SYLLABI BOOK

MASTER OF TECHNOLOGY
ELECTRONICS & COMMUNICATION SYSTEMS

Department of Electronics & Communication Engineering
Faculty of Technology
Dharmsinh Desai University
Nadiad – 387 001, Gujarat, India.

http://www.ddu.ac.in
ec@ddu.ac.in

2021-2022

TEACHING SCHEME FOR THE COURSE
M. TECH. ELECTRONICS & COMMUNICATION SYSTEMS
(Admission Year 2021)

SEMESTER I (2021-22)

	Subject	Teaching Scheme (hrs/week)			Examination Scheme					
		L	T	P	Theory	Sess	Prac	TW	Total	Credits
1	Wireless and Mobile Communication	3	0	2	60	40	-	25	125	4
2	Advanced Digital Signal Processing	3	0	2	60	40	-	25	125	4
3	Research Methodology and IPR	2	0	0	40	-	-	-	40	2
4	Software Project	0	0	2	-	-	50	-	50	1
	Elective - I									
5	Voice and Data Networks	3	0	2	60	40	-	25	125	4
5	Remote Sensing	3	0	2	60	40	-	25	125	4
5	Markov Chain and Queuing System	3	0	2	60	40	-	25	125	4
	Elective - II									
6	Analog and Digital CMOS VLSI Design	3	0	2	60	40	-	25	125	4
6	Digital Design and Verification	3	0	2	60	40	-	25	125	4
6	Fiber Optic Communication & Sensor Systems	3	0	2	60	40	-	25	125	4
									590	19

SEMESTER II (2021-22)

	Subject	Teaching Scheme (hrs/week)			Examination Scheme					
		L	T	P	Theory	Sess	Prac	TW	Total	Credits
1	Statistical Signal Analysis	3	0	2	60	40	-	25	125	4
2	Advanced Communication Networks	3	0	2	60	40	-	25	125	4
3	System Modelling & Simulation Project	0	0	2	-	-	50	-	50	1
	Elective - III									
4	RF and Microwave Circuit Design	3	0	2	60	40	-	25	125	4
4	Cognitive Radio	3	0	2	60	40	-	25	125	4
4	DSP Architecture	3	0	2	60	40	-	25	125	4
	Elective - IV									
5	Pattern Recognition and Machine Learning	3	0	2	60	40	-	25	125	4
5	Digital Image and Video Processing	3	0	2	60	40	-	25	125	4
5	Optical Networks	3	0	2	60	40	-	25	125	4
	Elective - V									
6	Advance Wireless Communication Systems	3	0	2	60	40	-	25	125	4
6	Satellite Communication	3	0	2	60	40	-	25	125	4
6	Multispectral Signal Analysis	3	0	2	60	40	-	25	125	4
									675	21

SEMESTER III (2022-23)

	Subject	Teaching Scheme (hrs/week)			Examination Scheme					
		L	T	P	Theory	Sess	Prac	TW	Total	Credits
1	Dissertation - I	0	**0**	**30**	-	-	125	225	350	16
2	Pedagogy Studies	2	0	0	-	-	50	-	50	0
									400	16

SEMESTER IV (2022-23)

	Subject	Teaching Scheme (hrs/week)			Examination Scheme					
		L	T	P	Theory	Sess	Prac	TW	Total	Credits
1	Dissertation - II	0	**0**	**30**	-	-	150	300	450	16
2	English for Research Paper Writing	2	0	0	-	-	50	-	**50**	0
									400	16

M. TECH. SEMESTER – I (ECS)

SUBJECT: WIRELESS AND MOBILE COMMUNICATION

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

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. 2.5G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE

2. Overview of digital modulation techniques: BPSK, QPSK, 8PSK, QAM, FSK and MSK, 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. Code Division Multiple Access: Introduction to CDMA technology, IS 95 and CDMA 2000 system

4. 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.

