ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
GUWAHATI

Course Structure and Syllabus
(From Academic Session 2018-19 onwards)

B.TECH
INSTRUMENTATION ENGINEERING

5TH SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Course Structure

(From Academic Session 2018-19 onwards)
B.Tech 5th Semester: Instrumentation Engineering
Semester V/ B.TECH/IE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	IE181501	Process Control	3	0	0	3	30	70
2	IE181502	OOP and Data Structures with C++	3	0	0	3	30	70
3	EI181503	Microprocessors	3	0	0	3	30	70
4	IE1815PE1*	Program Elective-1	3	0	0	3	30	70
5	IE1815OE1*	Open Elective-1	3	0	0	3	30	70
6	HS181506	Engineering Economics	3	0	0	3	30	70
Practical								
1	IE181512	OOP and Data Structures with C++ Lab	0	0	2	1	15	35
2	EI181513	Microprocessors Lab	0	0	2	1	15	35
3	SI181521	Internship-II (SAI – Academia)	0	0	0	1	-	100
TOTAL			**18**	**0**	**4**	**21**	**210**	**590**
Total Contact Hours per week : 22								
Total Credits: 21								

PROGRAMME ELECTIVES-1 SUBJECTS

Sl No.	Subject Code	Subject
1	IE1815PE11	Electronic Instruments
2	EI1815PE11	Advanced Control System
3	IE1815PE13	Introduction to MEMS
4	IE1815PE1*	Any other subject offered from time to time with the approval of the University

OPEN ELECTIVES-1 SUBJECTS

Sl No.	Subject Code	Subject
1	EI1815OE13	Digital Signal Processing
2	IE1815OE1*	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
IE181501	**Process Control**	**3-0-0**	**3**

Course Outcomes (COs):

On Completion of this course the students should be able to

CO1: Develop Mathematical modelling of various physical systems.
CO2: Analyse transient response of different control systems.
CO3: Apply control actions e.g. P, PI, PD and PID in process control.
CO4: Illustrate different controller tuning methods.

MODULE 1: Introduction

Definition of process & process control systems; Objectives & requirements; Classification & selection of process variables; Sources &nature of disturbances; hardware elements of process control systems, Block diagram reduction for MIMO system.

MODULE 2: Modelling of Physical Systems

Mathematical model of physical systems-liquid level system, thermal system, mixing process, CSTR, pressure system, flow system etc. interacting and non-interacting systems, RLC elements in process, linerization of nonlinear systems.

MODULE 3: Transient Response Analysis

Response of first and second systems due to load change at arbitrary points with P, I, P-I and P-I-D controllers; transient response specifications, effect of time delay and measurement lag on system response.

MODULE 4: Control Action and Controllers

On-Off, P, I, D, PI, PD and PID control actions, electronic controllers

MODULE 5: Design of Feed Back Controllers

Selection criterion for type of controllers, controller tuning-process reaction curve, Zeigler-Nichol's method, Cohen and Coon method and frequency domain method.

Textbooks/Reference Books:

1. Stephinopoulos G- Chemical process control (PHI).
2. Pollard A –Process control.
3. Coughanowr – Process System Analysis and Control (MH).
4. Hariot P-Process Control (TMH).
5. Johnson-Process Control Instrumentation Technology (JW).

Course Code	Course Title	Hours per week L-T-P	Credit C
IE181502	**OOP and Data Structures with C++**	**3-0-0**	**3**

Course Outcomes (COs):

CO1: To explain representation and operations on linear data structures.

CO2: To explain representation and operations on non-linear data structures.

CO3: To list the underlying concepts of object oriented programming.

CO4: To demonstrate C++ language features like classes, inheritance, access control, abstract class, operator overloading, virtual function, friend function, streams and pointers by writing example programs.

CO5: To build C++ programs for implementation of data structures.

