BIKANER TECHNICAL UNIVERSITY,

BIKANER

SCHEME

B.Tech.(Electronics & Communication Engineering)

Applicable for Students Admitted in 2021-22

BSC: Basic Sciences HSMC: Humanities, Social Science and Management DC: Professional Courses- Core DE: Professional Courses- Elective	UE: Other Open Elective PROJ: Project Work UI: Internship UGE: University General Elective Group

Teaching Examination Scheme
3rd Year-V Semester

SN	Category	Course Code	Course Title	Contact Hrs/week L	T	P	Marks Exam Hrs	IA	ETE	Total	Cr
THEORY											
1	DC	5EC4-1	Digital Communication	3	0	0	3	30	70	100	3
2		5EC4-2	Digital Signal Processing	3	0	0	3	30	70	100	3
3		5EC4-3	Microwave Engineering	3	0	0	3	30	70	100	3
4		5EC4-4	Control Systems	3	0	0	3	30	70	100	3
5	DE-I	**Department Elective : Any One**									
		5EC5-11	Information Theory & Coding	2	0	0	2	30	70	100	2
		5EC5-12	Satellite Communication								
		5EC5-13	Optimization Techniques								
6	DE-II	**Department Elective : Any One**									
		5EC5-14	Computer Networks	2	0	0	2	30	70	100	2
		5EC5-15	Internet of Things and Applications								
		5EC5-16	Introduction to Machine Intelligence								
SUB-TOTAL				**16**	**0**	**0**		**180**	**420**	**600**	**16**
PRACTICAL & SESSIONAL											
7	DC	5EC4-20	Digital Communication Lab	0	0	3	3	60	40	100	1.5
8		5EC4-21	Digital Signal Processing Lab	0	0	3	3	60	40	100	1.5
9		5EC4-22	Microwave Engineering Lab	0	0	3	3	60	40	100	1.5
10		5EC4-23	Internet of Things (IoT) Lab	0	0	3	3	60	40	100	1.5

11	UI	5EC7-30	Industrial Training (45 Days)	0	0	6	-	60	40	100	3
12	UGE	5EC8-00	Co-Curricular Activities	-	-	2	-	60	40	100	1
SUB-TOTAL				**0**	**0**	**20**		**360**	**240**	**600**	**10**
TOTAL OF V SEMESTER				**16**	**0**	**20**		**540**	**660**	**1200**	**26**

L = Lecture, **T** = Tutorial, **P** = Practical, **IA**=Internal Assessment**, ETE**=End Term Exam, **Cr**=Credits

SYLLABUS

V Semester (Electronic & Communication Engineering)

5EC4-01: Digital Communication	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand the performance of Pulse Modulation Schemes.

CO-2: Understand the performance of Line codes.

CO-3: Apply the knowledge of ISI problems in Digital communication.

CO-4: Compare the error probability for different digital modulation schemes like BPSK, BFSK, and QPSK etc.

CO-5: Apply the principle of spread spectrum communication and to illustrate the concept of FHSS and DSSS

S. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	**1**
2.	**Pulse Modulation:** Pulse Modulation, Sampling process, Performance comparison of various sampling techniques Aliasing, Reconstruction, PAM, Quantization, PCM, Quantization Noise in PCM system, Delta modulation, DPCM, ADPCM, ADM, Performance comparison of various pulse modulation schemes**.**	**9**
3.	**Line Codes:** On-Off (RZ), Polar (RZ), Bipolar (RZ), on-off (NRZ),-Polar (NRZ) & their Power spectrum density (PSD), HDB coding, B8ZS signaling.	**5**
4	**Baseband Pulse transmission:** Matched filter, Inter Symbol Interference (ISI), Nyquist Criteria for zero ISI, Ideal solution, Raised cosine spectrum, Eye Pattern	**7**
5.	**Digital Modulation schemes:** Pass band transmission model, Coherent Modulation Schemes- BPSK, QPSK, BFSK. Non-Coherent orthogonal modulation schemes, Differential Phase Shift Keying (DPSK) Detection of Binary modulation schemes in the presence of noise, BER for BPSK, QPSK, BFSK.	**10**
6.	**Spread spectrum Techniques:** Spread Spectrum Overview, generation of PN Sequences, Direct sequence spread spectrum systems & Frequency hoppded spread spectrum systems and their analysis, Introduction to W-CDMA and multiuser detection.	**8**
	Total	**40**

Suggested Books:

1. Taub & Schilling, Principles of Communication Systems, 4th edition, McGraw Hill publications, 2017.
1. Simon Haykin, Communication System, 3/e, Wiley Eastern Ltd, 2015.
2. B. Sklar, Digital Communication Fundamentals and Applications, 2nd Edition, Pearson Education, 2009
3. B.P.Lathi, Modern Digital and Analog Communication Systems, 3rd Edition, Oxford University Press 2007.
4. H P Hsu, Schaum Outline Series, Analog and Digital Communications‖, TMH 2006
5. J.G Proakis, Digital Communication‖, 4th Edition, Tata Mc Graw Hill Company, 2001.

5EC4-02: Digital Signal Processing	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Ability to compute Z transform analysis of LTI System.
CO-3: Analyze the DFT for discrete time signals.
CO-4: Analyze the Fast Fourier transform for discrete time signals.
CO-5: Structure realization of FIR and IIR systems.
CO-6: Understand designing of FIR and IIR filters.

S. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	**1**
2.	**Basic elements of digital signal Processing:** Z-Transform, Inverse Z-Transform, and Properties of the Z-Transform, Inversion of the Z-Transforms (by Power Series Expansion, by Partial-Fraction Expansion), Analysis of Linear Time-Invariant Systems in the z-Domain, Response of Systems with rational System Functions, Transient and Steady-State Responses, Causality and Stability.	**8**
3.	**Introduction to DFT:** Frequency-Domain Sampling and Reconstruction of Discrete-Time Signals, The Discrete Fourier Transform, The DFT as a Linear Transformation, Relationship of the DFT to other Transforms, Properties of the DFT: Periodicity, Linearity, and Symmetry Properties, Multiplication of Two DFTs and Circular Convolution, Additional DFT Properties, Linear Filtering Based on DFT.	**8**
4.	**Fast Fourier Transform:** FFT Algorithms, Direct Computation of the DFT, Radix-2 FFT Algorithms: Decimation-In-Time (DIT), Decimation-In-Time (DIF); Applications of FFT Algorithms: Use of the FFT Algorithm in Linear Filtering and Correlation.	**8**
5.	**Structure of FIR and IIR**: Structure for FIR Systems: Direct-Form Structure, Cascade-Form Structures, Structure for IIR Systems: Direct-Form Structures, Signal Flow Graphs and Transposed Structures, Cascade-Form Structures, Parallel-Form Structures.	**7**
6.	**Design of Filters:** Symmetric and Anti-symmetric FIR Filters, Design of Linear-Phase FIR Filters by using Windows, Design of Linear-Phase FIR Filters by the Frequency-Sampling Method; Design of IIR Filters from Analog Filters: IIR Filter Design by Impulse Invariance, IIR Filter Design by the Bilinear Transformation.	**8**
	Total	**40**

