ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati

Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH

INSTRUMENTATION ENGINEERING

6th SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati
Course Structure

(From Academic Session 2018-19 onwards)

B.Tech 6th Semester: Instrumentation Engineering

Semester VI/ B.TECH/IE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	IE181601	Optical Instrumentation	3	1	0	4	30	70
2	IE181602	Modern Analytical Instrumentation	3	0	0	3	30	70
3	IE181603	Biomedical Instrumentation	3	0	0	3	30	70
4	IE1816PE2*	Program Elective-2	3	0	0	3	30	70
5	IE1816OE2*	Open Elective-2	3	0	0	3	30	70
6	HS181606	Accountancy	2	0	0	2	30	70
Practical								
1	IE181614	Instrumentation Lab-III	0	0	2	1	15	35
2	EE181614	Electronics Design Lab	0	1	4	3	15	35
TOTAL			**17**	**2**	**6**	**22**	**210**	**490**
Total Contact Hours per week: 25								
Total Credits: 22								

N.B. 4-6 weeks Mandatory Industry Internship need to be done in the 6th semester break and the report is to be submitted and evaluated in 7th semester

PROGRAM ELECTIVE–2 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	IE1816PE21	Introduction to Robotics
2	IE1816PE22	Fluid Power and Control
3	EE1816PE22	Embedded System
4	IE1816PE2*	Any other subject offered from time to time with the approval of the University

OPEN ELECTIVE–2 SUBJECTS		
Sl. No	**Subject Code**	**Subject**
1	IE1816OE21	Introduction to Internet of Things
2	IE1816OE22	Principles of Analog Communication Engineering
3	IE1816OE2*	Any other subject offered from time to time with the approval of the University

Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
IE181601	**Optical Instrumentation**	**3-1-0**	**4**

COURSE OUTCOMES (COs):

CO1. Detail study about the basic concept and application of optical fibers and different modes of propagation of light through optical fiber
CO2. Gain knowledge of different types of optical sensors and their application in the practical fields like industries
CO3. To get an idea about the working of Lasers and various optical devices and instruments like microscopes, directional couplers, Charged coupled devices, etc.
CO4. To apply the knowledge gained in final year projects on Instrumentation Engineering particularly in the field of optical communication

MODULE 1: Optical Fiber **(8 Lectures)**
Introduction, Optical fiber fundamentals, basic principle of fiber-optics, Fiber Materials, Ray Propagation in Step-Index Fibers, Total internal reflection, Ray Propagation in Graded Index Fibers, modes in optical fibers, Theory, Monomode and multi-mode fibers, Attenuation in Optical Fibers – absorption, scattering and bending losses

MODULE 2: Power Launching and Coupling **(4 Lectures)**
Source-to-Fiber Power Launching, Power-coupling calculation, Equilibrium Numerical Aperture, Lensing schemes for coupling Improvement, GRIN lenses

MODULE 3: Fiber-Optic Sensors **(8 Lectures)**
Intensity Modulated Sensors, Phase Modulated Sensors, fiber optic sensors for industrial applications –displacement, pressure, acceleration, force, velocity and flow sensors, fiber optic current and voltage sensors. Fiber-optic Mach-Zehnder Interferometric sensor, Fiber-optic Gyroscope, Spectrally Modulated Sensors, Distributed Fiber Optic Sensors

MODULE 4: Optical Amplifiers **(2 Lectures)**
Semiconductor Optical amplifiers (SOA), Erbium Doped Fiber amplifiers

MODULE 5: Optical Sources **(8 Lectures)**
Light Emitting Diodes (LEDs), LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation of an LED. LASER diodes: Principle of Operation, Spontaneous, stimulated emissions and absorptions, Einstein's assumptions, population inversion, 3-level, 4-level – metastable state, block diagram- power supply, pumps, active medium- gain, resonant cavity-types, modes, characteristics of laser radiation, structure of gas and solid state lasers, pulse mode laser, Q-switched laser, semiconductor laser, Laser modes – Q-switching, frequency doubling, laser application – distance measurement, laser Doppler velocimeter, welding, cutting, machining

MODULE 6: Optical Instruments (6 Lectures)

Optical data processing fundamentals, characteristics of charged coupled devices. Opto-couplers and their applications in analog and digital devices, – microscopes, binocular, stereoscope, polarization and phase contrast microscope