MODULE 1:

Object Oriented Programming, Features of object oriented programming languages like data encapsulation, inheritance, polymorphism and late binding

MODULE 2:

Concept of a class, Access control of members of a class, instantiating a class, static and non-static members, overloading a method.

Deriving a class from another class, access control of members under derivation, different ways of class derivation, overriding of a method, run time polymorphism.

Concept of an abstract class. Concept of an interface, Implementation of an interface, Exception and exception handling mechanisms, Introduction to streams, use of stream classes, Serialization and de-serialization of objects

MODULE 3:

Data structures- definition, representation and operations on linear data structures like linear list, array, stack, queue, singly linked circular and non-circular lists, doubly linked circular and non-circular lists, double ended queue, priority queue; representation and operations on non-linear data structures like graph, tree, binary search tree, spanning tree; implementation of linear and non-linear data structures by writing C++ programs

Textbooks/Reference Books:

1. Bjane Strostrup, ―The C++ programming language‖, Addison-Wesley
2. Herbert Shildt, ―C++: The Complete Reference‖, 4th Edition
3. Matt Weisfeld, ―The Object-Oriented Thought Process‖, Pearson
4. J. P. Tremblay and P. G. Sorenson, "An Introduction to Data Structures with applications", Second Edition, Tata McGraw Hill, 1981
5. Sartaj Sahni, “Data Structures, Algorithms and Applications in C++”, Universities Press (I) Pvt. Ltd
6. Yedidyah Langsam, Moshe J. Augenstein, Aron m. Tenendaum, “Data Structures using Cand C++”, second edition, Pearson

Course Code	Course Title	Hours per week L-T-P	Credit C
EI181503	**Microprocessors**	**3-0-0**	**3**

Prerequisites:

- Analogue Electronics, Digital Electronics.

Course Outcomes (COs):

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

CO1: To define the basic concept of programmable device and structural arrangement of 8085 and its instructions.

CO2: Develop the general idea for interfacing memory devices and I/O devices to ensure unique address for each device.

CO3: To develop the basic concepts of PPIs and their operational concepts, and apply this knowledge in different engineering applications.

CO4: Develop assembly and machine language microprocessor programs for utilization in societal, academic and industrial purposes.

CO5: To demonstrate the basic evolutionary process leading to the development of microprocessor based system for a few practical applications.

MODULE 1: Microprocessor Architecture (6 Lectures)

Introduction to the microprocessor- Introduction to tri-state device- register, ALU, counter etc. Basic concepts of programmable device – Bus organization, system components etc. Block diagram of μP 0885- data bus, address bus, timing and control section, registers, etc

MODULE 2: Interfacing Memory Devices and I/O Devices (4 Lectures)

System BUS representation, Address space and its portioning; address decoding, memory and I/O mapping and management.

MODULE 3: Programming Microprocessors (12 Lectures)

Data representation, instruction formats, addressing modes, Instruction set, software design, assembly language programming, program looping, subroutine linkage - uses of stack and stack pointer, push pop operation etc. Assembly and code language programming with examples, timing diagram of instructions

MODULE 4: Support PPIs (12 Lectures)

PPIs - 8255, 8253 and 8279; their functional block diagram, operational modes and configuration of the device in different mode of operations, assembly language program for using the PPIs in application purposes. Such as, data transfer, counter operation and display data in seven segment LED display units and data to read data through key board respectively.

MODULE 5: Application of μP based system (6 Lectures)

Microprocessor based instrumentation system for measurement of physical parameters, such as- temperature, light intensity, smoke, moisture content etc. Operation electro-magnetic and static relay for switching operation. A traffic light control, speed controller of de motor etc.