Suggested Books:

1. Digital Signal Processing – Principles, Algorithms and Applications by J. G. Proakis and D. G. Manolakis, 4th Edition, Pearson.
2. Digital Signal Processing by A. V. Oppenheim and R. W. Schafer, PHI.
3. Principles of Signal Processing and Linear Systems by B.P. Lathi, Oxford.
4. Digital Signal Processing: A MATLAB-Based Approach by Vinay K. Ingle and John G. Proakis, Cengage Learning.
5. Fundamentals of Digital Signal Processing using MATLAB by Robert J. Schilling and Sandra L. Harris, Cengage Learning.
6. Sanjit K Mitra “Digital Signal Processing” TMH

5EC4-03: Microwave Engineering	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand the concepts of microwave Engineering and transmission line.

CO-2: Understand working of microwave waveguides and modes of propagation.

CO-3: Understand the concept of passive and active microwave Devices.

CO-4: Working principles of Klystron, Magnetrons and Traveling wave tubes

CO-5: Methods of various microwave measurements.

S. No.	Contents	Hours
1	**Introduction:** Objective, Scope and Outcome of the course	**1**
2.	**Introduction to Microwave Engineering:** History of Microwaves, Microwave Frequency bands, General Applications of Microwaves, Advantages of Microwaves**,** Microwave signal propagation, Transmission line, smith chart.	**6**
3.	**Mathematical model of Microwave Transmission:** Concept of Mode, Characteristics of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission **Microwave Waveguides:** Characteristics of TE and TM wave in rectangular wave guides, Dominant mode in rectangular waveguide, Introduction to Cylindrical waveguides, waveguide excitation.	**9**
4.	**Passive and Active microwave Devices:** Microwave Passive components:: Basic properties of 3-port and 4-port parameters, Power dividers, Couplers, Directional coupler, Termination, E-plane Tee, H-plane Tee, Magic Tee, Phase Shifter, attenuators, and circulators. **Microwave Active components:** Tunnel diode, Varactor diodes, Step recovery diodes, Schottky Barrier diodes, PIN diodes, Gunn Diodes, IMPATT and TRAPATT diodes.	**9**
5.	**Microwave tubes:** Limitations of conventional tubes in the microwave frequency ranges. Working principles of Klystron amplifier, Reflex klystron oscillator, Magnetrons, Traveling wave tubes.	**8**

6.	**Microwave Measurement:** Measurement of frequency and wavelength, Measurement of unknown loads, Measurement of reflection coefficient, VSWR, impedance, frequency, dielectric constant power, attenuation, phase shift and Noise.	**7**
	Total	**40**

Suggested Books:

1. Introduction to Microwaves -Wheeler G.J., Prentice-Hall
2. Microwave circuits & passive devices- Sisodia and Raghuvanshi, New Age International.
3. Microwave engineering-David M. Pozar, John Wiley & Sons, Inc.
4. Microwave Devices and Circuits- Samuel Y. Liao, Prentice Hall
5. Microwave and Radar Engineering- Kulkarni, McGraw Hill Education
6. Microwave Technology, PHI- Dennis Roddy
7. G. Kennedy - Electronic Communication systems, McGraw-Hill Book Company

5EC4-04: Control Systems	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand the concept of control systems and their types. Representation of control systems by block diagram and signal flow graph.

CO-2: Learn the importance of control systems and their transient analysis along with their design specifications. Also able to apply Laplace Transform for evaluation of time response.

CO-3: Know the concept of stability and its determination through Routh-Hurwitz stability criteria and Root Locus.

CO-4: Find the frequency response of a system through Polar plot, Nyquist plot and Bode plots.

S.No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Introduction of Control Systems**: Concept of open loop and closed loop control systems, Examples and applications of open loop and closed loop systems, Elements of control systems, Differential equations representation of Electro-Mechanical systems, Transfer function calculation by block diagram reduction techniques and signal flow method.	**9**
3.	**Laplace Transform and Transient Analysis of Control System:** Laplace Transformation, inverse Laplace transformation, Application of initial and final value theorem, Time response of first and second-order systems with impulse, step, ramp and parabolic inputs, Design specifications for second-order systems, Order, type and characteristics equation of control systems.	**9**
4.	**Error Analysis and Stability of Control System:** Steady state errors and error constants, Transient and steady state analysis of control systems, concept of stability and necessary conditions, Routh-Hurwitz stability criteria and limitations. Stability analysis through Root Locus Technique.	**8**
5.	**Control System Components and Controllers:** AC servomotor, synchronous and stepper motor. Application of Proportional, Integral and Derivative Controllers, Lead, Lag and Lead-Lag compensators.	**7**
6.	**Frequency Response Analysis:** Correlation between time and frequency responses, Polar plot, Nyquist plot and Nyquist stability criterion. Bode plots, Gain Margin and Phase Margin.	**7**
	Total	**41**

Suggested Books:

1. I. J. Nagrath and M. Gopal: Control Systems Engineering, New AgePublication.
2. K. Ogata: Modern Control Engineering, Prentice Hall of India.
3. Benjamin C. Kuo, Automatic Control Systems, Wiley India.
4. A.K. Jairath, Problems and Solutions of Control Systems, CBS Publishers.

5EC5-11: Information Theory and Coding	
Credit:2	**Max Marks:100(IA: 30,ETE: 70)**
2L+0T+ 0P	**End Term Exams:2 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO1: Derive equations for entropy, mutual information and channel capacity.

CO2: Implement the various source coding algorithms and analyze their performance.

CO3: Explain various methods of generation and detection of different types of error correcting codes

CO4: Design linear block codes and cyclic codes (encoding and decoding).

CO5: Implementation and decoding of a sequence using Convolutional codes.

Sr. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Information theory:** Concept of amount of information, Entropy: marginal, conditional and joint entropies, relation among entropies, Mutual information, information rate, channel capacity, redundancy and efficiency of Discrete channels, Cascaded channels, Shannon theorem.	**6**
3.	**Source coding:** Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy, Source coding theorem. Construction of basic source codes – Shannon Fano coding, Huffman coding, Minimum variance Huffman coding, Adaptive Huffman coding.	**8**
4	**Linear Block Codes:** Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Hamming Codes.	**10**
5	**Cyclic Codes:** Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding, Cyclic Hamming Codes, shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.	**8**
6	**Convolutional Codes:** Encoding of Convolutional Codes- Structural and Distance Properties, state, tree, trellis diagrams, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution	**8**

	codes. Application of Viterbi Decoding and Sequential Decoding.	
	Total	**41**

Suggested Books:

1. Ranjan Bose, "Information Theory, Coding and Cryptography", Tata McGraw Hill, 2nd edition.
2. Richard B. Wells, "Applied Coding and Information Theory for Engineers" Pearson Education, LPE 2004.
3. Thomas M Cover, Joy Thomas, "Elements of Information Theory", MGH 2006.
4. R. J. McEliece, The Theory of Information and Coding, Cambridge University Press
5. Shanmugam, K. Sam., "Digital and analog communication systems", Wiley India.

