CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

DEPARTMENT OF ECE

List of Open Elective Courses offered by ECE Dept. to other departments

R-20 Regulation with effect from AY 2020-21

S.no.	Course Code	Course Name	Departments	Semester	Open Elective no
1.	20EC O01	Remote Sensing and GIS	CSE,	VI	II
			CSE-AI&ML	VII	II
			CSE-IoT&CS including BT	VI	II
			IT	VIII	III
2.	20EC O02	Basics of DSP	Civil	VI	II
3.	20EC O03	Biomedical Instrumentation	Bio-Tech	VIII	III
			Chemical	VIII	IV
4.	20EC O04	Principles of Embedded Systems	EEE	VI	I
			Mech	VII	III
5.	20EC O05	System Automation and Control	Mech	VII	II
			CSE	VII	III
			CSE-AI&ML	VII	III
			CSE-IoT&CS including BT	VII	III
6.	20EC O06	MEMS and its Applications	Mech	VIII	IV
7.	20EC O07	Neural Networks and Fuzzy Logic	IT	VII	I
8.	20EC O08	Fundamentals of Biomedical Signal Processing	Bio-Tech	VIII	III
9.	20EC O09	Principles of VLSI	IT	VIII	II
10.	20EC O10	Fundamentals of Wireless Communications	CSE	V	I
			CSE-AI&ML	V	I
			CSE-IoT&CS including BT	V	I

20EC O01

REMOTE SENSING and GIS

(CSE, CSE-AI&ML, CSE-IoT&CS including BCT and IT)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic knowledge of Geography is required

Course Objectives:

This course is aims to:

1. Explain the fundamental concepts of remote sensing and digital imaging techniques.
2. Make the students to understand the principles of thermal and microwave remote sensing.
3. Make the students understand the significance of GIS and the process of GIS.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Demonstrate the understanding of basic concepts of remote sensing and interpret energy interactions.
2. Choose an appropriate technique for a given scenario by appreciating the types of remote sensing.
3. Distinguish the principle behind the working of microwave and LiDAR sensing.
4. Apply Microwave remote sensing techniques
5. Explain the procedure for encoding data and geospatial data analysis.

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	1	1	1	–	1	1	1	--	1	--	2	1	--	--
CO2	3	1	1	1	–	1	1	1	--	1	--	2	1	--	--
CO3	3	1	1	1	–	1	1	1	--	1	--	2	1	--	--
CO4	2	1	1	1	–	1	1	1	--	1	--	2	1	--	--
CO5	3	1	1	1	–	1	1	1	--	1	--	2	1	--	--

UNIT-I

Concept of Remote Sensing: Remote sensing definition, data, process, EM bands used in remote sensing, Interactions and recording of energy: interaction with atmosphere, interaction with earth surface features (soil, water, vegetation), recording of energy by sensors, Transmission, reception and processing, Image interpretation and analysis, Applications, Advantages and limitations of Remote sensing, Orbits of Remote sensing satellites, Indian remote sensing satellites.

UNIT-II

Digital Imaging: Types of Remote sensing, Sensor resolutions, Digital Image, Sensor components, Principle of a long-track and across-track scanning, Hyperspectral Imaging, Thermal Remote Sensing.

UNIT-III

Microwave Remote Sensing: Active and Passive Microwave Remote Sensing, Radar Imaging: Key components of imaging radar, viewing geometry, spatial resolution, principle of RAR, SAR and their range resolution, Satellite Radar Imaging, LIDAR.

UNIT-IV

Concept of Geographic Information Systems: Key components of GIS, joining spatial and attribute data, functions, advantages and applications of GIS, Spatial data model, Raster data model, Vector data model.

UNIT-V

Process of GIS and Geospatial analysis: Data sources, encoding raster data, encoding vector data, encoding attribute data, linking spatial and attribute data, Geospatial data analysis methods database query, geospatial measurement, overlay operations, network analysis and surface analysis. Integration of GIS and remote sensing.

Text Books:

1. Basudeb Bhatta, "Remote Sensing and GIS", 2/e, Oxford University Press, 2012.
2. Lillesand T.M., and Kiefer R.W. "Remote Sensing and Image Interpretation", 6/e, John Wiley &Sons, 2000.

