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