5EC5-12: Satellite Communication	
Credit:2	**Max Marks:100(IA: 30,ETE: 70)**
2L+0T+ 0P	**End Term Exams:2 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO1: Understand the basics of satellite orbits

CO2: Understand the satellite segment and earth segment

CO3: Analyze the various methods of satellite access

CO4: Understand the applications of satellites

CO5: Understand the basics of satellite Networks.

Sr. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Communication Satellite:** Orbit and Description: A brief History of Satellite Communication, Satellite Frequency bands, Satellite Systems, Applications, Orbital Period and Velocity, Effects of Orbital inclination, Azimuth and Elevation, Coverage and Slant range, Eclipse, Orbital perturbations , Placement of a Satellite in a Geo-Stationary Orbit.	**4**
3.	**Satellite Sub-Systems:** Altitude and orbit control system, TT&C Sub-System, Altitude control Sub-System, Power Systems, Communication Subsystems, Satellite antenna Equipment.	**5**
4.	**Satellite Link:** Basic transmission theory, system noise temperature and G/T ratio, Basic Link Analysis, Interference Analysis, Design of satellite links for specified C/N, (with and without frequency Re-use), Link Budget. **Propagation effects:** Introduction, Atmospheric Absorption, Cloud Attenuation, Tropospheric and Ionospheric Scintillation and Low angle fading, Rain Induced attenuation, rain induced cross polarization interference.	**8**
4	**Earth Station Technology:** Transmitters, Receivers, Antennas, Tracking systems, Terrestrial Interface, Power Test methods, Lower Orbit Considerations. **Satellite Navigation & Global Positioning Systems:** Radio and Satellite Navigation, GPS Position Location principles, GPS Receivers, GPS C/A code accuracy, Differential GPS.	**7**
5	**Satellite Packet Communications:** Message Transmission by FDMA: M/G/1 Queue, Message Transmission by TDMA, PURE ALOHA-Satellite Packet Switching, Slotted Aloha, Packet Reservation, Tree Algorithm.	**3**

	Total	**28**

Suggested Books:

1. Satellite Communications- Timothy Pratt, Charles Bostian and Jeremy Allnutt, WSE, Wiley Publications, 2nd Edition, 2003, John Wiley & Sons.
2. Satellite Communication Engineering- Wilbur L. Pritchand, Robert A Nelson and Henri G. Suyderhoud, 2nd Edition, Pearson Publications.
3. Digital Satellite Communications-Tri. T.Ha, 2nd Edition, 1990, Mc. Graw Hill.

5EC5-13: Computer Networks	
Credit:2	**Max Marks:100(IA: 30,ETE: 70)**
2L+0T+ 0P	**End Term Exams: 2 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand basic computer network technology.

CO-2: Learn about switching networks.

CO-3: Identify the different types of network topologies and protocols.

S. No.	Contents	Hours
1.	**Introduction:** Objective, Scope and Outcome of the course	01
2.	**Introduction to computer networks and the internet:** Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic mail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.	05
3.	**Switching in networks:** Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Cross bar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing.	07
4.	**Transport layer:** Connectionless transport - User Datagram Protocol, Connection oriented transport –Transmission Control Protocol, Remote Procedure Call. Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.	06
5.	**Network layer:** Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing.	06
6.	**Link layer:** ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, Switches.	05
	Total	30

Suggested Books:

1. A. S. Tanenbaum (2003), Computer Networks, 4th edition, Pearson Education/ PHI, New Delhi, India.
2. Behrouz A. Forouzan (2006), Data communication and Networking, 4th Edition, Mc Graw-Hill, India.
3. Kurose, Ross (2010), Computer Networking: A top down approach, Pearson Education, India.
4. An Engineering Approach to Computer Networks-S.Keshav,2nd Edition,Pearson Education

5EC5-14:Optimization Techniques	
Credit:2	**Max Marks:100(IA: 30,ETE: 70)**
2L+0T+ 0P	**EndTermExams:2 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: To study the concept of optimization techniques and their classification.

CO-2: To study the Linear programming concepts and able for problem solving using various LP methods.

CO-3: To study and understand Queuing models and distributions.

CO-4: Define and explain the different statistical distributions like Binomial, Poisson, Normal, Uniform, and Exponential distributions and compute the method of least squares, correlation and regression.

CO-5: To study and understand the Unconstrained Optimization methods.

CO-6: To study and understand the Constrained Optimization methods.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**INTRODUCTION:** Introduction to Optimization: Engineering application of Optimization – Statement of an Optimization problem – Optimal Problem formulation – Classification of Optimization problem.	**7**
3.	**LINEAR PROGRAMMING:** Examples of linear programming problems – formulation simplex methods variable with upper bounds – principle- duality - dual simplex method - sensitivity analysis – revised simplex procedure – solution of the transportation problem – assignment – network minimization – shortest route problem – maximal two problem – L.P. representation of networks.	**10**
4.	**QUEUING THEORY:** Queuing Models, classification of queuing models, probability distribution in queuing systems, poison and exponential distributions -Queues with combined arrivals and departures-random and series queues.	**6**
5.	**UNCONSTRAINED OPTIMIZATION:** Maximization and minimization of convex functions. Necessary and sufficient conditions for local minima – speed and order of convergence – unibariate search – steepest and desent methods-metcher reeves method -conjugate gradient method.	**9**
6.	**CONSTRAINED OPTIMIZATION:** Necessary and sufficient condition – equality constraints, inequality constraints -kuhu – tucker conditions – gradient projection method – penalty function methods – cutting plane methods of sibel directions.	**8**
	Total	**41**

Suggested Books:

1. Rao S.S, “Optimization – Theory and applications”, Wiley Easter Ltd., 1979

2. Hadley G. “Nonlinear and – dynamic programming” Addison Wesley Publishing Co. 1964.

3. Cordan C.C. Beveridge and Robert S. Schedther, “Optimization, Theory and Practice” McGraw Hill Co.1970.

4.HarndyA.Tahh. “Operations Research, An Introduction”, Macmillan Publishers Co.NewYork, 1982.