5. Equalization, Diversity, Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving. Channel Coding & Speech Coding

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 (eMBB, uRLLC, mMMTC-5G IoT)

RECOMMENDED TEXT / REFERENCE BOOKS

1. Andreas F. Molisch, Wireless Communications, Second Edition, John Wiley & Sons Ltd. 2011
2. T. S. Rappaport, “Wireless Communications Principles and Practice”, 2nd Edition, PHI, 2002.

3. V. K. Garg, J. E. Wilkes, "Principle and Application of GSM", Pearson Education, 5th Edition, 2008.
4. V. K. Garg, "IS-95 CDMA & CDMA 2000", Pearson Education, 4th Edition, 2009.
5. William C. Y. Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", 2nd Edition, TMH, 1995.
6. Asha Mehrotra, "A GSM system Engineering" Artech House Publishers Bosten, London, 1997.
7. Multiple Access Techniques for 5G Wireless Networks and Beyond, aezi, Mojtaba, Ding, Zhiguo, Poor, H. Vincent, Springer International Publishing, 2020.

M. TECH. SEMESTER – I (ECS)

SUBJECT: VOICE AND DATA NETWORKS

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. Network Design Issues, Network Performance Issues, Network Terminology, centralized and distributed approaches for networks design, Issues in design of data networks, Layered and Layer less Communication, Cross layer design of Networks.

2. Data Communication Networks and their Design, Link layer design- Link adaptation, Link Layer Protocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, Selective Repeat protocols and their analysis.

3. Unit 3: Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1 and other Markov systems, Multiple Access Protocols for Local Area Networks.

4. Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup, Dynamic IP Address Configuration, Routing in Internet, Internet Routing Protocols – OSPF and BGP, Mobile IP, Translating IP addresses to domain names.

5. Unit 5: End to End Protocols, TCP and UDP. TCP Congestion Control - Additive Increase/Multiplicative Decrease , Slow Start, Fast Retransmit/ Fast Recovery, Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

6. Socket Interface - Concept of Process, Process Creation (Forking) and Process Identification, Concurrent and Iterative mode of services, Socket Introduction Socket System calls.

RECOMMENDED TEXT / REFERENCE BOOKS

1. D. Bertsekas and R. Gallager, “Data Networks”, 2nd Edition, Prentice Hall, 1992.

2. L. Peterson and B. S. Davie, “Computer Networks: A Systems Approach”, 5th Edition, Morgan Kaufman, 2011.

3. Kumar, D. Manjunath and J. Kuri, “Communication Networking: An analytical approach”, 1st Edition, Morgan Kaufman, 2004.

4. Walrand, “Communications Network: A First Course”, 2nd Edition, McGraw Hill, 2002.

5. Leonard Kleinrock, “Queueing Systems, Volume I: Theory”, 1st Edition, John Wiley and Sons, 1975.

6. Aaron Kershenbaum, “Telecommunication Network Design Algorithms”, McGraw Hill, 1993.

7. Vijay Ahuja, “Design and Analysis of Computer Communication Networks”, McGraw Hill, 1987

8. TCP/IP Protocol Suite, 7th Edition By: Behrouz A. Forouzan Publisher: Tata McGraw Hill
9. Internetworking with TCP/IP Vol.1, 2, 3, 2nd Edition By: Douglas Comer Publisher: Prentice Hall of India
10. Unix Network Programming, 1st Edition By: W. R. Stevens Publisher: Prentice Hall of India
11. TCP/IP Illustrated Vol. I, 1st Edition By: W. R. Stevens Publisher: Pearson Education

M. TECH. SEMESTER – I (ECS)
SUBJECT: REMOTE SENSING
SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in Remote sensing.

2. Data Acquisition: Types of Platforms–different types of aircrafts-Manned and Unmanned spacecrafts – sun synchronous and geo synchronous satellites –Types and characteristics of different platforms –LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD etc

3. Photographic products, B/W, color, color IR film and their characteristics –resolving power of lens and film - Opto mechanical electro optical sensors –across track and along track scanners-multispectral scanners and thermal scanners–geometric characteristics of scanner imagery -calibration of thermal scanners.