MODULE 7: Holography (4 Lectures)

Holographic data systems, photographic systems, holography, holographic interferometry

Textbooks/Reference Books:

1. Optics: Ghatak, TMH
2. Opto-electronics: An Introduction – Wolf and Smith, PHL
3. An Introduction to Fibre Optics – Shotwell; PHI (EEE)
4. Optical Fiber Communication by Gerd Keiser, McGraw Hill International Edition
5. Fiber Optics and Opto electronics by R. P. Khare, Oxford University Press
6. Optical Fiber Communications Principles and Practice by John M. Senior, Pearson Education
7. Optoelectronics and Fiber Optics Communication by C.K.Sarkar and D.C Sarkar, New Age International

Course Code	Course Title	Hours per week L-T-P	Credit C
IE181602	**Modern Analytical Instrumentation**	**3-0-0**	**3**

COURSE OUTCOMES (COs):

After the successful completion of the course students should be able to:

CO1. Explain various sampling techniques of liquid and gases; compare different gas analyzer and chromatographs

CO2. Estimate the content of hydrocarbons, carbon mono oxide and other harmful gases to check the extent of air pollution. Rate various measurement techniques of pH and analytical instruments used in these techniques

CO3. Explain various non-contact type measurement techniques, especially radioactive technique and justify their application in level and thickness measurement

CO4. Classify online and offline measurement techniques of various parameters and discuss their advantages and disadvantages

CO5. Analyze different techniques of spectrometry to find the composition of substance, their molecular structure etc. and discuss the advantages and disadvantages of these techniques

MODULE 1: Colorimetry and Spectrophotometry (8 Lectures)

Special methods of analysis – Beer-Lambert law – Colorimeters – UV-Vis spectrophotometers –Single and double beam instruments – Sources and detectors – IR spectrophotometers – Types–Attenuated total reflectance flame photometers – Atomic absorption spectrophotometers – Sources and detectors – FTIR spectrophotometers
– Flame emission photometers

MODULE 2: Chromatography (5 Lectures)

Different techniques – Gas chromatography – Detectors – Liquid chromatographs – Applications – High-pressure liquid chromatographs – Applications

MODULE 3: Industrial Gas Analyzers and Pollution Monitoring Instruments (7 Lectures)

Types of gas analyzers – Oxygen, NO2 and H2S types, IR analyzers – Thermal conductivity analyzers – Analysis based on ionization of gases – Air pollution due to carbon monoxide, hydrocarbons – Nitrogen oxides – Sulphur-dioxide estimation – Dust and smoke measurements

MODULE 4: pH Meters and Dissolved Component Analyzers (5 Lectures)

Principle of pH measurement – Glass electrodes – Hydrogen electrodes – Reference electrodes, selective ion electrodes and ammonia electrodes – Biosensors – Dissolved oxygen analyzer –Sodium analyzer – Silicon analyzer

Module 5: Radio Chemical and Magnetic Resonance Techniques (8 Lectures)

Nuclear radiations – Detectors – GM counter – Proportional counter – Solid state detectors –Gamma cameras – X-ray spectroscopy – Detectors – Diffractometers – Absorption meters –Detectors – NMR – Basic principles – NMR spectrometer – Applications – Mass spectrometers –Different types – Applications

Textbooks/Reference Books:

1. R.S. Khandpur, “Handbook of Analytical Instruments”, Tata McGraw Hill.
2. H.H. Willard, L.L. Merritt, J.A. Dean, and F.A. Settle, “Instrumental Methods of Analysis”, CBS Publishing and Distribution.
3. R. D. Braun, “Introduction to Instrumental Analysis”, McGraw Hill.
4. G.W. Ewing, “Instrumental Methods of Analysis”, McGraw Hill.
5. D.A. Skoog, and D.M. West, “Principles of Instrumental Analysis”, Saunders Publishing.
6. C.K. Mann, T.J. Vickers and W.H. Gullick, “Instrumental Analysis”, Harper and Row Publishers.

