ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY
Guwahati
Course Structure and Syllabus

(From Academic Session 2018-19 onwards)

B.TECH
INSTRUMENTATION ENGINEERING

3rd SEMESTER

ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

Course Structure
(From Academic Session 2018-19 onwards)

B.Tech 3rd Semester: Instrumentation Engineering

Semester III/ B.TECH/IE

Sl. No.	Sub-Code	Subject	Hours per Week			Credit	Marks	
			L	T	P	C	CE	ESE
Theory								
1	MA181301A	Mathematics III-A (for branches other than CSE and ECE/ETE)	2	1	0	3	30	70
2	EI181302	Electrical Circuit Analysis	3	1	0	4	30	70
3	EI181303	Analog Electronics	3	0	0	3	30	70
4	IE181304	Transducers	3	0	0	3	30	70
5	EI181305	Digital Electronics	3	0	0	3	30	70
6	MC181306	Constitution of India	2	0	0	0 (PP/NP)	-	100
Practical								
1	EI181313	Analog Electronics Lab	0	0	2	1	15	35
2	EI181315	Digital Electronics Lab	0	0	2	1	15	35
3	IE181317	Instrumentation Lab-I	0	0	3	1.5	15	35
4	SI181321	Internship-I (SAI - Social)	0	0	0	1	-	100
TOTAL			16	2	7	**20.5**	**195**	**655**
Total Contact Hours per week : 25								
Total Credits: 20.5								

N.B. MC181306 is a Mandatory Audit Course (No Credit). It will be evaluated as PP (Pass) or NP (Not Pass)

Detailed Syllabus:

Course Code	Course Title	Hours per week L-T-P	Credit C
MA181301A	**Mathematics III-A** (for branches other than CSE and ECE/ETE)	**2-1-0**	**3**

MODULE 1: Partial Differential Equation: (15 Hours)
Formation of Partial Differential equations, Linear partial differential equation of first order, Non-linear partial differential equations of first order, Charpit's method, Method of separation of variables, boundary value problem with reference to the one dimensional heat and wave equation.

MODULE 2: Probability Theory: (15 Hours)
Review of basic probability and Bayes' theorem, Probability distribution, Binomial, Poisson and normal distribution, Joint distribution, Test of significance, fitting of straight line by least square method, Elementary concept of Markov Chain.

MODULE 3: Laplace Transform: (10 Hours)
Laplace transform of elementary function, Properties of Laplace transform, inverse Laplace transform, convolution theorem, Solution of ordinary differential equations with the help of Laplace transform.

Textbooks/References:

1. Advanced Engineering Mathematics: Erwin Kreyszig
2. Higher Engineering Mathematics: B V Ramana
3. Theory and problems of Probability: Seymour Lipschutz
4. A text book of engineering Mathematics: N. P. Bali & M. Goel
5. Statistical Methods: An Introductory Text- J.Medhi, New Age International Publishers

Course Code	Course Title	Hours per week L-T-P	Credit C
EI181302	**Electrical Circuit Analysis**	**3-1-0**	**4**

Pre-requisite: Knowledge of basic electrical engineering

Course Objectives:

- To impart the basic knowledge about various elements of electric circuits.
- To inculcate the understanding about application of Network Theorems for solving circuits and modelling circuits using matrix representation.
- To understand network topology, transient phenomenon and two port networks.
- To be able to apply various techniques of networks synthesis from network functions.

Course Outcomes:

At the end of the course, the students will be able to

CO1:
Apply appropriate laws of various circuit elements to develop mathematical models, detailing their constructional features and their applications.

CO2:
Make use of various network theorems to evaluate variety of networks and to model given networks using appropriate matrix representation amenable to various types of network analysis.

CO3:
Model networks using elementary graph theory and to analyse given networks for their transient response.

CO4:
Utilize the concept of two port networks, their characteristics and mode of interconnection to evaluate various networks.

CO5: Synthesize networks from various network functions like admittance and impedance functions.