4. Scattering System: Microwave scatterometry, types of RADAR –SLAR –resolution – range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect-different types of Remote Sensing platforms –airborne and space borne sensors -ERS, JERS, RADARSAT, RISAT - Scatterometer, Altimeter-LiDAR remote sensing, principles, applications.

5. Thermal And Hyper Spectral Remote Sensing: Sensors characteristics-principle of spectroscopy-imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing – thermal sensors, principles, thermal data processing, applications.

6. Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing –Radiometric correction–Image enhancement–Image classification– Principles of LiDAR, Aerial Laser Terrain Mapping.

RECOMMENDED TEXT / REFERENCE BOOKS

1. Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, John Wiley & Sons-2000, 6th Edition
2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition, 1995.
3. John A.Richards, Springer –Verlag, Remote Sensing Digital Image Analysis, 1999.

4. Paul Curran P.J. Principles of Remote Sensing, ELBS; 1995.
5. Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.
6. Sabins, F.F. Jr, Remote Sensing Principles and Image interpretation, W. H. Freeman & Co, 1978

M. TECH. SEMESTER – I (ECS)
SUBJECT: ADVANCE DIGITAL SIGNAL PROCESSING
SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. Overview of DSP, Overview of discrete time signal and systems, Convolution and correlations and their application, Characterization in time and frequency, overview of Z-transform and its applications, overview of DFT, 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 sub-band coding.

3. Minimum mean square error and linear minimum mean square error criteria, FIR Wiener filter and linear prediction, steepest descent algorithm and LMS algorithm, Recursive Least Square algorithm. Applications: Adaptive Modelling and System Identification, Inverse Adaptive Modelling, Deconvolution, Adaptive Inverse Control, Adaptive Interference Cancelling.

4. Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation.

5. Fixed and floating point representation of numbers, quantization noise in signal representations, finite word-length effects in coefficient representation, limit cycle oscillations, scaling to prevent overflow

6. Characteristics of DSP algorithms and hardware requirements, von Neumann architecture, Harvard architecture, parallelism and hardware units of typical digital signal processor. Architectural details of TMS320C6x. Introduction to wavelets, Wavelet transform applications.

RECOMMENDED TEXT / REFERENCE BOOKS

1. J. G. Proakis and D. G. Manolakis, “Digital signal processing: Principles, Algorithm and Applications”, 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, “Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets”, 1st Edition, John Wiley and Sons Ltd, 1999.
3. Bruce W. Suter, “Multirate and Wavelet Signal Processing”, 1st Edition, Academic Press, 1997.
4. Digital Signal Processing: A computer Based Approach, 2nd Edition By: S. K. Mitra Publisher: Tata McGraw Hill

5. Analog and Digital Signal Processing, 2nd Edition By: Ashok Ambardar Publisher: THOMSON Brooks
6. Digital Signal Processing: A Practical Approach, 2nd Edition, By - Emmanuel Ifeachor , Barrie Jervis Publisher: Pearson.
7. M. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley & Sons Inc., 2002.
8. S. Haykin, "Adaptive Filter Theory", 4th Edition, Prentice Hall, 2001.
9. D. G. Manolakis, V. K. Ingle and S. M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

M. TECH. SEMESTER – I (ECS)

SUBJECT: ANALOG AND DIGITAL CMOS VLSI DESIGN

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. Introduction-VLSI Design Flow, Technology Scaling & Road map, Scaling issues.

Digital CMOS Design

2. Review of Basic MOS structure and its static behaviour, CMOS Transistor RC model, Inverter: Static CMOS inverter, Switching threshold AC & DC analysis of CMOS logic and their evaluation, Dynamic behaviour, Power consumption.

3. Combinational logic - Static CMOS design, Logical effort, Dynamic logic, Speed and power dissipation in dynamic logic, Cascading dynamic gates, CMOS transmission gate logic.