5. Beightferand S., “Foundations of Optimization Pill”, New Delhi, 1979.

5EC5-15: Internet of Things (IoT) and applications	
Credit:2	**Max Marks:100(IA: 30,ETE: 70)**
2L+0T+ 0P	**End Term Exams:2 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO1: Understand the various concepts, terminologies and architecture of IoT systems.

CO2: Understand and apply various protocols for design of IoT systems.

CO4: Understand IoT Open source architecture and devices.

CO5: Understand various applications of IoT.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Introduction to IOT**: IoT and its impertinence, Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.	**4**
3.	**IOT Protocols:** Protocol Standardization for IoT, Efforts, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards, IEEE802.15.4–BACNet Protocol, Modbus, KNX, Zigbee, Network layer, APS layer, Security	**6**
4	**IOT Architecture:** IoT Open source architecture (OIC), OIC Architecture & Design principles, IoT Devices and deployment models, IoTivity : An Open source IoT stack, IoTivity stack architecture, Resource model and Abstraction.	**6**
5	**Web of Things:** Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Unified Multitier WoT Architecture, WoT Portals and Business Intelligence.	**6**
6	**IOT Applications:** IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.	**4**
	Total	**27**

Suggested Books:

1. Hakima Chaouchi, “The Internet of Things Connecting Objects to the Web” ISBN : 978-1-84821-140-7, Wiley Publications.
2. Olivier Hersent, David Boswarthick, and Omar Elloumi, ― “The Internet of Things: Key Applications and Protocols”, Wiley Publications.
3. Vijay Madisetti and ArshdeepBahga, ― “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.
4. J. Biron and J. Follett, "Foundational Elements of an IoT Solution", O'Reilly Media, 2016.
5. Boyle. Internet of Things: Technologies and Applications for a New Age of Intelligence, 2018, 2nd Edition, Academic Press, USA.

5EC5-16: Introduction to Machine Intelligence	
Credit:2	**Max Marks:100(IA: 30,ETE: 70)**
2L+0T+ 0P	**End Term Exams:2 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO1: To understand the Artificial Neural network algorithms.
CO2: To understand concept of Supervised and Unsupervised machine learning algorithms.
CO3: To design and development of the machine learning algorithms for solution of different problems.
CO4: To understand concept of Deep learning.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Overview of Neural Network:** Introduction to Artificial Neural Networks (ANN), Models of a Neuron, Network structure Error–correction learning, Feed-forward Network Functions, Single neuron/ Perception networks: Network Training, Gradient descent optimization, Multilayer Perception: Back propagation algorithm.	**6**
3.	I**ntroduction to Machine Learning:** Types of machine learning, Supervised learning, Unsupervised learning, basic concepts in machine learning, K Nearest Neighbors.	**6**
4	**Kernels and SVM:** Kernel functions, Optimal Hyper-plane for linearly patterns, Optimal Hyper-plane for non-separable patterns, SVMs for classification. Dimensionality Reduction: Subset Selection, Principal Component Analysis (PCA), linear discriminant analysis (LDA).	**7**
5	**Introduction to Deep learning:** Introduction to Neural Networks, Deep generative models, Deep directed networks, Deep belief networks, Deep neural networks, Deep auto-encoders, Applications of deep networks.	**6**
	Total	**26**

Suggested Books:

1. S. Haykin, Neural Networks - A Comprehensive Foundation, Peasrson Education, India
2. C. M. Bishop, Pattern Recognition and Machine Learning, Springer , 2013
3. Tom M. Mitchell, Machine Learning, McGraw Hill Education (India) , 2013
4. Ethem Alpaydin, Introduction to Machine Learning, MIT Press , 2nd edition, 2010.

5EC4-20: Digital Communication (Lab)	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand the working of Pulse Code Modulation.

CO-2: Perform ASK, PSK, FSK digital modulation techniques using training kits.

CO-2: Perform GSM and CDMA using evaluation kits.

CO-3: Pseudo Random Binary PN sequence generation.

S. No.	Name of Experiments
1.	To perform PCM generation and demodulation.
2.	To perform Amplitude Shift Keying (ASK) modulation and demodulation
3.	To perform Binary-Frequency Shift Keying (B-FSK) modulation and demodulation.
4.	To perform Binary-Phase Shift Keying (B-PSK) modulation.
5.	To study and implement Digital Phase Detector and to detect the phase difference between two sinusoidal waves.
6.	To study and implement Frequency Synthesizer.
7.	To test the various AT commands on GSM Evaluation Kit for IMSI Information along with performing basic implementation of GSM based Mobile Phone Kit.
8.	To study and perform basic implementation of CDMA (DSSS) on CDMA Evaluation Kit.
9.	To study and implement TDM based experiments related to various modulation schemes on Evaluation Kit.
10.	To perform the generation of Pseudo Random Binary sequence and determine the chip rate using PN sequence.

5EC4-21: Digital Signal Processing Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Familiarization with MATLAB and Simulink.
CO-2: Generate continuous and discrete signals using mathematical expression.
CO-3: Perform various operations on continuous and discrete time signals.
CO-4: Generate random signals with different distributions.
CO-5: Perform digital signal processing using DFT, FFT algorithms and Z-transform.
CO-6: Design of filters and analyze the frequency response.

S. No.	Name of Experiments
1.	Introduction: Objective, scope and outcome of the course.
2.	Generation of continuous and discrete elementary signals (impulse, unit-step, ramp) using mathematical expression.
3.	Perform basic operations on signals like adding, subtracting, shifting and scaling.
4.	Perform continuous and discrete time Convolution (using basic definition).
5.	Checking Linearity and Time variance property of a system using convolution, shifting.
6.	To generate and verify random sequences with arbitrary distributions, means and variances for following: (a) Rayleigh distribution (b) Normal distributions: N(0,1). (c) Gaussion distributions: N (m, x) (d) Random binary wave.
7.	To find DFT / IDFT of given DT signal.
8.	N-point FFT algorithm.
9.	To implement Circular convolution.
10.	MATLAB code for implementing z-transform and inverse z-transform.
11	Perform inverse z-transform using residuez MATLAB function.
12	MATLAB program to find frequency response of analog LP/HP filters.
13	To design FIR filter (LP/HP) using windowing (rectangular, triangular, Kaiser) technique using simulink.

5EC4-22: Microwave Engineering Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand the characteristics and working of various microwave components..

CO-2: Understand the working of X-band slotted line.

CO-3: Understand working of Gunn and PIN diode.

CO-3: Working of Micro strip line and components.