Textbooks/Reference Books:

1. Microprocessor architecture, programming and applications—Ramesh S Gaonakar –Penram International (T1)
2. Fundamentals of Microprocessors and Microcontrollers—B Ram—Dhanpat Rai Publications (T2)
3. The 8085 Microprocessor and Programming and Interfacing—K Udantkus—Pearson Education (T3)

Course Code	Course Title	Hours per week L-T-P	Credit C
IE1815PE11	Electronic Instruments	3-0-0	3

Course Outcomes (COs):

CO1: Understand construction and working principle of Digital Electronic instruments for measurement purposes.

CO2: Use Digital Instruments in automation

CO3: Investigate the operation, performance, applications of recorders, signal converters, signal generator.

CO4: Design digital transducers for physical quantities measurement.

MODULE 1: Digital Instrument Basics (10 Lectures)

Revision: Qualities of Measurements, Digital representation of an analog quantity; Basic logic circuits; Digital display; Digital counting; ADC [linear ramp ADC, Digital ramp, Successive approximation

MODULE 2: Digital Voltmeters (5 Lectures)

Ramp type, integrating type [Voltage to time & voltage to frequency conversion]; Resolution, sensitivity, General specifications of a DVM; Range changing.

MODULE 3: Digital Instruments (10 Lectures)

Multimeters, Frequency meters – working, accuracy n applications; Automation in Digital Instruments; Microprocessor based Instruments.

MODULE 4: Miscellaneous Instruments (8 Lectures)

Signal Generators--Basic and Modern Lab types. Working of- Spectrum Analyzers, Distortion meter, True RMS meter, Low level Voltmeter.

MODULE 5: Recorders (8 Lectures)

Objectives & requirements of recording data, working principle and circuit diagrams of Strip-chart & X-Y recorders, Plotting device characteristics on an X-Y recorder. Frequency Modulation recording, Digital data recording, Recorder selection

MODULE 6: Fundamentals of Data Acquisition System (DAS) and Conversion (4 Lectures)

Objective of a DAS; Signal Conditioning of the inputs; Single channel & multi-channel DAS; D/A & A/d Converters.

Textbooks/ Reference Books:

1. A Course in Electrical and Electronic Measurements and Instrumentation 19th Ed 2011 - A. K. Sawhney and Puneet Sawhney, Dhanpat Rai & Sons.
2. A Course in Electrical and Electronic Measurements and Instrumentation 14th Ed 2014 – J. B. Gupta, S. K. Kataria & Sons. 3) Electrical Measurements and Measuring Instruments 2nd Ed 2013 – R. K. Rajput, S. Chand & Co.
3. Electronic Instrumentation and Measurements 3rd Ed 2013 – Davis A. Bell, Oxford University Press
4. Electronic Instrumentation, 3rd Ed 2010 - H. S. Kalsi, McGraw Hill
5. Electrical Measurement and Measuring Instruments 2011 - E.W. Golding and F.C Widdis, Reem Publications Pvt. Ltd.

Course Code	Course Title	Hours per week L-T-P	Credit C
EI1815PE11	**Advanced Control System**	**3-0-0**	**3**

Prerequisites:
Control System

Course Objectives: To provide

- The knowledge of state variable and its application to control system
- Nonlinear control system,
- Discrete control system
- Optimal control system.
- Give the stability of a given discrete control system

MODULE 1: State Space Analysis (10 Lectures)
State Space Representation, Solution of State Equation, State Transition Matrix, Canonical Forms – Controllable Canonical Form, Observable Canonical Form, Jordan Canonical Form. Controllability and Observability: Tests for controllability and observability for continuous time systems – Time varying case, minimum energy control, time invariant case, Principle of Duality, Controllability and observability form Jordan canonical form and other canonical forms.

MODULE 2: Nonlinear Control system (8 Lectures)
Introduction to nonlinear systems, Types of nonlinearities, describing functions, describing function analysis of nonlinear control systems. Phase-Plane Analysis: Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

MODULE 3: Stability Analysis (6 Lectures)
Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems. Modal Control: Effect of state feedback on controllability and observability, Design of State Feedback Control through Pole placement. Full order observer and reduced order observer

MODULE 4: Optimal Control (3 Lectures)
Formulation of optimal control problem. State regulator problem. Output regulator problem. Tracking problem, Continuous-Time Linear Regulators.