Analog CMOS VLSI Design

4. Single Stage Amplifier - CS stage with resistance load, Divide connected load, Current source load, Triode load, CS stage with source degeneration, Source follower, Common gate stage, Cascade stage, Choice of device models. Differential Amplifiers: Basic difference pair, Common mode response, Differential pair with MOS loads, Gilbert cell.

5. Passive and active current mirrors - Basic current mirrors, Cascade mirrors, Active current mirrors. Frequency response of CS stage: Source follower, Common gate stage, Cascade stage and difference pair, Noise.

6. Operational Amplifiers - Single stage OPAMP, Two stage OPAMP, Gain boosting, Common mode feedback, Slew rate, PSRR, Compensation of 2 stage OPAMP, Other compensation techniques

Physical Design & Testing

7. Physical Design - Floor Planning, Placement, CTS, Routing, Introduction to verification.

8. Programmable ASICs - Programmable ASIC Logic Cells, IO cells, Interconnect

9. Testing - Boundary Scan Test, Fault modelling and simulation, ATPG & PODEM, Built in self-test.

Advanced Technologies

10. Short channel effects, High–k, Metal Gate Technology, FinFET, TFET – Overview, Structure.

RECOMMENDED TEXT / REFERENCE BOOKS

1. J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design perspective", Prentice Hall electronics and VLSI series, 2nd Edition.
2. BehzadRazavi , "Design of Analog CMOS Integrated Circuits", TMH, 2007.
3. Phillip E. Allen and Douglas R. Holberg, "CMOS Analog Circuit Design", Oxford, 3rd Edition
4. Michael John Sebastian Smith, Application Specific Integrated Circuits, 6th Indian Edition, Pearson Education
5. John P. Uyemura, Introduction to VLSI Circuits and Systems, 1st Edition, Wiley publisher
6. Baker, Li, Boyce, "CMOS Circuit Design, Layout, and Simulation", Wiley, 2nd Edition.

M. TECH. SEMESTER – I (ECS)
SUBJECT: DIGITAL DESIGN AND VERIFICATION
SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. Revision of basic Digital systems: Combinational Circuits, Sequential Circuits, Logic families. Synchronous FSM and asynchronous design, Metastability, Clock distribution and issues, basic building blocks like PWM module, pre-fetch unit, programmable counter, FIFO, Booth's multiplier, ALU, Barrel shifter etc.
2. Verilog/VHDL Comparisons and Guidelines, Verilog: HDL fundamentals, simulation, and test bench design, Examples of Verilog codes for combinational and sequential logic, Verilog AMS
3. System Verilog and Verification: Verification guidelines, Data types, procedural statements and routines, connecting the test bench and design, Assertions, Basic OOP concepts, Randomization, Introduction to basic scripting language: Perl, Tcl/Tk
4. Current challenges in physical design: Roots of challenges, Delays: Wire load models Generic PD flow, Challenges in PD flow at different steps, SI Challenge - Noise & Crosstalk, IR Drop, Process effects: Process Antenna Effect & Electro migration
5. Programmable Logic Devices: Introduction, Evolution: PROM, PLA, PAL, Architecture of PAL's, Applications, Programming PLD's, FPGA with technology: Antifuse, SRAM, EPROM, MUX, FPGA structures, and ASIC Design Flows, Programmable Interconnections, Coarse grained reconfigurable devices
6. IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, and Use of external hard IP during prototyping, Case studies, and Speed issues. Testing of logic circuits: Fault models, BIST, JTAG interface

RECOMMENDED TEXT / REFERENCE BOOKS

1. Douglas Smith, “HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog”, Doone publications, 1998.
2. Samir Palnitkar, “Verilog HDL: A guide to Digital Design and Synthesis”, Prentice Hall, 2nd Edition, 2003.
3. Doug Amos, Austin Lesea, Rene Richter, “FPGA based Prototyping Methodology Manual”, Synopsys Press, 2011.
4. Christophe Bobda, “Introduction to Reconfigurable Computing, Architectures, Algorithms and Applications”, Springer, 2007.
5. Janick Bergeron, “Writing Test benches: Functional Verification of HDL Models”, Second Edition, Springer, 2003.