Course Code	Course Title	Hours per week L-T-P	Credit C
IE181603	Biomedical Instrumentation	3-0-0	3

COURSE OUTCOMES (COs):

After the successful completion of the course students should be able to:

CO1. Analyze the human body- its anatomy and physiology, its response when interfaced to various instruments

CO2. Explain the origin of bioelectric potentials, their measurement, significance of their measurements, various instruments used to measure them, problems encountered when measuring them

CO3. Distinguish between invasive and non-invasive measurements-their advantages and disadvantages and justify their application according to the situation

CO4. Design the lay-out of hospitals and justify the position of placements of various equipment according to the requirements. The students will also be able to explain various therapeutic equipment used in different ailments

CO5. Categorize different medical imaging techniques and justify their use as per their requirements. The students will also be able to compare different image enhancement techniques use to enhance the image

MODULE 1: Physiological Systems and Signals (4 Lectures)

Biology of the heart, circulatory and respiratory systems, auditory systems, physiology of nerve and muscle cells, fundamental organization of brain and spinal cord

MODULE 2: Bio Signals (2 Lectures)

Origin of bioelectric signals, electrocardiogram (ECG), phonocardiogram (PCG), encephalogram (EEG) and electromyogram (EMG), spectral characteristic of bio signals

MODULE 3: Electrodes and Transducers (5 Lectures)

Electrodes: silver-silver chloride electrodes, electrodes for ECG, EEG, EMG, Microelectrodes.
Different types of transducers and their selection for Bio medical applications. Ion-exchange membrane electrodes, enzyme electrode, glucose sensors, immune-sensors

MODULE 4: Recording Systems (5 Lectures)

Preamplifier, Signal conditioning: Differential amplifier, current to voltage converter, instrumentation amplifier; biomedical filters: LPF, HPF, bandpass, band stop (Notch filter); source of noise in low level measurement, recording systems for ECG, PCG, EEG and EMG

MODULE 5: Instrumentation for Clinical Laboratory (4 Lectures)

Measurement of pH value of blood, ESR measurement, Hemoglobin measurement, oxygen and carbon dioxide concentration in blood, GSR measurement, polarographic measurement, computer applications

MODULE 6: Medical Imaging Systems (4 Lectures)

X-ray imaging, Computed tomography, ultrasonic imaging systems, Magnetic resonance imaging system, and thermal imaging systems

MODULE 7: Therapeutic Equipment **(4 Lectures)**

Cardiac pacemaker, cardiac defibrillators, hemodialysis machine, lithotripters, ventilators, bionic ear

MODULE 8: Patient Monitoring Systems **(6 Lectures)**

Intensive cardiac care, bedside and central monitoring systems, patient monitoring through bio-telemetry, implanted transmitters, telemetering multiple information. Sources of electrical hazards and safety techniques

Textbooks/Reference Books:

1. L. Cromwell, F. J. Weibell, E.A. Pfeeiffer, "Biomedical Instrumentation and Measurement", Pearson Education, 2003
2. R.S. Khandpur, "Handbook of Biomedical Instrumentation", TATA Mc-GRAW HILL
3. J. Enderle, S. Blanchard, J. Bronzino, "Introduction to Biomedical Engineering", Academic Press

Course Code	Course Title	Hours per week L-T-P	Credit
IE1816PE21	**Introduction to Robotics**	**3-0-0**	**3**

Course Objective: This course aims to familiarise students with basic terminologies of the robotics sciences and essential knowledge required to get started in the field of Robotics

Course outcome:

After completion of course, students would be able:

CO1: To express his/her views as per terminologies related to Robotics technology

CO2: To apply logic for selection of robotic sub systems and systems

CO3: To analyse basics of principals of robot system integration

MODULE 1: Introduction to Robotics (10 Lectures)

Brief History, Basic Concepts of Robotics such as Definition , Three laws, Elements of Robotic Systems i.e. Robot anatomy, DOF, Link Description, Link to reference frame connections, Denavit-Hartenberg Approach, D-H Parameters, Position Representations, Homogeneous Transformation Matrix, Forward Kinematics. Inverse Kinematics, Geometric and analytical approach, Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc., Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device etc., Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot

MODULE 2: Grippers and Sensors for Robotics (5 Lectures)

Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot

MODULE 3: Drives and Control for Robotics (5 Lectures)

Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control

MODULE 4: Programming and Languages for Robotics (10 Lectures)

Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS

MODULE 5: Related Topics in Robotics (5 Lectures)

Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, New trends & recent updates in robotics

Text Books:

1. S. K. Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)

References:

1. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006)

2. Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019)
3. S. B. Niku, Introduction to Robotics – Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
4. J. Angeles, Fundamentals of Robotic Mechanical Systems Theory Methods and Algorithms, Springer (1997)
5. Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dutta, Industrial Robotics 2nd edition, SIE, McGraw Hill Education (India) Pvt Ltd (2012)
6. R. D. Klafter, Thomas A. Chmielewski, and Mechael Negin, Robotic Engineering – An Integrated Approach, EEE, Prentice Hall India, Pearson Education Inc. (2009)

Course Code	Course Title	Hours per week L-T-P	Credit C
IE1816PE22	**Fluid Power and Control**	**3-0-0**	**3**

MODULE 1: Hydraulic Components (8 Lectures)

Introduction to fluid power system-Pascal's Law-Hydraulic fluids-Hydraulic pumps-Gear, Vane and Piston pumps-Pump Performance-Characteristics and Selection-actuators-valves-pressure control-flow control and direction control valves-Hydraulic accessories-Hydraulic Accumulator. Hydraulic actuators, control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and design

MODULE 2: Pneumatic Components (6 Lectures)

Introduction to Pneumatics-Compressors-types-Air treatment-FRL unit-Air dryer-Control valves-Logic valves-Time delay valve and quick exhaust valve-Pneumatic Sensors–types-characteristics and applications

MODULE 3: Fluid Power Circuits (6 Lectures)

Circuit Design Methodology-Sequencing circuits-Overlapping signals-Cascade method-KV Map method-Industrial Hydraulic circuits-Double pump circuits-Speed control Circuits-Regenerative circuits-Safety circuits-Synchronizing circuits-Accumulator circuits

MODULE 4: Electro-Pnuematics and Hydraulics (4 Lectures)

Relay, Switches-Solenoid-Solenoid operated valves-Timer-Counter-Servo and proportional control-Microcontroller and PLC based control-Design of electro-pneumatic and hydraulic circuits

MODULE 5: Application, Maintenance and Trouble Shooting (8 Lectures)

Development of hydraulic / pneumatic circuits applied to machine tools-Presses-Material handling systems-Automotive systems-Packaging industries-Manufacturing automation-Maintenance and trouble shooting of Fluid Power circuits-Safety aspects involved

TEXT BOOKS:

1. Anthony "Esposito, Fluid Power with applications", Prentice Hall international–1997
2. Majumdar.S.R, "Oil Hydraulics", Tata McGraw Hill, 2002
3. Majumdar S.R, "Pneumatic systems-principles and maintenance", Tata McGraw Hill 1995
4. Werner Deppert, "Kurt Stoll, Pneumatic Application", Vogel verlag–1986

REFERENCES

1. John Pippenger, Tyler "Hicks, Industrial Hydraulics", McGraw Hill International Edition, 1980
2. Andrew Parr, "Hydraulics and pneumatics", Jaico Publishing House, 2003.FESTO, "Fundamentals of Pneumatics", Vol I, II, III

Course Code	Course Title	Hours per week L-T-P	Credit C
EE1816PE22	**Embedded System**	**3-0-0**	**3**

Course Outcomes (COs): After the successful completion of the course student should be able:
CO1: To define the basic concept and function of programmable device and structural arrangement of such device
CO2: To demonstrate the architecture of 8051 with special reference to the instructions available for software development
CO3: To define use of SFRs for vector interrupts for timer and serial data transfer operations
CO4: To apply the knowledge of microcontroller in the development process of embedded system. Such as, key board, display unit and application based interfaced system according to the task of the system
CO5: To apply the knowledge of Advanced Microcontroller for the development of embedded systems

MODULE 1: Introduction (5 Lectures)
Introduction to Programmable device, concept of common BUS, operation of a programmable device, design and realization of a simple programmable device Microcontroller/Microprocessor) with simple instructions like – data transfer, ALU operations, port operation etc. History of Microcontroller and Microprocessor. Difference between Microcontroller and Microprocessor. MPU of different categories- such as Microcontroller-8051, AVR etc, their specific features, advantages

MODULE 2: Microcontroller 8051 (3 Lectures)
Introduction. MCS-51 Architecture. Registers, I/O Ports. Memory organization. Hardware interrupts, Timer and Serial input/out

MODULE 3: Assembly and C Programming of Microcontroller 8051 (10 Lectures)
Instructions- Addressing modes, Arithmetical. Logical. Jumps. Loops and Call etc. Interrupts, Timers/ Counters and Serial Communications