Suggested Reading:

1. James B. Campbell and Randolph H. Wynne, "Introduction to Remote Sensing", the Guilford Press, 2011.
2. Michael N DeMers, "Fundamentals of GIS", 2/e, John Wiley, 2008.

20ECO02

BASICS OF DIGITAL SIGNAL PROCESSING

(CIVIL)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic concepts of signals are required

Course Objectives:

This course aims to:

1. Learn the advantages of DSP over analog signal processing.
2. Analyze discrete-time signals in the frequency domain using DFT and FFT.
3. Learn the theory of digital filters.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the concept of Discrete time signals and systems
2. Analyze the frequency domain representation of discrete time sequence using DTFT and DFT.
3. Apply FFT to the given sequence.
4. Implementation of FIR filter for the given specifications
5. Design an IIR filter for the given specifications.

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	03	03	03	02	03	02	-	-	02	02	-	02	03	03	02
CO2	03	03	03	02	02	02	-	-	02	02	-	02	03	03	02
CO3	03	03	03	02	03	02	-	-	02	02	-	02	03	03	01
CO4	03	03	03	02	02	02	-	-	02	02	-	02	03	03	02
CO5	03	03	03	02	03	02	-	-	02	02	-	02	03	03	02

UNIT-I

Discrete Time Signals and Systems: Introduction, basic elements of a digital signal processing system, advantages and disadvantages of Digital Signal Processing over Analog signal processing, sampling theorem, analog to digital and digital to analog conversion. Discrete-Time System: Mathematical representation of Discrete Time Systems, Concept of Impulse response and Transfer function, Linear and Time invariant systems, Concept of causality and stability.

UNIT-II

Frequency Domain Analysis of Discrete Time Sequences: Discrete Time Fourier Transform (DTFT), properties of DTFT, Discrete Fourier Transform (DFT) and its properties, relationship between DFT to the DTFT, circular convolution.

UNIT-III

Fast Fourier Transform (FFT): Introduction, Radix-2 Decimation –In- Time (DIT) and Decimation- In- Frequency (DIF) FFT algorithms, Bit reversal order, In-place computation.

UNIT-IV

FIR Filter Design: Characteristics of FIR filters, Linear phase filters, Design of FIR (LPF, HPF, BPF and BSF) filters using Truncation and Windows, Comparison between FIR and IIR filters.

UNIT-V

IIR Filter Design: Characteristics of IIR filters, Conversion from analog filters to digital filters using Impulse Invariance Method (IIM) and Bilinear Transformation (BLT) methods, prewarping. Realization diagrams- Direct form I & II.

Text Books:

1. Alan V. Oppenheim & Ronald W. Schafer, “Digital Signal Processing,” PHI, 2/e, 2010.
2. John G. Proakis&Dimtris G. Manolakis, “Digital Signal Processing Principles, Algorithms and Application,” PHI, 4/e, 2012.

Suggested Reading:

1. Sanjit K Mitra, " Digital Signal Processing", Tata Mc Graw Hill, Third edition, 2006
2. ChiTsong Chen, "Digital Signal Processing", Indian edition, 2009.

20EC O03

PRINCIPLES BIOMEDICAL INSTRUMENTATION

(Bio-Tech, Chemical)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge about human body and measurement concepts are required

Course Objectives:

This course aims to:

1. To understand the physiological systems, present in the human body.
2. To understand the application of electronic systems used in modern healthcare.
3. To acquire, process and analyses Bio medical signals.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Describe the physiological, physical and chemical background of the most common bioelectrical phenomena.
2. Understand the electrode theory, different types of electrodes and transducers required to detect bioelectric signals.
3. Elucidate cardiovascular system, human assist devices and other physiological measurements.
4. Analyze and compare the different medical imaging systems using computers.
5. Explain patient monitoring systems through bio-telemetry and realize safety requirements of biomedical instrumentation.