M. TECH. SEMESTER – I (ECS)

SUBJECT: FIBER OPTIC COMMUNICATION & SENSOR SYSTEMS

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. INTRODUCTION TO FIBER - Fiber structures and wave guiding fundamentals, optical source, power launching and coupling, photo detectors, optical receiver's transmission link analysis.

2. MULTICHANNEL SYSTEMS - WDM Lightwave systems, WDM Components, System performance issues, TDM, CDM and sub carrier multiplexing.

3. SOLITON SYSTEM - Fiber Solitons, Soliton-based communication, Loss Managed Soliton.

4. OPTICAL SWITCHING AND NETWORKS - Introduction, applications, technologies, SONET, wavelength routed network.

5. ALL-OPTICAL TIME-DIVISION MULTIPLEXING TECHNOLOGY - Role of All-optical TDN technology, Key Technologies for its systems.

6. OPTICAL FIBER SENSOR TECHNOLOGY - Multimode optical fiber sensors, distributed fiber optic sensors.

7. FIBER OPTICS APPLICATIONS - LANs, Broadband networks, sensing systems, system measurements

RECOMMENDED TEXT / REFERENCE BOOKS

1. Fiber Optics Communications, 4th Edition By: Gerd Keiser Publisher: Tata McGraw Hill
2. Optical Fibers and Fiber Optic Communication Systems, 2nd Edition By: Subir Kumar Sarkar Publisher: S. Chand
3. Optical Fiber Communication: Principles and Systems, 1st Edition By: A. Selvarajan, S Kar, T Srinivas Publisher: Tata McGraw Hill
4. Optical Fiber Communication: Principles and Practice, 2nd Edition By: John M. Senior Publisher: Prentice Hall of India
5. WDM Optical Networks, 1st Edition By: C. Siva Ram Murthy and Mohan Gurusamy Publisher: Prentice Hall of India

M. TECH. SEMESTER – I (ECS)

SUBJECT: RESEARCH METHODOLOGY AND IPR

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
2	0	0	2	2	40	0	0	40

DETAILED SYLLABUS

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, Trademark 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.

RECOMMENDED TEXT / REFERENCE BOOKS

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

M. TECH. SEMESTER – I (ECS)
SUBJECT: SOFTWARE PROJECT
SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
0	0	2	2	1	-	-	50	50

Each student will take up a software project based on Object Oriented Design.

M. TECH. SEMESTER – II (ECS)

SUBJECT: RF AND MICROWAVE CIRCUIT DESIGN

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

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. MICROSTRIP ANTENNA ARRAY
Fundamentals of Array Antenna, Linear & Planar Arrays, Array Synthesis, Adaptive Array, Microstrip Array

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 FET, 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

RECOMMENDED TEXT / REFERENCE BOOKS

1. Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", Author House, 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.
7. C. A. Balanis, "Antenna Theory", Wiley, 3rd Edition, 2005.

M. TECH. SEMESTER – II (ECS)
SUBJECT: COGNITIVE RADIO
SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

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, cross-layer design for cognitive radio networks.

RECOMMENDED TEXT / REFERENCE BOOKS

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.

M. TECH. SEMESTER – II (ECS)
SUBJECT: DSP ARCHITECTURE
SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

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.

RECOMMENDED TEXT / 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.