MODULE 4: Application of MCS-51 (10 Lectures)
Interfacing LCD., Key board, principle DAC and ADC-Multi-channel programmable parallel data BUS ADC, Multi-channel programmable SPI base ADC. Basic features of an embedded system used for real-time practical application. Data- logger. Development of instrumentation system for measurement of - light intensity, temperature, pressure, flow, frequency, pulse width, voltage, angular speed etc. Generation of PWM wave. PID controller, analytical instruments such as Sequential control and interlock control

MODULE 5: Introduction to AVR ATmega 8/16/32 (12 Lectures)
Introduction to AVR ATmega 8/16/32, Basic port operation, configuration in-built ADC for sampling analog signal, serial data communication thorough TxD and RxD. fundamental of timer operations and EEPROM data read write operation

Textbooks:

1. Microcontrollers: Theory and Applications – by A V Deshmukh
2. The 8051 Microcontroller and Embedded system using assembly and C. – Md Ali Mazidi, Rolin D. Mc-Kindly and Janice Gillistie.
3. The AVR Microcontroller and Embedded using assembly and C. - Md Ali Mazidi, Sarmad Naimi and Sepehr Naimi

Course Code	Course Title	Hours per week L-T-P	Credit C
IE1816OE21	**Introduction to Internet of Things**	**3-0-0**	**3**

Course outcomes:
On the completion of this course, the students will be able to:
CO1: Understand the concepts and significance of Internet of Things
CO2: Develop in-depth knowledge of data communication
CO3: Make use of basic IoT protocols in communication
CO4: Design IoT based network structure and develop in-depth knowledge of IoT architecture
CO5: Demonstrate basic IoT applications in our daily life and industry

MODULE 1: Basic concepts of IoT (6 Lectures)
Introduction to IoT; Elements of an IoT ecosystem; IoT components: sensor networks, characteristics of measurement systems, front-end electronics: instrumentation amplifier, filtering; Privacy and security issues; Benefits and challenges of IoT

MODULE 2: Data Communications (4 Lectures)
Signal processing, sampling, quantization, digitization; Data transmission, data flow, channelization, modulations; Error detection and correction; OSI model, layers in OSI model

MODULE 3: IoT Protocols (6 Lectures)
Protocols; Communication protocols, medium access control, TCP/IP protocol; Protocol standardization for IoT; Issues with IoT standardization; MQTT and HTTP, publisher and subscriber model; RFID protocols; WSN protocols

MODULE 4: IoT Networking (5 Lectures)
Network structures; Wired and wireless communications for IoT; Switching networks; Machine-to-Machine; Software-defined network

MODULE 5: IoT Architecture (7 Lectures)
Computer architecture: pipeline, RISC and CISC architectures; IoT architecture, IoT stack, IoTivity stack architecture

MODULE 6: Applications of IoT (6 Lectures)
Industrial IoT; SCADA; Smart cities; Smart applications; Case study: agriculture, healthcare, water management

Textbooks/Reference Books:

1. Arshdeep Bahga and Vijay Madisetti, 'Internet of things: a hands-on approach', VPT, 2014.
2. Dieter Uckelmann, Mark Harrison, and Florian Michahelles (Eds), 'Architecting the internet of things', Springer, 2011.
3. Olivier Hersent, David Boswarthick, and Omar Elloumi, 'The internet of things – key applications and protocols', Wiley, 2012.

4. Pethuru Raj and Anupama C. Raman, 'The internet of things: enabling technologies, platforms, and use cases', CRC Press, 2017.
5. Honbo Zhou, 'The internet of things in the cloud: a middleware perspective', CRC Press, 2012.
6. Francis daCosta, 'Rethinking the internet of things: a scalable approach to connecting everything', Apress Publication, 2013.
7. Cuno Pfister, 'Getting started with the internet of things,' O'Reilly Media, 2011.
8. Peter Waher, 'Learning internet of things', Packt Publishing, 2015.