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	02	02	02	02	01	02	-	-	-	-	-	02	03	02	02
CO2	02	03	03	03	01	02	-	-	-	-	-	02	03	02	02
CO3	02	03	03	03	02	02	-	-	-	-	-	02	03	03	02
CO4	02	03	03	03	03	02	-	-	-	-	-	02	03	03	02
CO5	02	03	03	03	03	02	-	-	-	-	-	02	03	03	02

UNIT-I

Introduction to Bio Medical Instrumentation: Components of the Man-Instrument system, Physiological systems of the body, Problems encountered in measuring a living system. Sources of Bio electric potentials: Resting and action potentials, propagation of action potentials, Bio electric potentials.

UNIT-II

Basic Transducer Principles: Transducer principles, active and passive transducers, their bio medical applications.
Electrodes: Electrode theory, bio potential electrodes, bio chemical transducers.

UNIT-III

Cardiovascular System: The heart and cardiovascular system, the heart, blood pressure, blood flow, heart sounds, ECG, Measurement of blood pressure, blood flow, cardiac output, and heart sounds and PCG. Patient care and monitoring systems: Elements of Intensive care systems, patient monitoring systems, other instruments, organization of the hospital for patient care monitoring, pace makers, defibrillators.

UNIT-IV

Bio Medical Amplifiers: Basic requirements, differential amplifier, carrier amplifier, chopper amplifier, phase sensitive detector. EEG: Signal sources, EEG recording, applications of EEG. EMG: Surface and needle electrodes, EMG, measurement of conduction velocity, ERGand EOG

UNIT-V

Bio telemetry: Introduction, physiological parameters adaptable to biotelemetry, components of telemetry system, implantable units, applications of telemetry in patient care. Computer in Biomedical instrumentation: digital computer, microprocessor, interfacing computer with other medical equipment, biomedical computer applications, Introduction to CAT scanner. X-Ray: X-ray unit, radiation therapy, Introduction to MRI.

Text Books:

1. LeslieCromwell, Fred J Weibell andErich A.P Feiffer,'Bio Medical Instrumentation and Measurements', PHI, 2nd edition, 2003.
2. C Raja Rao and SK Guha, 'Principles of Medical Electronics and Bio Medical Instrumentation', Universities press,2013.

Suggested Reading:

1. R.S Khandpur, 'Handbook of Biomedical Instrumentation', McGraw-Hill Education, 3rd edition, 2014
2. Andrew G. Webb, 'Principles of Biomedical Instrumentation', Cambridge University Press, 2017

20EC O04

PRINCIPLES OF EMBEDDED SYSTEMS

(EEE, Mech)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: Fundamental knowledge about electronic device is required

This course aims to:

1. To learn the fundamentals of the embedded system design.
2. To learn architecture details of embedded processors
3. To analyze various embedded applications and debugging tools.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand hardware and software details of embedded system.
2. Analyze the architecture and instruction set of embedded processors.
3. Develop the embedded system design cycle
4. Apply various debugging tools for embedded system applications.
5. Design different case studies for embedded applications

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	2	1	1	1	2	-	-	-	-	-	-	1	2	3	-
CO2	2	3	2	2	2	-	-	-	-	-	-	-	2	3	-
CO3	2	2	3	2	2	-	-	-	-	-	-	-	2	3	-
CO4	2	2	3	2	3	-	-	-	-	-	-	-	2	3	-
CO5	2	2	3	2	3	-	-	-	-	-	-	1	2	3	-

UNIT I

Introduction to Embedded systems: Embedded systems vs General computing systems, Classifications, Applications areas, Processor embedded into a system, Processor selection for embedded system, Embedded hardware units and devices in a system, Design metrics and Challenges in embedded system design.

UNIT II

Embedded Processors: PIC 18 Family Overview, Architecture, Instruction Set, Addressing modes, Timers and Interrupts of PIC 18. Capture/Compare and PWM modules of PIC 18.

UNIT III

Introduction to advanced processor architectures: ARM design philosophy. ARM data flow model, Register organization, Program Status Register, Pipeline, Introduction to exceptions. ARM instruction set.

UNIT IV

Embedded System Design Cycle: Embedded system design and co-design issues in system development process, Design cycle in the development phase for an embedded system. Embedded software development tools: Host and Target machines, Linker/Locators for embedded software, Embedded software into the target system.