MODULE 5: Discrete Time Systems (5 Lectures)
Introduction to discrete – time systems; Z- transform, inverse Z- transformation; solving difference equation by the Z-transform method; pulse- transfer function; stability analysis in the Z- plane.

Textbooks:

1. K. Ogata, Modern Control Engineering, PHI.
2. I.J. Nagarath, M.Gopal, Control Systems Engineering, NAI.
3. D. Roy Choudhury., Modern Control Engineering,PHI
4. B.N.Sarkar., Advanced Control System, PHI

Reference Books:

1. M. Gopal, Modern Control System Theory, New Age International.
2. Stainslaw H. Zak, Systems and Control, Oxford Press.
3. B.C. Kuo., Automatic Control System, PHI

Course Code	Course Title	Hours per week L-T-P	Credit C
IE1815PE13	**Introduction to MEMS**	**3-0-0**	**3**

Course Outcomes (COs):

CO1: Understanding the basic concepts of evaluation of MEMS and fabrication process steps
CO2: Differentiate different types of transduction mechanism for sensor design
CO3: Develop mathematical modelling of basic microactuators and sensors.
CO4: Analyse interfacing techniques and different limitations in design
CO5: Clear understanding of various MEMS Applications

MODULE 1: Introduction to MEMS and Microsystems (4 Lectures)
Scaling of forces to the micro world, MEMS Design and fabrication process, outline- Introduction to microsensors, Evaluation of MEMS, Microsensors, Market Survey.

MODULE 2: Technology and Fabrication (8 Lectures)
MEMS Materials, MEMS Materials properties, Microelectronic Technology for MEMS, Micromachining Technology for MEMS, Micromachining process in detail, Bulk micromachining, Surface micromachining Etch stop techniques and microstructure, Fabrication process steps in detail.

MODULE 3: Mathematical Modeling and MEMS sensor design (10 Lectures)
Classical Mechanics, Newtonian Mechanics, Lagrenges equation of motion, Hamilton Equation of motion, Thermo analysis, MEMS micro sensors Thermal, Micro machined micro sensors mechanical, MEMS Pressure and flow sensor, MEMS Inertial Sensors: accelerometer and gyro sensors, Different types of transduction for inertial MEMS**.**

MODULE 4: Microactuators (8 Lectures)
Electromagnetic and thermal microactuation, Mechanical design of microactuators, Microactuators examples micro valves, micro pumps, micro-motors, microactuator systems, Ink jet printer heads, micro mirror TV projector

MODULE 5: Interface Electronics for MEMS (6 Lectures)
Temperature drift and damping analysis concept, Polymer MEMS and carbon nanotubes CNT, Wafer bonding and packaging of MEMS

MODULE 6: Application of MEMS (2 Lectures)
MEMS for space Application, MEMS for biomedical Applications (Bio-MEMS)

Textbooks/ Reference Books:

1. Micro Electro mechanical systems- Tsu, 2006
2. Micro system Design – Stephen D senturia, Kluwer Academic Publishers, 2001

Course Code	Course Title	Hours per week L-T-P	Credit C
EI1815OE13	**Digital Signal processing**	**3-0-0**	**3**

Prerequisites: Signals and Systems

COURSE OBJECTIVES:

- To teach the basic concepts of Discrete Signals and Digital Signals
- To teach Digital Signal Processing Algorithms.

COURSE OUTCOMES: At the end of this course, the students will be able to

CO1: Represent signals mathematically in continuous and discrete-time, and in the frequency domain
CO2: Analyze discrete-time systems using z-transform.
CO3: Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.
CO4: Design digital filters for various applications.
CO5: Apply digital signal processing for the analysis of real-life signals.