M. TECH. SEMESTER – II (ECS)

SUBJECT: PATTERN RECOGNITION AND MACHINE LEARNING

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. Revisiting concepts of Image Processing

2. Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes' rule, discriminant functions, loss functions and Bayesian error analysis

3. Linear Models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification

4. Neural Network: perceptron, multi-layer perceptron, back-propagation algorithm, error surfaces, practical techniques for improving back-propagation, additional networks and training methods, Adaboost, Deep Learning

5. Linear Discriminant Functions: decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support vector machine

6. Algorithm independent machine learning: lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers

7. Unsupervised learning and clustering: k-means clustering, fuzzy k-means clustering, hierarchical clustering

RECOMMENDED TEXT / REFERENCE BOOKS

1. Tom Mitchell, Machine Learning. McGraw-Hill, 1997.
2. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Classification", 2nd Edition John Wiley & Sons, 2001.
3. Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009.
4. Christopher Bishop, Pattern recognition and machine learning, Springer Verlag, 2006.
5. Peter Harrington, Machine Learning in Action, Manning Shelter Island
6. Simon Haykin, Neural Networks and Learning Machines, 3rd edition, Pearson, PHI.

M. TECH. SEMESTER – II (ECS)

SUBJECT: DIGITAL IMAGE AND VIDEO PROCESSING

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. **Digital Image and Video Fundamentals -** Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations, Image Transforms. Need for image transforms, DFT, DCT, Walsh, Hadamard transform, Haar transform, Wavelet transform

2. **Image and Video Enhancement and Restoration -** Histogram, Point processing, filtering, image restoration, algorithms for 2-D motion estimation, change detection, motion-compensated filtering, frame rate conversion, deinterlacing, video resolution enhancement, Image and Video restoration (recovery).

3. **Image and Video Segmentation -** Discontinuity based segmentation- Line detection, edge detection, thresholding, Region based segmentation, Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation, Morphological image processing.

4. **Colour image Processing -** Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, Full colour processing

5. **Image and Video Compression -** Lossless image compression including entropy coding, lossy image compression, video compression techniques, and international standards for image and video compression (JPEG, JPEG 2000, MPEG-2/4, H.264, SVC), Video Quality Assessment

6. **Object recognition -** Image Feature representation and description-boundary representation, boundary descriptors, regional descriptors, feature selection techniques, introduction to classification, supervised and unsupervised learning, Template matching, Bayes classifier

RECOMMENDED TEXT / REFERENCE BOOKS

1. Ed. Al Bovik ,"Handbook of Image and Video Processing", 2nd Edition, Academic Press, 2000.
2. J. W. Woods, "Multidimensional Signal, Image and Video Processing and Coding",2nd Edition, Academic Press, 2011.
3. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
4. A. M. Tekalp, "Digital Video Processing", 2nd Edition, Prentice Hall, 2015.
5. S. Shridhar, "Digital Image Processing", 2nd Edition, Oxford University Press, 2016.

M. TECH. SEMESTER – II (ECS)
SUBJECT: OPTICAL NETWORKS
SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

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

2. WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.

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

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

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

6. Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.

RECOMMENDED TEXT / 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.

M. TECH. SEMESTER – II (ECS)

SUBJECT: STATISTICAL SIGNAL ANALYSIS

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

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

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, Poisson process, Markov Process

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

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

5. 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.

6. Spectral Analysis - Estimated autocorrelation function. Periodogram, Averaging the Periodogram (Barlett Method), Welch Modification, Parametric method. AR(p) spectral estimation and detection of Harmonic signals

RECOMMENDED TEXT / REFERENCE BOOKS

1. Papoulis and S.U. Pillai. "Probability, Random Variables and Stochastic Process" 4th Edition. McGraw-Hill. 2002.

2. D.G. Manolakis. V.K. Ingle and S.M. Kogon. "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.

3. Detection, Estimation, and Modulation Theory, Part 1 Harry L. Van Tree, John Wiley & Sons.

4. Mourad Barkat, "Signal Detection and Estimation", Artech House, 2nd Edition, 2005

M. TECH. SEMESTER – II (ECS)

SUBJECT: ADVANCED COMMUNICATION NETWORK

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

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

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

3. Packet Scheduling Algorithms-requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Latency Rate servers and delay bounds in packet switched networks for LBAP traffic. Active Queue Management - RED. IP switching and MPLS.