UNIT V

Debugging tools and Applications: Integration and testing of embedded hardware, testing methods, Debugging techniques, Laboratory tools and target hardware debugging: Logic Analyzer, Simulator, Emulator and In-Circuit Emulator, IDE. **Case Studies:** Design of Embedded Systems using Microcontrollers – for applications in the area of communications and automotives. (GSM/GPRS, CAN, Zigbee).

Text Books:

1. Raj Kamal, "Embedded Systems-Architecture, Programming and Design," 3/e, Tata McGraw Hill Education, 2015.
2. Andrew N.SLOSS, DomonicSymes Chris Wright "ARM System Developers Guide- Designing and optimizing system software" ELSEVIER 1st Edition2004.
3. Mazidi, MCKinlay and Danny Causey, "PIC Microcontrollers and Embedded Systems", Pearson Education. 2008

Suggested Readings:

1. David E.Simon, "An Embedded software primer", Pearson Education,2004.
2. Steve Furber "ARM System on Chip Architecture" 2/e Pearson education, 2000.

20EC O05

SYSTEM AUTOMATION AND CONTROL

(Mech, CSE, CSE-AI&ML, CSE-IoT & CS including BCT)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge about physical parameters in industry is required

Course Objectives:

This course aims to:

1. Learn the concepts industrial control systems
2. Learn how to measure the physical parameters in industry
3. Learn the applications of Robots in industry.

Course Outcomes:

After completion of this course, students will be able to:

1. Understand the features of various automatic and process control systems.
2. Define and analyze various measuring parameters in the industry.
3. Compare performance of various controllers (P, PD, PI, and PID).
4. Illustrate the role of digital computers in automation.
5. Develop various robot structures for different applications.

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	2	2	3	2	2	1	-	-	1	-	-	2	3	3	1
CO2	3	3	3	2	1	1	-	-	1	-	-	1	3	3	1
CO3	3	3	3	3	2	1	-	-	1	-	-	2	3	3	1
CO4	2	2	2	2	2	2	-	-	1	-	-	2	3	3	1
CO5	3	3	3	3	2	2	-	-	2	-	-	1	3	3	3

UNIT-I

Introduction to Automatic Control Systems: Purpose of Automatic Control, How an Industrial Control System is implemented, Introduction to Automatic Control theory.

Sensors: Sensor definition, Different types of Sensors:Motion, Position, Force, Level sensors, and Thermo couples.

UNIT-II

Theory of Measurements: Measurement goals and concepts, Scale factor, Linearity, accuracy, Range, Resolution, Precision and repeatability.

Measurement Techniques and Hardware: Typical Sensor outputs, Bridge measurements: General equation for bridge balance, Resistance balanced Wheatstone bridge, Variable voltage type measurements, Frequency type measurements.

UNIT-III

Process Controllers: What is a Controller, uses of Controllers, Open loop and closed loop Control, proportional, PD, PI, PID Controllers, Analog and Digital methods of Control.

Controller Hardware: Analog and Digital Controllers.

UNIT-IV

Digital Computers as Process Controllers: Use by Digital Computer for process control, Information required by the computer, Information required by the process, Computer Interface electronics, Digital Computer input-output, computer processing of data, Digital Process control computer design, Computer programming.
Actuators: Electro mechanical - Linear motion and rotary motion solenoids, DC motors, AC motors and Stepped motors.

UNIT-V

Robots: What are robots, Robots and process Control systems, Degrees of freedom, factories of the future, Delivery, Disposal and transport systems, Sensing elements, Robot Classifications and Applications. Trouble shooting System failures: Preliminary steps and other troubleshooting aids.

Text Books:

1. Ronald P. Hunter, "Automated process control systems – concepts and Hardware", 2/e, PHI, 1987.
2. Norman A. Anderson, "Instrumentation for process measurement and Control", 3/e, CRC Press, 2005.

Suggested Reading:

1. Kuo B. C, "Automatic Control Systems", 9th edition
2. A.K Sawhney,"A course on Electrical and Electronic Measurements and Instrumentation".

