:

1.	Mid Sem. Evaluation	20 Marks
2.	End Sem. Evaluation	20 Marks
3.	Attendance	15 Marks
4.	Lab Assessment	45 Marks
	Total	100 Marks

Advanced Wireless and Mobile Communication Lab

COURSE CODE:
COURSE CREDITS: 2
CORE/ELECTIVE/AUDIT/MOOCs: CORE
L-T-P: 0-0-4

Course Outcomes (COs)

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

1. Analyze and implement fundamental wireless and mobile communication techniques including GSM, CDMA, QAM, QPSK, multiplexing, and OFDM using simulation and SDR-based platforms.
2. Demonstrate practical understanding of cellular communication systems, software-defined radio (SDR), and digital communication links through experimentation, configuration, and performance evaluation.
3. Design and evaluate source coding, channel coding, and error control techniques for reliable wireless communication in real-time environments.

List of Assignments:

1. Introduction to Matlab and WiComm-T (SDR) kit.
2. Implementation of Quadrature Amplitude Modulation and Demodulation (QAM) (16QAM, 64QAM)
3. Implementation of Quadrature Phase Shift Keying Modulation and Demodulationsystem. (Constellation plots, Phase and frequency offset)
4. Performance analysis of baseband digital communication link.
5. To demonstrate Time Division Multiplexing and Demultiplexing
6. To demonstrate Frequency Division Multiplexing and Demultiplexing
7. To demonstrate GSM communication system.
8. To demonstrate OFDM communication system.
9. To demonstrate OFDM communication system.
10. Implementation of source coding techniques.
11. Implementation of channel coding and error control coding techniques.

Suggested Books / Resources:

[1] A. Goldsmith, *Wireless Communications*. Cambridge, U.K.: Cambridge University Press, 2005.

[2] J. G. Proakis and M. Salehi, *Digital Communications*, 5th ed. New York, NY, USA: McGraw-Hill, 2008.

Evaluation Scheme:

1.	Mid Sem. Evaluation	20 Marks
2.	End Sem. Evaluation	20 Marks
3.	Attendance	15 Marks
4.	Lab Assessment	45 Marks
	Total	100 Marks