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

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

6. Protocols for Advanced Wireless Networks - Issues in Designing a Transport Layer Protocol for Wireless Networks, Classification of Transport Layer Solutions, TCP proposals over wireless networks, Transport Protocols for Interplanetary Communication & Issues.

7. Wireless Sensor Networks - Architecture, Data Dissemination, Data Gathering, Location Discovery, Need for energy management

RECOMMENDED TEXT / REFERENCE BOOKS

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

M. TECH. SEMESTER – II (ECS)

SUBJECT: ADVANCED WIRELESS COMMUNICATION SYSTEMS

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. Multicarrier techniques, Orthogonal Frequency Division Multiplexing (OFDM), Cyclic prefix, OFDMA, AMC, bit and power allocation, PAPR, Synchronization issues. Introduction to NOMA.

2. Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems, Exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Spatial Multiplexing, Spectral efficiency and capacity, Transmitting independent streams in parallel, Mathematical notation

3. MIMO precoding, MIMO Beam forming channel state information (CSI) and channel estimation techniques

4. Case study - MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity based pre-coding, Pre-coding codebooks, Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments, Complex baseband multipath channels, Narrowband and wideband channels, MIMO channel models.

5. 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, Spectrum Management, Spectrum Sharing, Spectrum Overlay cognitive Radio, potential applications of cognitive radio.

6. Relaying, Multi-Hop, and Cooperative Communications - Introduction and Motivation, Fundamentals of Relaying, Relaying with Multiple, Parallel Relays, Routing and Resource Allocation in Multi-Hop Networks, Routing and Resource Allocation in Collaborative Networks, Relay Network Coding, Applications.

RECOMMENDED TEXT / REFERENCE BOOKS

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

4. Andreas F. Molisch, Wireless Communications, Second Edition, John Wiley & Sons Ltd. 2011
5. Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.
6. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
7. Bruce Fette, "Cognitive radio technology", Elsevier, 2nd Edition, 2009.
8. Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
9. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
10. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.
11. Multiple Access Techniques for 5G Wireless Networks and Beyond, aezi, Mojtaba, Ding, Zhiguo, Poor, H. Vincent, Springer International Publishing, 2020.

M. TECH. SEMESTER – II (ECS)

SUBJECT: SATELLITE COMMUNICATION

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

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

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

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

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

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

6. Modulation and Multiple Access Schemes used in satellite communication. Typical case studies of VSAT, DBS-TV satellites and few recent communication satellites launched by NASA/ ISRO. GPS.

RECOMMENDED TEXT / REFERENCE BOOKS

1. Timothy Pratt and Others, "Satellite Communications", Wiley India, 2nd edition, 2010.
2. S. K. Raman, "Fundamentals of Satellite Communication", Pearson Education India, 2011.
3. Tri T. Ha, "Digital Satellite Communications", Tata McGraw Hill, 2009.
4. Dennis Roddy, "Satellite Communication", McGraw Hill, 4th Edition, 2008.

M. TECH. SEMESTER – II (ECS)

SUBJECT: MULTISPECTRAL SIGNAL ANALYSIS

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
3	0	2	5	4	60	40	25	125

DETAILED SYLLABUS

1. Hyperspectral Sensors and Applications: Introduction, Multi-spectral Scanning Systems (MSS), Hyperspectral Systems, Airborne sensors, Space borne sensors, Ground Spectroscopy, Software for Hyperspectral Processing, Applications, Atmosphere and Hydrosphere, Vegetation, Soils and Geology, Environmental Hazards and Anthropogenic Activity

2. Overview of Image Processing: Introduction, Image File Formats, Image Distortion and Rectification, Radiometric Distortion, Geometric Distortion and Rectification, Image Registration, Image Enhancement, Point Operations, Geometric Operation, Image Classification, Supervised Classification, Unsupervised Classification, Crisp Classification Algorithms, Fuzzy Classification Algorithms, Classification Accuracy Assessment, Image Change Detection, Image Fusion, Automatic Target Recognition