20EC O06

MEMS AND ITS APPLICATIONS

(Mech)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Course Objectives: Knowledge of sensors is required

This course aims to:

1. Provide knowledge of semiconductors, various materials used for MEMS.
2. Introduce various Electrostatic and Thermal Sensors and Actuators.
3. Educate on the applications of MEMS to various disciplines.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand various materials used for MEMS.
2. Design the micro devices and systems using the MEMS fabrication process.
3. Analyze the operation of different Sensors and Actuators.
4. Interpret the micro devices and systems using Polymer MEMs.
5. Apply different MEMS devices in various disciplines.

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	3	2	2	1	1	-	-	-	-	-	-	1	3	2	1
CO2	3	3	3	3	3	-	2	-	-	-	-	-	3	3	2
CO3	3	3	2	2	2	-	-	-	-	-	-	1	3	3	2
CO4	3	2	2	2	1	-	2	-	-	-	-	1	3	2	1
CO5	3	3	3	2	1	-	-	-	-	-	-	1	3	2	2

UNIT- I

Introduction: The History of MEMS Development, The Intrinsic Characteristics of MEMS: Miniaturization, Microelectronics Integration, Parallel Fabrication with Precision, Devices: Sensors and Actuators- Energy Domains and Transducers, Sensors Considerations, Sensor Noise and Design Complexity: Actuators Considerations.

UNIT- II

Introduction to Micro Fabrication: Overview of Micro fabrication, Overview of Frequently used Micro fabrication Processes: Photolithography, Thin Film Decomposition, Thermal Oxidation of Silicon, Wet Etching, Silicon Anisotropic Etching, Plasma Etching and Reactive Etching, Doping, Wafer Dicing, Wafer Bonding, Microelectronics Fabrication Process Flow, Silicon based MEMS Processes, Packaging and Integration, Process Selection and Design.

UNIT- III

Electrostatic Sensing and Actuation: Introduction to Electrostatic Sensors and Actuators, Parallel: Plate Capacitor, Applications of Parallel Plate Capacitors, Interdigitated Finger Capacitors, Applications of Combo Drive Devices: Inertia Sensors, Actuators. Thermal Sensing and Actuation: Introduction to Thermal Sensors, Thermal Actuators, Fundamentals of Thermal Transfer, Sensors and Actuators Based on Thermal Expansion, Thermal Couples, Thermal Resistors, Applications- Inertia Sensors, Flow Sensors, Infrared Sensors.

UNIT- IV

Piezo resistive Sensors: Origin and Expression of Peizo resistivity, Piezo resistive Sensor Materials: Metal Strain Gauges, Single crystal Silicon, Polycrystalline Silicon, Applications of Piezo resistive Sensors: Inertial sensors, Pressure Sensors, Tactile Sensors, flow Sensors. Piezoelectric Sensors: Introduction, Properties of Piezoelectric Materials, Applications- Inertia Sensors, Acoustic Sensors, Tactile Sensors, Flow Sensors.

UNIT- V

Polymer MEMS: Introduction, Polymers in MEMS- Polyimide, SU-8, Liquid Crystal Polymer (LCP), Representative Applications- Acceleration Sensors, Pressure Sensors, Flow Sensors, Tactile Sensors. Case Studies of Selected MEMS Products: Blood Pressure (BP) Sensor, Microphone, Acceleration Sensor and Gyros.

Text Books:

1. Chang Liu, “Foundations of MEMS”, 2/e, Pearson Education Inc., 2012.
2. Tai Ran Hsu, “MEMS & Micro Systems Design and Manufacture”, Tata McGraw Hill, 2002.

Reference Books:

1. P. Rai Choudary, “MEMS and MEMS Technology and Applications”, PHI publications, 2009.
2. Mohamed Gad-el-Hak, “The MEMS Handbook”, CRC press, 2001.

20EC O07

NEURAL NETWORKS AND FUZZY LOGIC

(IT)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Probability knowledge is required

Objectives:

This course aims to:

1. Learn various types of neural networks
2. Learn the concepts of Fuzzy systems
3. Study the applications of neural networks and Fuzzy controllers.