S. No.	Name of Experiments
1	**Introduction:** Objective, scope and outcome of the course.
2	Study of various microwave components and instruments like frequency meter, attenuator, detector and VSWR meter. (a) Measurement of guide wavelength and frequency using a X-band slotted line setup. (b) Measurement of low and high VSWR using a X-band slotted line setup.
3	Introduction to Smith chart, measurement of SWR, shift in minimum standing wave with unknown load and calculation of unknown load impedance using Smith chart.
4	Study the behavior of terminated coaxial transmission lines in time and frequency domain.
5	(a) V-I characteristics of a Gunn diode and determine the output power and frequency as a function of voltage. (b) Study the square wave modulation of microwave signal using PIN diode.
6	Study the square wave modulation of microwave signal using PIN diode. Study and measure the power division and isolation characteristics of a microstrip 3dB power divider.
7	Study of rat race hybrid ring (equivalent of waveguide Magic-Tee) in micro-strip.
8	(a) To study the characteristics of micro-strip 3dB branch line coupler, strip line backward wave coupler as a function of frequency and compare their bandwidth. (b)Measure the microwave input, direct, coupled and isolated powers of a backward wave strip line coupler at the centre frequency using a power meter. From the measurements calculate the coupling, isolation and directivity of the coupler.

5EC4-23: Internet of Things (IoT) Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

S. No.	Name of Experiments
1	**Introduction:** Objective, scope and outcome of the course.
2	Connection of an Arduino board with ESP8266 wifi module
3	IoT based control of an LED using Arduino.
4	IoT and cloud based data logger using LM35 and Arduino.
5	IoT based home automation using Arduino.
6	IoT based street light control using Arduino.
7	IoT based DC motor speed control using Arduino.
8	IoT based temperature logger using Arduino, LM35 and ESP8266.

SCHEME & SYLLABUS OF UNDERGRADUATE DEGREE COURSE

Electronic & Communication Engineering

V & VI Semester

Effective for the students admitted in year 2021-22 and onwards.

eaching and Examination Scheme

3rd Year – V Semester

S.No.	Category	Course Code	Course Title	Contact hrs/ week L	T	P	Marks Exam Hrs.	IA	ETE	Total	Cr
THEORY											
1	DC	5EC4-01	Digital Communication	3	0	0	3	30	70	**100**	**3**
2		5EC4-02	Digital Signal Processing	3	0	0	3	30	70	**100**	**3**
3		5EC4-03	Microwave Engineering	3	0	0	3	30	70	**100**	**3**
4		5EC4-04	Control Systems	3	0	0	3	30	70	**100**	**3**
5	DE	**Department Elective : Any One**		2	0	0	2	30	70	**100**	**2**
		5EC5-11	Information Theory & Coding								
		5EC5-12	Satellite Communication								
		5EC5-13	Optimization Techniques								
6	DE	**Department Elective: Any One**		2	0	0	2	30	70	**100**	**2**
		5EC5-14	Computer Networks								
		5EC5-15	Internet of Things and Applications								
		5EC5-16	Introduction to Machine Intelligence								
		Sub-Total		**16**	**0**	**0**		**180**	**420**	**600**	**16**
PRACTICAL & SESSIONAL											
7	DC	5EC4-20	Digital Communication Lab	0	0	3	3	60	40	**100**	**1.5**
8		5EC4-21	Digital Signal Processing Lab	0	0	3	3	60	40	**100**	**1.5**
9		5EC4-22	Microwave Engineering Lab	0	0	3	3	60	40	**100**	**1.5**
10		5EC4-23	Internet of Things (IoT) Lab	0	0	3	3	60	40	**100**	**1.5**
11	UI	5EC7-30	Industrial Training (45 Days)	0	0	6	-	60	40	**100**	**3**
12	CCA	5EC8-00	Co-Curricular Activities	0	0	2	-	60	40	**100**	**1**
		Sub- Total		**0**	**0**	**20**		**360**	**240**	**600**	**10**
		TOTAL OF V SEMESTER		**16**	**0**	**20**		**540**	**660**	**1200**	**26**

L: Lecture, T: Tutorial, P: Practical, Cr: Credits
ETE: End Term Exam, IA: Internal Assessment

3rd Year – VI Semester

THEORY											
S. No.	Category	Code	Course Title	Contact hrs./week			Marks				Cr
				L	T	P	Exam Hrs.	IA	ETE	Total	
1	DC	**6EC4-01**	Linear Integrated Circuit	3	0	0	3	30	70	100	3
2	DC	**6EC4-02**	Antenna & RADAR	3	0	0	3	30	70	100	3
3	DC	**6EC4-03**	Digital Integrated Circuit	3	0	0	3	30	70	100	3
4	DC	**6EC4-04**	Optical Fiber Communication	3	0	0	3	30	70	100	3
5	DC	**6EC4-05**	MOBILE COMMUNICATION	3	0	0	3	30	70	100	3
6	DE-3	6EC5-11	Nano Electronics	2	0	0	2	30	70	100	2
		6EC5-12	Neural Network and Fuzzy Logic Control								
		6EC5-13	Biomedical Instrumentation								
Sub Total				**17**	**0**	**0**		**180**	**420**	**600**	**17**
PRACTICAL & SESSIONAL											
7	DC	6EC4-20:	Linear Integrated Circuit Lab	0	0	3		60	40	100	1.5
8	DC	6EC4-21:	Antenna & Radar Lab	0	0	3		60	40	100	1.5
9	UI	6EC7-50	Mini project	0	0	4		60	40	100	2
10	UGE	6EX8-00	*Co-Curricular Activities*	0	0	4		60	40	100	2
Sub- Total				**0**	**0**	**14**		**240**	**160**	**400**	**7**
TOTAL OF VI SEMESTER				**17**	**0**	**14**		**420**	**580**	**1000**	**24**

L: Lecture, T: Tutorial, P: Practical, Cr: Credits
ETE: End Term Exam, IA: Internal Assessment

SYLLABUS
VI Semester (Electronic & Communication Engineering)

6EC4-01: Linear Integrated Circuit	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand different topologies of feedback amplifier and design them.

CO-2: Analyze different type of oscillators and design them.

CO-3: Develop the basic understanding of amplifier designing and its analysis using hybrid pie model. Also analyze amplifier operation at low and high frequency and its frequency responses.

CO-4: Inspect and analyze different type of tuned amplifier

CO-5: Demonstrate different type of large signal amplifier and design and analyze them.