3. Mutual Information: A Similarity Measure for Intensity Based Image Registration: Introduction, Mutual Information Similarity Measure, Joint Histogram Estimation Methods, Two-Step Joint Histogram Estimation, One-Step Joint Histogram Estimation, Interpolation Induced Artifacts, Generalized Partial Volume Estimation of Joint Histograms, Optimization Issues in the Maximization of MI

4. Independent Component Analysis: Introduction, Concept of ICA, ICA Algorithms, Preprocessing using PCA, Information Minimization Solution for ICA, ICA Solution through Non-Gaussianity Maximization, Application of ICA to Hyperspectral Imagery, Feature Extraction Based Model, Linear Mixture Model Based Model, An ICA algorithm for Hyperspectral Image Processing, Applications using ICA.

5. Support Vector Machines : Introduction, Statistical Learning Theory, Empirical Risk Minimization, Structural Risk Minimization, Design of Support Vector Machines, Linearly Separable Case, Linearly Non-Separable Case, Non-Linear Support Vector Machines, SVMs for Multiclass Classification, One Against the Rest Classification, Pair wise Classification, Classification based on Decision Directed Acyclic Graph and Decision Tree Structure, Multiclass Objective Function, optimization Methods , Applications using SVM.

6. Markov Random Field Models: Introduction, MRF and Gibbs Distribution, Random Field and Neighborhood ,Cliques, Potential and Gibbs Distributions, MRF Modeling in Remote Sensing Applications, Optimization Algorithms, Simulated Annealing, Metropolis Algorithm, Iterated Conditional Modes Algorithm

RECOMMENDED TEXT / REFERENCE BOOKS

1. Pramod K. Varshney, Manoj K. Arora, "Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data", Springer, 2013.
2. S. Svanberg, "Multi-spectral Imaging– from Astronomy to Microscopy – from Radio waves to Gamma rays", Springer Verlag, 2009.

M. TECH. SEMESTER – II (ECS)

SUBJECT: SYSTEM MODELLING & SIMULATION PROJECT

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme			
Lect	Tut	Prac	Total		Ext	Sess.	Prac	Total
0	0	2	2	1	-	-	50	50

Each student will take up a project on System modelling using a simulation platform as a prelude to the M.Tech. Dissertation activities to be carried out during Semester III & Semester IV.

M. TECH. SEMESTER – III (ECS)

SUBJECT: DISSERTATION PHASE – I

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme		
Lect	Tut	Prac	Total		Prac	TW	Total
0	0	30	30	16	225	125	350

Each student will take up a project involving analysis, design, and implementation and testing of substantial hardware, software or any combination of them related to live problems in the fields of study.

A dissertation report will be prepared and submitted for a viva-voce examination.

M. TECH. SEMESTER – III (ECS)
SUBJECT: PEDAGOGY STUDIES
SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme		
Lect	Tut	Prac	Total		Prac	TW	Total
2	0	0	2	0	-	50	50

DETAILED SYLLABUS

1. Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

2. Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

3. Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

4. Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes

5. Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

RECOMMENDED TEXT / REFERENCE BOOKS

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

M. TECH. SEMESTER – IV (ECS)
SUBJECT: DISSERTATION PHASE – II
SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme		
Lect	Tut	Prac	Total		Prac	TW	Total
0	0	30	30	16	300	150	450

Each student will take up a project involving analysis, design, and implementations and testing of substantial hardware, software or any combination of them related to live problems in the fields of study.

A dissertation report will be prepared and submitted for a viva-voce examination.

M. TECH. SEMESTER – IV (ECS)

SUBJECT: ENGLISH FOR RESEARCH PAPER WRITING

SYLLABUS & SCHEME (W.E.F. 2021)

Teaching Scheme (Hours/Week)				Credits	Examination Scheme		
Lect	Tut	Prac	Total		Prac	TW	Total
2	0	0	2	0	-	50	50

DETAILED SYLLABUS

1. Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

2. Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

3. Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

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

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

6. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

RECOMMENDED TEXT / 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's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011