MODULE 1: Discrete-Time Signals and Systems (6 Lectures)
Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

MODULE 2: Z-transform (6 Lectures)
z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using z-transform, Properties of z-transform for causal signals, Interpretation of stability in z-domain, Inverse z-transforms.

MODULE 3: Discrete Fourier Transform (10 Lectures)
Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

MODULE 4: Design of Digital filters (12 Lectures)
Design of FIR Digital filters: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High-pass filters. Effect of finite register length in FIR filter design. Parametric and non-parametric spectral estimation. Introduction to multi-rate signal processing.

MODULE 5: Applications of Digital Signal Processing (6 Lectures)
Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

Textbooks/Reference Books:

1. J. G. Proakis and D.G. Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Prentice Hall,1997.
2. A.V. Oppenheim and R. W. Schafer, "Discrete Time Signal Processing", Prentice Hall,1989.

Course Code	Course Title	Hours per week L-T-P	Credit C
HS181506	**Engineering Economics**	**3-0-0**	**3**

Course Outcomes (COs):

The students will be able to

1. Acquire knowledge about economics its nature, scope and importance.
2. Understand the economic laws, principles, and theories and their relevance in present day situation.
3. Develop the ability of critical thinking to meet the challenges at the national and global problems.
4. Apply knowledge in finding out socio-economic problems and appropriate measures to deal with them.
5. Equip students with vital knowledge to run government and non-government institutions and bodies.
6. Assemble knowledge which is vital for industry and research and evolve proper policy for economic development.

MODULE 1: Introduction To Economics (3 Lectures)

Meaning and Definition of Economics, Nature and Scope of Economics, Concept of Micro and Macro Economics.

MODULE 2: Utility Analysis (3 Lecture)

Meaning of Utility, Utility Function, Consumers Equilibrium, Concept of Indifference Curve, properties of Indifference Curve, Equilibrium under Indifference Curve.

MODULE 3 : Demand and Supply Analysis (4 Lectures)

Law of Demand, Demand Function, Elasticity of Demand, Types of Elasticity of Demand, Measurement of Elasticity of Demand, Demand Forecasting, Law of Supply, Supply Function.

MODULE 4: Revenue, Production & Cost Analysis (4 Lectures)

Average, Marginal and Total Revenue, Revenue Function, Average, Marginal and Total Cost, Cost Function, Short and Long Run Cost Curves. Break Even Point, Managerial Uses of Cost Function, Cobb Douglas Production Function.

MODULE 5: Market Structure (4 Lectures)

Concept of Market, Price-Output Determination under Perfect Competition, Monopoly Market and Monopolistic Competition.

MODULE 6 : Money, Banking and National Income (8 Lectures)

Definition of Money, Function of Money, Index Numbers, Construction of Index Numbers, value of Money, Causes of Inflation, Functions of Commercial and central bank, Central bank and its monetary policy, Money Market and Capital Market, Functions of Stock exchange, Concept of National Income, Measurement of National Income, Concept of Investment.

MODULE 7: Introduction to Environmental Economics (5 Lectures)

Concept of Environmental Economics, Cost -Benefit Analysis, Social Cost, Externalities, Concept of Pareto Equilibrium, Externality, Market Failure.

MODULE 8: Public Finance (3 Lectures)

Introduction to Public Finance, Concept of Budget, Types of Budget, Budget Receipts, Concept of Goods and services Tax (GST)

Textbooks/Reference Books:

1. Managerial Economics by V. Agarwal: Pearson Pvt. Limited, New Delhi.
2. Engineering Economics by Dr. A. Ahmed & G. Begum: Chandra prakash, Guwahati
3. Principles of Engineering Economics with Application by Dr. Z. A. Khan, A. N. Siddiquee, B. Kumar, M. H. Abidi: Cambridge University Press.
4. Public Finance and Public Policy by Dr. R. K Choudhury: Kalayani publishers
5. Quantitative Methods for Economics by R. Veerachamy: New Age International Publication Ltd.
6. Micro and Macro Economics by Dr. M. L. Seth: Educational Publishers, Agra -3
7. A Koutsoyiannis: Modern Microeconomics
8. Environmental Economics by R. N. Bhattacharya: Oxford Publication.