Course Outcomes:

Upon completion of this course, students will be able to:

1. Understand the principles of Neural Networks and Fuzzy Logic fundamentals.
2. Apply the basic concepts to model the Neural Networks and Fuzzy Logic systems.
3. Compare the Neural Network based systems and Fuzzy Logic based systems.
4. Analyze Fuzzy Logic controllers and its applications.
5. Explain the concepts of Fuzzy target tracing control systems.

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	1	1	1	1	1	-	-	-	-	-	-	2	2	1	1
CO2	3	3	2	2	1	-	-	-	-	-	-	2	3	1	1
CO3	2	2	2	1	1	-	-	-	-	-	-	1	2	1	1
CO4	2	2	3	2	1	-	-	-	-	-	-	2	3	1	1
CO5	1	1	2	1	2	-	-	-	-	-	-	1	2	1	1

UNIT-I

Introduction: Introduction to ANS (Artificial Neural systems) Technology, ANS simulation, Types of Neural Networks: Hopfield, perceptron and related models, Adaline and Madaline: Adaline and the Adaptive Linear Combiner, the Madaline and simulating the Adaline.

UNIT-II

Probabilistic Models, Fuzzy ARTMAP and Recurrent Networks:Probabilistic Neural Networks, General Regression Neural Networks, Fuzzy ARTMAP, Recurrent Back propagation Neural Networks.

UNIT-III

Application of Neural Networks: - Design and optimization of Systems: Non-Linear optimization, Inverse design problems, Pattern Recognition Applications: Control Chart pattern Recognition, Recognition of Machine-Cells in a group technology layout. Complex pattern Recognition tasks: Pattern mapping, pattern variability.

UNIT-IV

Introduction to Fuzzy systems, Fuzzy sets and operations on Fuzzy sets, Basics of Fuzzy relations, Fuzzy measures, Fuzzy integrals, Transform Image coding with Adaptive Fuzzy systems.

UNIT-V

Fuzzy Target Tracking control systems, Fuzzy and Math Model Controllers, Real Time Target Tracking, Fuzzy Controller, Fuzzified CMAC and RBF – Network based self-learning Controllers.

Text Books:

1. James A. Freeman and David M. Skapura, "Neural Networks: Algorithms Applications and Programing Techniques", Pearson Education, India, 2008.
2. James A. Anderson, "An introduction to Neural Networks", PHI, 2003.

Suggested Readings:

1. B. Yegnanarayana, "Artificial Neural Networks", PHI Publications, India, 2006.
2. M.AnandaRao and J.Srinivas, "Neural Networks:Algorithms and Applications", Narosa Publications, 2009

20EC O08

FUNDAMENTALS OF BIOMEDICAL SIGNAL PROCESSING

(Bio-Tech)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Knowledge about human body and signals concepts are required

Course Objectives:

1. Understand the physiological systems, present in the human body.
2. Understand the signal processing techniques used for ECG and EEG.
3. Understand the concept of BCI

Course Outcomes: The student will be able to:

1. Describe the physiological, physical, and chemical background of the most common bioelectrical phenomena.
2. Implement signal processing techniques on biomedical signals.
3. Adapt various detection techniques to identify ECG parameters
4. Assess various Signal Processing techniques for analysis of EEG
5. Understand the signal processing steps involved in Brain-Computer Interface.

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS01	PSO2	PSO3
CO1	2	2	2	2	1	2	-	-	1	1	-	2	3	2	2
CO2	2	3	3	3	1	2	-	-	1	1	-	2	3	2	2
CO3	2	3	3	3	2	2	-	-	1	1	-	2	3	3	2
CO4	2	3	3	3	3	2	-	-	1	1	-	2	3	3	2
CO5	2	3	3	3	3	2	-	-	1	1	-	2	3	3	2

UNIT-1: **Biomedical Signals and Acquisition**

Introduction to bio-signals: Cell structure. Origin of bioelectric potentials. Biomedical signals. The Brain and its potentials. Electrophysiological origin of brain waves. EEG signal and its characteristics. ECG signal origin and characteristics. Normal and abnormal ECG. **Data Acquisition:** Sampling in time, aliasing, interpolation, and quantization.