Sr. No.	Contents	Hours
1.	**INTRODUCTION:** Objective, Scope and Outcome of the course	**1**
2.	**BASICS OF OPERATIONAL AMPLIFIERS** Ideal OP-AMP characteristics, General operational amplifier stages -and internal circuit diagrams of IC 741, DC characteristics, AC characteristics, frequency response of OP-AMP, slew rate	**7**
3.	**APPLICATIONS OF OPERATIONAL AMPLIFIERS** Basic applications of op-amp – Inverting and Non-inverting Amplifiers-V/I & I/V converters, Voltage Follower, summer, subtractor, differentiator and integrator. Instrumentation amplifier, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters. Design and testing of Inverting, Non inverting and Differential amplifiers, Integrator and Differentiator. Design of Instrumentation amplifier, Active low-pass, High-pass and band-pass filters, Schmitt Trigger using op-amp.	**6**
4.	**ANALOG MULTIPLIER AND PLL** Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable trans-conductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing. Design and testing of PLL characteristics and its use as Frequency Multiplier,	**8**
5.	**ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS** Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion -	**8**

	Over-sampling A/D Converters.	
6.	**WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS** Sine-wave generators, Multi-vibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator-Frequency to Voltage and Voltage to Frequency converters, Design and testing of Astable & Monostable multi-vibrators, Phase shift and Wien bridge oscillators, DC power supply.	**9**
	Total	**39**

Suggested Books

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd.,Fifth edition 2018.
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", ForthEdition,Tata Mc Graw-Hill, 2014.
3. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4 th Edition, Prentice Hall / Pearson Education,2001.
4. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits",Sixth Edition, PHI, 2001.
5. Michael Jacob, "Applications and Design with Analog Integrated Circuits", Prentice Hall of India,1996. 6. William D.Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education,2004. 7. S.Salivahanan& V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2008.

6EC4-02: Antenna & RADAR	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO1 Define various antenna parameters
CO2 Analyze radiation patterns of antennas
CO3 Evaluate antennas for given specifications.
CO4 Illustrate techniques for antenna parameter measurements
CO5 Familiarize with fundamentals of RADAR.
CO6 Detect moving targets by the use of Doppler effect.
CO7 Analyze the performance of simple Tracking RADAR.

Sr. No.	Contents	Hours
1.	**INTRODUCTION:** Objective, Scope and Outcome of the course	**1**
2.	**ELECTROMAGNETIC RADIATION AND ANTENNA FUNDAMENTALS**: Review of Maxwell's equations: Retarded vector potential, Solution of wave equation in retarded case, Concept of radiation, Antenna equivalent circuits, Antenna characteristics: Radiation pattern, Beam solid angle, Radiation intensity, Directivity, Gain, Input impedance, Polarization, Bandwidth, Effective aperture, Antenna effective height, Antenna temperature.	**7**
3.	**WIRE ANTENNA AND ANTENNA ARRAYS-WIRE ANTENNAS:** Hertizian dipole , Short dipole, Radiation resistance and Directivity, Half wave Dipole, Monopole, Small loop antennas. Antenna Arrays: Linear Array and Pattern Multiplication, Two-element Array, Uniform Array, Array with non-uniform Excitation, Binomial Array.	**7**
4.	**APURTURE ANTENNAS**: Aperture Antennas: Slot antenna, Horn Antenna, Pyramidal Horn Antenna, Reflector Antenna-Flat reflector, Corner Reflector, Common curved reflector shapes, parabolic reflector, Lens Antenna.	**6**
5.	**SPECIAL AND BROAD BAND ANTENNAS-SPECIAL ANTENNAS:** Long wire, V and Rhombic Antenna, Yagi-Uda Antenna, Turnstile Antenna, Helical Antenna- Axial and Normal mode helix, Bi-conical Antenna, Frequency Independent Antenna, Log periodic Dipole Array, Spiral Antenna, Microstrip Patch Antennas.	**6**
6.	**RADAR FUNDAMENTAL:** Principle of detection and ranging, Radar frequencies and bands. Applications, Radar block diagram and operation. Radar Range Equation: Range prediction, Minimum detectable signal, Receiver noise SNR, Integration of radar pulses. Radar cross section of targets, Transmitter Power, PRF and system losses & Propagation effects.	**7**
7.	**CW FM Radar:** Doppler effect, CW Radar, Frequency-modulated CW Radar, Multiple-frequency CW Radar. MTI and Pulse Doppler Radar: MTI delay lines,	**6**

	Delay line Cancellers, Coherent and Non-Coherent MTI, Pulse Doppler Radar.	
8.	**Total**	**40**

Suggested Books

1. Sisir. Das and A. Das, Antenna and wave propagation, Tata McGraw-Hill Education Pvt. Ltd, (2013).
2. A.R. Harish and M. Sachidananda, Antennas and Wave Propagation, Oxford Univ. Press, Edition (2011).
3. J.D. Kraus, Antennas, Tata McGraw-Hill, 2nd Edition, 1999
4. Introduction to Radar System, 3rd, M I Skolink, MGH. (2003).
5. Nathanson, F.E., "Radar Design Principles", McGraw-Hill Inc., 1991
6. D.K.Barton, Modern radar systems analysis, Artech House, 1988 8. Microwave and radar engineering, G.S.B. Rao, Pearson P, 2013

6EC4-03: Digital Integrated Circuit	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Describe the various design entities.

CO-2: Analyze the depth of designing a Digital IC and use the concept of logical effort for Transistor sizing.

CO-3: Describe the static and dynamic behavior of CMOS.

CO-4: Distinguish between Combinational CMOS design and Sequential CMOS design.

CO-5: Design synchronous and asynchronous sequential circuits.

Sr. No.	Contents	Hours
1.	**INTRODUCTION:** Objective, Scope and Outcome of the course	**1**
2.	**DIGITAL LOGIC FAMILIES, INTERFACING AND INTRODUCTION TO VHDL:** Introduction to logic families, CMOS logic, CMOS steady state and dynamic electrical behavior, CMOS logic families. Bipolar logic, transistor-transistor logic, TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing, Emitter coupled logic. Design flow, program structure, levels of abstraction, Elements of VHDL: Data types, data objects, operators and identifiers. Packages, Libraries and Bindings, Subprograms. VHDL Programming using structural and data flow modeling.	**7**
3.	**BEHAVIORAL MODELING:** Process statement, variable assignment statement, signal assignment statement, wait statement , if statement, case statement ,null statement, loop statement, exit statement, next statement ,assertion statement, more on signal assignment statement ,Inertial Delay Model, Transport Delay Model ,Creating Signal Waveforms, Signal Drivers , Other Sequential Statements , Multiple Processes. Logic Synthesis, Inside a logic Synthesizer.	**8**
4.	**COMBINATIONAL LOGIC DESIGN:** Binary Adder-Subtractor, Ripple Adder, Look Ahead Carry Generator, ALU, Decoders, encoders, multiplexers and de-multiplexers, parity circuits, comparators, Barrel Shifter, Simple Floating-Point Encoder, Dual Priority Encoder, Design considerations of the above combinational logic circuits with relevant Digital ICs, modeling of above ICs using VHDL.	**9**
5.	**SEQUENTIAL LOGIC DESIGN:**SSI Latches and flip flops, Ring Counter, Johnson Counter, Design of Modulus N Synchronous Counters, Shift Registers, Universal Shift Registers, Design considerations of the above sequential logic circuits with relevant Digital ICs, modeling of above ICs using VHDL.	**8**
6.	**SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS:** Basic design steps: State diagram, state table, state assignment, choice of flip flops and derivation of next state and output expressions, timing diagram. State assignment	**8**

	problem: One hot encoding. Mealy and Moore	
	Total	**41**

Suggested Books:

1. Digital Design Principles & Practices – John F. Wakerly, PHI/ Pearson Education Asia, 3rd Ed., 2005.
2. VHDL Primer – J. Bhasker, Pearson Education/ PHI, 3rd Edition.
3. Fundamentals of Digital Logic with VHDL Design- Stephen Brown, ZvonkoVranesic, McGrawHill, 3rd Edition.