Course Code	Course Title	Hours per week L-T-P	Credit C
IE1816OE22	**Principles of Analog Communication Engineering**	**3-0-0**	**3**

MODULE 1: Introduction **(4 Lectures)**

An over view of communication process-electronic communication; Typical communication channels, Distortion less transmission, Signal transmission through BPF - pre envelope and complex envelope

MODULE 2: Electromagnetic Wave Propagation **(4 Lectures)**

Electromagnetic radiation, Propagation modes of EM waves-ground wave, Sky wave, Space wave, Tropospheric scatter, Extra terrestrial communication, Dipole antenna, Resonant antenna, Non resonant antenna, Marconi and Hertz antenna, Antenna coupling at medium frequencies, Directional high frequency antenna, Microwave antenna, Wide band antenna

MODULE 3: Random Signals and Noise **(6 Lectures)**

Review of probability theory, Random variables, Probability distribution functions & probability density function, Joint probability density function, Gaussian distribution, Raleigh's distribution and exponential distribution, Error function, Random processes, Average and variance of random processes, Source of noise, Noise as a random process, White noise, Noise transmission through LTI system, SNR, Noise temperature, Available power of a noise source, Calculation of rms noise voltage, Noise equivalent resistance of an amplifier, Noise figure

MODULE 4: Carrier Wave Modulation and Detection **(5 Lectures)**

Need for modulation, Amplitude modulation (AM), AM modulators-low level and high level modulation techniques, AM detectors, Superheterodyne reciever principles, ICIC receiver for AM, Frequency modulation (FM) – Narrow Band (NB) FM & Wide Band (WB) FM, FM modulators, FM detectors, Noise in FM systems, Phase modulation, Suppressed Carrier (SC) modulation – Double Side Band (DSB)-SC & Single Side Band (SSB)-SC, Generation and detection of SC modulation system, Phase and frequency error in SC modulation system, Frequency Division Multiplexing (FDM)

MODULE 5: Pulse Modulation **(6 Lectures)**

Nyquist sampling theorem, Pulse modulation systems – Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Phase Modulation (PPM), Aliasing, Natural sampling and flat top sampling, Quantization, Quantization error, Pulse Code Modulation (PCM), Companding, Time Division Multiplexing (TDM), Cross top, Differential PCM, Delta modulation (DM), Adaptive DM

MODULE 6: Digital Data Transmission **(5 Lectures)**

Coherent and Non-coherent Techniques, Base band data transmission & reception, Binary matched filter, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Phase Shift Keying (PSK), Quadrature Phase Shift Keying (QPSK), Differential Phase Shift Keying (DPSK), Quadrature Amplitude Modulation (QAM), Minimum Shift Keying (MSK), Error probability, Gaussian Minimum Shift Keying (GMSK), M-ary Communication, Timing & synchronization

MODULE 7: Information Theory and Coding **(4 Lectures)**

Information content of a signal, Information rate, Shannon's Capacity theorem, Channel capacity, Shannon Limit, Coding: Entropy coding, Error detection & correction codes, Parity check codes, Block codes, Algebraic codes, Convolutional codes

Textbooks/Reference Books:

1. Communication Systems (Analog and Digital) 6th Ed 2012 – Dr Sanjay Sharma, S. K. Kataria & Sons
2. Communication Systems 4thEd 2001 - Simon Haykin, John Wiley & Sons
3. Communication Systems 5thEd 2009 - Simon Haykin, John Wiley & Sons
4. Modern Digital and Analog Communication Systems 4th Ed 2009 - B P Lathi and Zhi Ding, Oxford University Press
5. Communication Systems 1968 - B. P. Lathi, John Wiley & Sons
6. Principles of Communication Systems 4th Ed 2013 - Herbut Taub, Donald L. Schilling, Goutam Saha, McGraw Hill
7. Electronic Communication Systems 4th Ed 1992 - George Kennedy and Bernard Davis, McGraw Hill
8. Analog and Digital Communication Systems 5th Ed 2003 - Martin S. Roden, Discovery Press.
9. Digital Transmission Engineering 2nd Ed 2005 - John B Anderson, John Wiley and Sons

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181606	**Accountancy**	**2-0-0**	**2**

MODULE 1:
Concept and classification of Accounts, Transaction, Double Entry system of Book Keeping, Golden rules of Debit and Credit, Journal- Definition, advantages, Procedure of Journalising, Ledger, advantages, rules regarding Posting, Balancing of Ledger accounts, Trial Balance- Definition, objectives, procedure of preparation

MODULE 2:
Name of Subsidiary Books, Cash Book-definition, advantages, objectives, types of Cash Book, preparation of different types of cash books, Bank Reconciliation Statement, Regions of disagreement between Cash Book with Pass Book balance, preparation of Bank Reconciliation Statement

MODULE 3:
Final Account: Preparation of Trading Account, Profit and Loss Account with adjustments

MODULE 4:
Concept of Capital Expenditure and revenue Expenditure, Bad debts, Provision for Bad and Doubtful debts, Provision for discount on Debtors, Outstanding expenses, Prepaid expenses, Accrued Income

MODULE 5:
Introduction to Depreciation Accounting- Meaning, causes, factors, methods of charging depreciation etc.