UNIT-2: Digital Signal Processing Techniques

Signal processing: Review of Discrete-time signals and systems – LTI systems – Response of LTI systems. Basic properties of discrete-time systems, Convolution, **Transform analysis of LTI system**: DTFT, DFT, STFT – Introduction to wavelets – CWT and DWT with Haar wavelet. **Noise cancellation:** Types of noise in bio-signals; Digital filters – IIR and FIR – Notch filters – the cancellation of 50 Hz signal in ECG.

UNIT-3: Cardiological Signal Processing

ECG Filtering and Frequency Analysis. Filter design for noise removal. ECG parameters and their estimation. Normal and Abnormal ECG. Arrhythmia analysis monitoring.

ECG data compression techniques: AZTEC, CORTES, TPA

UNIT-4: Neurological and allied signal processing

Detection and analysis of EEG rhythms. Parametric modeling, Detection of Spindles and spikes. Sleep stage identification. Linear prediction theory; Autoregressive (AR) method; Recursive estimation of AR parameters.

UNIT-5: Brain-Computer Interface (BCI)

Signal modalities in BCIs, Generic setup for a BCI, Feature extraction, and Feature translation involved in BCIs. Different types of BCI techniques. EEG/ECG Based BCI, Spikes Based BCI. Systems Engineering in BCI.

Text books:

1. *John G. Webster, "*Medical Instrumentation: Application and Design" Wiley, 4/e, 2015.
2. Wai Yie Leong, "EEG Signal Processing: Feature Extraction, Selection, and Classification Methods", Institution of Engineering & Technology, 2019.
3. Willis J.Tompkins, "Biomedical Digital Signal Processing", Prentice-Hall of India Pvt. Ltd., 2012.

Suggested Reading:

1. D.C. Reddy, "Biomedical Signal Processing: Principles and Techniques" McGraw Hill, 2005.
2. Monson H.Hayes, "Statistical Digital Signal Processing and Modeling", Wiley-India, 2009.
3. Jonathan Wolpaw and Elizabeth Winter Wolpaw, "Brain-Computer Interfaces: Principles and Practice", Oxford University Press, 2012.

20EC O09

PRINCIPLES OF VLSI
(IT)

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: Basic Electronics and Digital Logic Fundamentals are required

Course Objectives:

1. To study various characteristics of MOS transistor.
2. To learn various concepts required to obtain the digital logic layout diagrams.
3. To learn various memory design concepts.
4. To study various VLSI Fabrication process steps.

Course Outcomes:

The student will be able to

1. Understand characteristic behavior of MOSFET
2. Describe various MOS layers and layout design rules.
3. Implement various CMOS logic circuits.
4. Design various MOS memories.
5. Understand the concepts of VLSI technology.

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	-	-	-	-	-	-	-	2	1	1	1
CO2	1	1	2	1	-	-	1	1	-	-	-	2	2	2	2
CO3	1	2	1	1	1	-	1	1	-	-	-	2	2	2	2
CO4	1	2	1	-	1	-	1	1	-	-	-	2	2	2	1
CO5	-	1	-	1	-	-	-	1	-	-	-	2	1	1	1

UNIT – I

Introduction to MOS Technology: Basic MOS Transistor action. Enhancement and Depletion Modes. Basic electrical properties of MOS. Threshold voltage and Body Effect.

UNIT-II

MOS and CMOS circuit Design Process: N-Well, P-Well and Twin-Tub process. MOS Layers, Stick diagrams, Lambda based Design rules and Layout diagrams.

UNIT – III

CMOS Design: Design of MOS inverters with different loads. Basic Logic Gates with CMOS: INVERTER, NAND, NOR, AOI and OAI gates. Transmission gate logic circuits, BiCMOS inverter, D flip flop using Transmission gates.

UNIT – IV

Memories: Design of Dynamic Register Element, 3T, 1T Dynamic RAM Cell, 6T Static RAM Cell. NOR and NAND based ROM Memory Design.

UNIT-V

Introduction to VLSI Technology and Fabrication Process: Various layers of IC, Wafer preparation and crystal growth, Oxidation, CVD, Lithography, Etching, Ion implantation, Diffusion techniques.