6EC4-04: Optical Fiber Communication	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Demonstrate an understanding of optical fiber communication link, structure, propagation and transmission properties of an optical fiber.

CO-2: Estimate the losses and analyze the propagation characteristics of an optical signal in different types of fibers.

CO-3: Describe the principles of optical sources and power launching-coupling methods.

CO-4: Compare the characteristics of fiber optic receivers.

CO-5: Design a fiber optic link based on budgets.

CO-6: To assess the Optical Transmission systems.

Sr. No.	Contents	Hours
1.	**INTRODUCTION:** Objective, Scope and Outcome of the course	1
2.	**FUNDAMENTALS OF FIBER OPTICS:** Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model. Different types of optical fibers, Modal analysis of a step index fiber.	8
3.	**FIBER MEASUREMENT:** Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR	7
4.	**OPTICAL SOURCES** - LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.	8
5.	**OPTICAL SWITCHES** - coupled mode analysis of directional couplers, electro-optic switches. Optical amplifiers - EDFA, Raman amplifier.	8
6.	**ANALOG AND DIGITAL OPTICAL TRANSMISSION SYSTEMS:** WDM and DWDM systems. Principles of WDM networks. Nonlinear effects in fiber optic links. Concept of self-phase modulation, group velocity dispersion and solition based communication.	8
	Total	**40**

Suggested Books:

1. Optical Fiber Communications (3rd edition)- Gerd keiser
2. Optical Fiber Communications -John M Senior
3. Optical Fiber Communications -Robert .Gagliardi, Sherman Karp
4. Principles of light wave communications-Goran Einarsson

6EC4-05: MOBILE COMMUNICATION	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
3L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes: Upon successful completion of the course the students will be able to

CO-1: Demonstrate knowledge on : cellular concepts like frequency reuse, fading, equalization, GSM ,CDMA.

CO-2. Demonstrate knowledge hand-off and interface and apply the concept to calculate link budget using path loss model

CO-3. Demonstrate knowledge equalization and different diversity techniques.

CO-4. Apply the concept of GSM in real time applications.

CO-5. Compare different multiple access techniques in mobile communication.

S. No.	Contents	Hours
1.	**INTRODUCTION:** Objective, Scope and Outcome of the course	**1**
2.	**MOBILE COMMUNICATION SYSTEMS:** Introduction to mobile communication systems, Comparison of wireless systems and trends. Cellular concept and system design fundamentals, channel assignment strategies, Hand-off strategies. Interference and system capacity. Improving capacity in cellular systems.	9
3.	**MOBILE RADIO PROPAGATION:** Concepts of Mobile radio propagation, Ground reflection model, diffraction sculpturing, Indoor propagation models, outdoor propagation models, ray tracing and site specific signaling.	7
4.	**EQUALIZATION:** Fundamentals of Equalizers, Linear equalizers, Non-linear equalizers, Decision feedback equalizers, MLSE. **DIVERSITY TECHNIQUES:** Space diversity: MRC, EGC Selection diversity, Polarization diversity, Frequency diversity, Time diversity. Modulation techniques for mobile radio.	7
5.	**GLOBAL SYSTEM FOR MOBILE (GSM)**: Historical overview, System overview: The air interface, Logical and physical channels, Synchronization, Coding, Equalizer, Circuit-switched data transmission, Establishing a connection and handover, Services and billing.	7
6.	**MULTIPLE ACCESS TECHNIQUES:** FDMA, TDMA, CDMA and Wireless systems and standards.GSM, IS-95, 3G (IMT-2000,UMTS, 4G (WIMAX)	9
	Total	**40**

Suggested Books:

1. Wirless Communication - Principle and practice – T.S. Rappaport
2. Mobile Communication – Schwartz•
3. Wireless Communications and Networks- William Stallings.•
4. Designing CDMA 2000 Systems – Leonard Korowajczuk, Bruno DEsouza, Abren Xavier and ArlindoMorieira
5. Fartes CDMA Access and Switching for Terrestrial and Satellite Networks- Diakoumis,

Gerakoulis, Evaggelos.•

6EC5-11: **NANO ELECTRONICS**	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
2L+0T+ 0P	**End Term Exams:3 hrs.**

Course Outcomes: Upon successful completion of the course the students will be able to
CO1: Explain the fundamental of quantum mechanics behind Nano electronics, concepts of nanoscale MOSFET, CMOS scaling with its limits.
CO2: Molecular electronics involving single molecules as electronic devices.
CO:3 Design and analysis of Nano structure and nano Electronic devics using MOSFET,FINFETs,
CO4: Describe resonant tunneling transistors, single electron transistors, and new storage, optoelectronic, and spintronic devices

S. No.	Contents	Hours
1	**UNIT 1:** Introduction: Objective, scope and outcome of the course.	01
2	**UNIT 2:**Introduction to nanotechnology, meso structures, Basics of Quantum Mechanics: Schrodinger equation, Density of States. Particle in a box Concepts, Degeneracy. Band Theory of Solids. Kronig-Penny Model. Brillouin Zones.	9
3	**UNIT 3:** Shrink-down approaches: Introduction, CMOS Scaling, The nano scale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issuesetc.).	9
4	**UNIT 4:** Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation.	10
	Total	**29**

Suggested Books:

1. Hasan Raza,Nano, Electronics Fundamentals,Springer
2. Vladmir V.Mitin &Michel A.Stroscio,Indroduction to NanoElectronics,Cambridge
3. Avik Ghosh, NanoElectronics A molecular view,World scientific publisher

6EC5-12: **Neural Network and Fuzzy Logic Control**	
Credit:2	**Max Marks:100(IA: 30,ETE: 70)**
2L+0T+ 0P	**EndTermExams:2 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Learn concepts, architecture and working of artificial neural networks
CO-2: Understand supervised and unsupervised learning algorithms
CO-3: Understand Fuzzy set theory and operations, Fuzzy Relations and Fuzzy inference system
CO-4: Design Fuzzy logic controller for industrial applications