Textbooks/Reference Books:

1. Theory and Practice of accountance- KR Das, KM Sinha, KS Pal Choudhury, Dr. A Rahman, PK Pujary
2. Book- Keeping & Accountancy- C Mohan Juneja, J R C Chawla, KK Saksena
3. Double Entry Book- Keeping & Accountancy- JR Batliboi

Course Code	Course Title	Hours per week L-T-P	Credit C
IE181614	**Instrumentation Lab-III**	**0-0-2**	**1**

Experiment No.	Title of the Experiment	Objective of the Experiment
1	PID Temperature Controller	1. To study PID control action 2. Tune the controller to obtain optimum result
2	Stepper motor	1. Understand the working of stepper motor 2. To program the motor to operate in CCW and CW direction with user control speed
3	PLC trainer	1. To study the PLC system and to learn Ladder programming 2. Perform some PLC programming
4	Audiometer	1. Study audiometer 2. Perform Audio testing
5	ECG	1. Study ECG and its placement of probe 2. Perform ECG on subject

Text books:

1. Modern Control Engineering, K Ogata
2. Biomedical Instrumentation, R. S Khandpur and Raghbir Khandpur

Course Code	Course Title	Hours per week L-T-P	Credit C
EE181614	**Electronics Design Lab**	**0-1-4**	**3**

Course Outcomes (COs): After the successful completion of the course student will be able to:
CO1: design electronic systems to meet the requirements of society, academia and industry
CO2: analyze the performance of electronic system after completion of its design
CO3: write technical report after completion and testing of electronic system
[1 (One) mini project or at least 2 (two) advance level design type experiments may be carried out in the following mixed or single categories; One or more quiz tests or class tests may be taken to assess and motivate the students]

Electronics Design Lab should have softwares like MATLAB Simulink, Microsim, Proteus, PSPICE, LABVIEW, Xilinx, VHDL, Verilog HDL; and hardwares like Microprocessor based system development kit, Microcontroller based system development kit, FPGA based system development kit like Xilinx and Vivado

Sl. No.	Title	Topics in the Module	No. of Lectures	No. of Practical hours
1	Microprocessor based design	Develop a microprocessor based system for smart home or industrial control	1	9
2	Microcontroller based design	Develop a microcontroller based system for smart home or industrial control	1	9
3	FPGA based design	Develop a FPGA based system for smart home or industrial control: Use Xilinx system	4	10
4	Testing of designed electronic system	Perform the desired tests and quality checks. Perform market surveys for outsourcing the developed electronic systems. Write technical reports on the developed electronic systems including the feedback from the sites of utility	1	5

Textbooks/ Reference Books:

1. Ramesh S Gaonkar: Microprocessor architecture, programming and applications, Penram International
2. B Ram: Fundamentals of Microprocessors and Microcontrollers, Dhanpat Rai Publications
3. K Udantkus: The 8085 Microprocessor and Programming and Interfacing, Pearson Education
4. Wayne Wolf: FPGA-Based System Design, Prentice Hall

5. Cem Unsalan, Bora Tar: Digital System Design with FPGA Implementation Using Verilog and VHDL, McGraw-Hill
6. Samir Palnitkar: Verilog Hdl, Pearson
7. B. Bala Tripura Sundari, T. R. Padmanabhan: Design through Verilog HDL, Wiley
8. Louise H. Crockett, Ross A. Elliot, Martin A. Enderwitz , Robert W. Stewart: The Zynq Book: Embedded Processing with the ARM Cortex-A9 on the Xilinx Zynq-7000 All Programmable SoC, Strathclyde Academic Media Publication
9. Sanjay Churiwala: Designing with Xilinx® FPGAs: Using Vivado, Springer
10. Xilinx Inc: Xilinx Student Edition 2.1i Software, Pearson
11. Alexander G. Dean: Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach, ARM Education Media

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