Course Code	Course Title	Hours per week L-T-P	Credit C
IE181512	OOP and Data Structures with C++ Lab	0-0-2	1

Course Outcomes (COs)

CO1: Develop C++ programs for solving problems using inheritance and polymorphism.
CO2: Develop C++ programs that use interfaces for problem solving.
CO3: Develop C++ programs for implementation of data structures using/without using template classes.
CO4: Make use of stream classes for performing input and output and handle exception conditions.
CO5: Interact Effectively on a social & interpersonal level with fellow students to receive clear procedural instructions.
CO6: Share task responsibilities to complete assignments and ethically Develop professional and technically sound reports.

C and C++ Experiments:

1. Write a program to implement the concept call by value & call by reference in C.
2. Write a program to display the mark sheet of N students using concept of array and structures in C.
3. Write a program to multiply two matrices using array of pointers.
4. To write a C++ program to find the sum for the given variables using function with default arguments.
5. To write a C++ program to find the value of a number raised to its power that demonstrates a function using call by value.
6. To write a C++ program and to implement the concept of Call by Address.
7. To write a program in C++ to prepare a student Record using class and object.
8. Write a program to design a class representing complex numbers and having the functionality of performing addition and multiplication of two complex numbers using operator overloading.
9. Write a program for developing a matrix class which can handle integer matrices of different dimensions. Also overload the operator for addition, multiplication and comparison of matrices.
10. To write a C++ program to implement the concept of Function Overloading.
11. To write a C++ program for implementing the inheritance concept.
12. To write a C++ program to implement the concept of Virtual functions.
13. To write a C++ program for sorting elements by bubble sort using function templates.
14. Write a C++ program to print the Fibonacci series.
15. Write a C++ program to find the number of vowels present in the given character array using pointer arithmetic.

Course Code	Course Title	Hours per week L-T-P	Credit C
EI181513	**Microprocessors Lab**	**0-0-2**	**1**

Prerequisites:

- Microprocessor 8085 and applications.

Course Outcomes (COs):
After the successful completion of the course student should be able to:

CO1: To define the basic concept of programmable device and structural arrangement of 8085 and its instructions.

CO2: To define the general idea for interfacing memory devices and I/O devices to ensure unique address for each device

CO3: To define the basic concept of PPIs and their operational aspects.

CO4: To apply the knowledge of PPIs for different engineering applications

CO5: To demonstrate the basic evolutionary process leading to the development of microprocessor based system for a few practical applications

List of Experiments:

Experiment 1: Familiarization of the Microprocessor Kit – (a) editing a program (b) Verifying the program (c) Executing the program and verifying the outcome of the program.
Experiment 2: Developing and testing simple program for data transfer –between memory to Microprocessor or Microprocessor to memory using direct and indirect instructions.
Experiment 3: Write a program to add the data stored in memory location CA00 and CA01. Store the result in memory location CA02, if there is a carry, store 01H in the memory locationCA03, and otherwise store 00H in memory location CA03.
Experiment 4: Developing and test program for transfer block of 100 data from starting location CA00 H to next block having starting location CB00 H
Experiment 5: Developing and test program for to sort a set of data in ascending order stored in memory starting at C050.
Experiment 6: Developing and test program performing addition on two numbers using interrupt RST 7.5 key.
Experiment 7: Develop and test program to blink the LED's interfaced to port A of 8255.
Experiment 8: Develop and test simple program for key board and & segment LED operation using 8279
Experiment 9: Group project to develop traffic light control program using the traffic light control

Note: Laboratory experiments are to be conducted using instruction sheets provided by the instructor.

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