S. No.	Contents	Hours
1.	**INTRODUCTION:** Objective, Scope and Outcome of the course	1
2.	**INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS:** Artificial neural network and their biological motivation, Terminology, Introduction to ANN Architecture, Models of neuron, Topology, Characteristics of artificial neural networks, Types of activation functions.	5
3.	**LEARNING METHODS:** Error correction learning, Hebbian learning, Perceptron, XOR Problem, Perceptron learning rule, Convergence theorem, Adaline.	5
4.	**SUPERVISED AND UNSUPERVISED LEARNING:** Multilayer Perceptron, Back propagation learning algorithm, Momentum factor, Radial basis function network,	5
5.	**FUNDAMENTALS OF FUZZY LOGIC:** Introduction to classical sets - Properties, operations and relations; Fuzzy sets, Uncertainty, Operations, properties, cardinalities, membership functions. Fuzzy relations**:** Fuzzy cartesian product, Composition-Max min and Max-product composition, Tolerance and Equivalence relations.	6
6.	**FUZZY INFERENCE SYSTEMS AND CONTROL :** Fuzzification, Membership value assignment, Defuzzification to crisp sets, Defuzzification methods, Natural language, Linguistic hedges, Fuzzy rule base system, Graphical techniques of inference, Basic architecture of Fuzzy logic controller, Fuzzy Engineering process control.	7
	Total	**31**

Suggested Books:

1. Timothy J. Ross, Fuzzy Logic with Engineering Applications, John Wiley and sons, 2010.
2. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.
3. Introduction to Neural Networks using MATLAB 6.0 - S.N.Sivanandam, S.Sumathi, S.N.Deepa, TMH, 2006
4. S. Haykin, “Neural Networks, A Comprehensive Foundation”, Pearson Education Inc., 2008.

6EC5-13:

6EC5-13**: Biomedical Instrumentation**	
Credit:3	**Max Marks:100(IA: 30,ETE: 70)**
2L+0T+ 0P	**End Term Exams:3 hrs.**

	Course Outcomes: Upon successful completion of the course, students will be able to **CO-1:** Learn the basics of physiology and anatomy of human body sub-systems **CO-2:** To learn about generation of biopotentials, working of bio-transducers and bio-electrodes. **CO-3:** Learn functioning of various medical instruments **CO-4:** Learn safety standards used in biomedical equipments	
Se. No.	**Contents**	**Hours**
1.	**INTRODUCTION:** Objective, Scope and Outcome of the course	**1**
2.	**TRANSDUCERS AND ELECTRODES:** Principles and classification of transducers for Bio-medical applications, Electrode theory, Different types of electrodes, Selection criteria for transducers and electrodes. **Biopotentials-** Electrical activity of excitable cells, ECG, EMG, EEG, ERG, EOG.	**6**
3.	**CARDIOVASCULAR SYSTEM MEASUREMENTS:** Measurement of blood pressure, Blood flow, Cardiac output, Cardiac rate, Heart sounds, Electrocardiograph, Phonocardiograph, Plethysmograph, Echocardiograph.	**7**
4.	**INSTRUMENTATION FOR CLINICAL LABORATORY:** Measurement of pH value of blood, ESR measurement, Hemoglobin measurement, O_2 and CO_2 concentration in blood, GSR measurement. Spectrophotometry, Chromatography, Hematology,	**6**
5.	**MEDICAL IMAGING**: Diagnostic X-rays, CAT, MRI, Thermography, Ultrasonography, Medical use of isotopes, Endoscopy.	**7**
6.	**PATIENT CARE, SAFETY MEASURES AND BIOTELEMETRY:** Elements of Intensive care monitoring, Basic hospital systems and components, Physiological effects of electric currents, Shock hazards from electrical equipments, Safety measures, Standards & practices. **Biomedical telemetry:** Introduction, block diagram and description of single channel/multi channel telemetry systems.	**6**
7.	**THERAPEUTIC AND PROSTHETIC DEVICES:** Introduction to cardiac pacemakers, Defibrillators, Ventilators, Muscle stimulators, Diathermy, Heart lung machine, Hemodialysis, Applications of Laser.	**7**
	Total	**40**

Suggested Books:

1. Biomedical Instrumentation and Measurements By Cromwell, 2nd edition, Pearson Education

2. Medical Instrumentation Application and Design, John G. Webster, John Wiley and sons, New York, 1998.
3. Handbook of Biomedical Instrumentation By R. S. Khandpur, TMH
4. Introduction To Biomedical Equipment Technology By Carr & Brown
5. Biomedical Digital Signal Processing, Tompkins, PHI

6EC4-20: Linear Integrated Circuit Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Design and experiment with various amplifiers and oscillators circuits using BJTs and FETs

CO-2: Design Multivibrator circuit using BJT/FET

CO-3: Implement Mini Project related to amplifiers/Oscillators.

Practical are to be performed using the bread-boards and SPICE simulators.

S. No.	List of Experiments
1.	To design a comparator circuit and study the non-linear applications of Op- Amp.
2.	To design and test the Schmitt Trigger for the given UTP and LTP using IC 741 Op-Amp.
3.	To design a circuit and study the following waveform generators using IC 741 Op-Amp. (a) Sine wave generator. (b) Square wave generator. (c) Triangular wave generator. (d) Sawtooth wave Generator.
4.	To design and test the following circuits using IC-555 (a) Astable Multivibrator. (b) Monostable Multivibrator. (c) Voltage to Frequency converter. (c) Schmitt Trigger.
5.	To design Voltage Limiter circuit and Precision rectifier using IC741 Op-Amp.
6.	To design and study the circuit of a voltage to frequency converter using IC741Op-Amp.
7.	To design and study the performance of an Instrumentation amplifier.
8.	To design an integrator and differentiator using IC 741 Op-Amp.
9.	To design a band pass filter and notch filter using IC 741 Op-Amp.
10.	To design and test a 2nd order low pass filter and high pass filter using IC 741 Op-Amp.
11	SPICE simulation and testing of Instrumentation amplifier, Active lowpass, High-pass and band-pass filters, Schmitt Trigger using op-amp
12	Simulation of Analog multiplier using SPICE lab

13	SPICE Simulation of D/A and A/D converters

6EC4-21: Antenna & Radar Lab	
Credit:1.5	**Max Marks:100(IA:60,ETE: 40)**
0L+0T+3P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: To understand the working of a microprocessor/controller.

CO-2: To learn to program a processor using assembly language.

CO-3: Implement Mini Project related to amplifiers.

S. No.	List of Experiments
1	Study of the structure and operation of wired, aperture, planar and array antennas.
2	Measurement of radiation pattern of all wired and aperture antennas
3	Measurement of radiation pattern of planar antennas
4	Measurement of radiation pattern of reflector antennas
5	Measurement of radiation pattern of array antennas
6	Analysis of co-polarization and cross polarization
7	Design and simulation of microstrip antenna using CST tool.
8	Measurement of antenna parameters using Network Analyzer.
9	Introduction to RADAR
10	Derivation of RADAR range equation