Text Books:

1. Kamran Eshraghian, Douglas A. Pucknell, SholehEshraghian, "Essentials of VLSI circuits and systems", PHI, 2011.
2. Neil H E Weste, David Harris, Ayan Banerjee "CMOC VLSI Design –A circuit and System Perspective", 3/e, Pearson Education, 2006.
3. J.D.Plummer, M.D.Deal and P.B.Griffin, "The Silicon VLSI Technology Fundamentals", Practice and modeling, Pearson Education 2009.

Suggested Reading:

1. John P. Uyemura, "Introduction to VLSI Circuits and systems", John Wiley & Sons, 2011.
2. Simon Sze" VlSI Technology, 2/E", McGraw-Hill Education (India) Pvt Limited-2003

20ECO10

FUNDAMENTALS OF WIRELESS COMMUNICATIONS

(CSE, CSE-AI&ML, CSE-IoT&CS including BCT**)**

Instruction	3 L Hours per week
Duration of SEE	3 Hours
SEE	60 Marks
CIE	40 Marks
Credits	3

Prerequisite: A course on basics of electronics is required

Course Objectives:

1. To familiarize the concepts related to cellular communication and its capacity.
2. To teach students the fundamentals of propagation models and multipath fading.
3. To describe diversity schemes applied in wireless communication and understand the latest Wireless technologies

Course Outcomes:

1. Understand the overview of Wireless Communication.
2. Relate the cellular concepts like frequency reuse, hand off, coverage and capacity.
3. Analyse the mobile radio propagation with large scale and small scale fading.
4. Select the suitable diversity technique to combat the multipath fading effects.
5. Compare the multiple access techniques and apply to wireless standards

Course Articulation Matrix:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	-	1	-	-	-	-	1	1	2	1
CO2	2	1	1	2	1	-	1	-	-	-	-	1	2	2	1
CO3	2	2	1	2	2	-	2	-	-	-	-	1	2	1	1
CO4	2	1	1	1	1	1	1	-	-	2	-	2	1	1	1
CO5	2	1	1	1	1	1	1	-	-	1	-	1	1	1	1

UNIT-I

An overview of wireless communications: Roadmap of cellular communications. First-Generation systems. Second-Generation systems. Third-Generation systems, Fourth-Generation systems and Fifth-Generation Systems.

UNIT-II

The Cellular Concept-System Design Fundamentals: Introduction, Frequency Reuse, Channel Assignment Strategies. Handoff Strategies. Interference and System Capacity. Power Control for Reducing Interference.

UNIT-III

Mobile Radio Propagation: Large-Scale Path Loss, Introduction to Radio Wave Propagation, Free Space Propagation Model, the Three Basic Propagation Mechanisms, **Small-Scale Fading and Multipath:** Small-Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Types of Small-Scale Fading.

UNIT-IV

Diversity Techniques: Practical Space Diversity Considerations- Selection Diversity, Feedback or Scanning, Maximal Ratio Combining Diversity Equal Gain Combining. **Orthogonal frequency division multiplexing:** Introduction, Principle of OFDM. OFDM transceivers Cyclic prefix, Spectrum of OFDM, Fading mitigation in OFDM. Intercarrier interference.

UNIT-V

Multiple access techniques: Duplexing: FDD versus TDD. FDMA. TDMA. CDMA . OFDMA. SDMA
Wireless Standards: Global System for Mobile (GSM). GSM Services and Features, GSM System Architecture, GSM Radio Subsystem. GPRS and EDGE- features.

TEXT BOOKs:

1. Theodore S. Rappaport - Wireless Communications Principles and Practice, 2nd Edition, Pearson Education, 2003.
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, First Edition, 2005.
3. Ke-Lin Du, Concordia University, Montréal,M. N. S. Swamy- Wireless Communication Systems.From RF Subsystems to 4G Enabling Technologies. April 2010

REFERENCE BOOKS:

1. Sanjay Kumar, "Wireless Communication the Fundamental and Advanced Concepts" River Publishers, Denmark, 2015
2. Andreas F.Molisch - Wireless Communications John Wiley, 2nd Edition, 2006.
3 Wireless Communications and Networking, Vijay Garg, Elsevier Publications, 2007.