MODULE 1: Elements of electric circuits: (5 Lectures)
resistor: Practical engineering devices. Solid & wire frame of common resistive materials, carbon film and metal film resistors. Heat dissipating area (wattage), tolerance and temperature stability of resistors. Mathematical models, the capacitor: Comparison of properties of different traditional & modern dielectric materials (e.g. paper, ceramic, polystyrene polycarbonates etc.) Short description of electrolytic capacitor- wet & solid dielectrics, solid tantalum & aluminium capacitors, Mathematical models, the inductors: Mutual inductance, Properties of core materials.

Brief studies of iron & ferrite cores, Mathematical models (only assignments).

MODULE 2: Network theorems: (8 Lectures)
Millman's theorem, Reciprocity theorem, Compensation & Tellegen's, etc. Analysis of coupled circuits. The dot rule & equivalent conductivity coupled forms of magnetically coupled circuits.

MODULE 3: Methods for the solution of circuit equations: (4 Lectures)
Analysis of electrical network with – independent/dependent ideal, practical current voltage and current sources – both of DC and AC. Solution of network equations by matrix methods.

MODULE 4: Network topology: (5 Lectures)
Elementary graph theory as applied to electrical networks. Matrices of graph: Incidence matrix, circuit matrix, cut set matrix. Advanced techniques of equation formulation for numerical solutions.

MODULE 5: Transient phenomenon: (7 Lectures)
Forcing functions-impulse, step and ramp functions Study and solution of simple circuits undergoing transient disturbances, A.C. transients, Time domain equations and solutions by Laplace transforms

MODULE 6: Two port Network: (7 Lectures)
General principles, ABCD, Z, Y and hybrid parameters, Analysis of networks in tandem. Transmission lines. Lumped and distributed models. Combination/Interconnection of two ports network.

MODULE 7: Introduction to Network Synthesis: (9 Lectures)
Realizability of networks, positive real function (PRF) and its properties, Hurwitz polynomial, Routh-Hurwitz Array, properties of various immittance functions (LC, RC, RL), Foster and Caur forms of realization of network for given driving point impedance/admittance function.

Text Books:

1. Basic Electrical Engineering—A Chakravarti, S Nath, C K Chanda, Tata Mcgrawhill, 2017
2. Network Analysis and Synthesis—Smarajit Ghosh,PHI, First Edition
3. Electric Circuit----J.A. Edminiter. (Mcgraw hill)
4. Networks and Systems ---D Roychowdhury, New Age International Publications, 1998
5. A course in Electric Circuit Analysis—Soni & Gupta

Reference Books:

1. Computer aided Network Design—Donald A. Calahan (Tata Mcgraw hill)
2. Engineering Circuit analysis---- W. H. Hayt Jr. & J.E. Kemmerly (Mcgraw hill)
3. Network Analysis---M E Van Valkenburg, PHI, 2006
4. Electric Circuits----C K Alexander and M N O Sadiku, McGraw Hill Education ,2004

Course Code	Course Title	Hours per week L-T-P	Credit C
EI181303	**Analog Electronics**	**3-0-0**	**3**

Course Objectives:

- To teach the basic concept and applications of various analog electronic devices and circuits.
- To develop problem formulation and problem solving ability amongst the students.

Course Outcomes: At the end of this course, the students will be able to

CO1:
Identify and analyze various types of diodes and their applications.

CO2:
Characterize and analyze the performance and applications of BJTs and FETs.

CO3:
Analyze the performance of cascaded amplifiers.

CO4:
Analyze the effects of Negative and Positive Feedback on amplifiers.

CO5:
Analyze and design basic OPAMP applications.

MODULE 1: The P-N Junction: (8 Lectures)
Charge Flow Description and Energy Band Description of P-N Junction. Shockley's Equation. Resistance and Capacitances associated with a P-N Junction. Piecewise linear model of Diode. Effect of temperature.

Practical applications of diodes, Rectifiers and Filters, Clippers, Clampers, Voltage Multipliers.

Special Purpose Diodes- Zener Diode, LED, Photo-Diode, Varactor Diode, Tunnel Diode, Schottky Diode.

MODULE 2: Bipolar Junction Transistor: (12 Lectures)
Construction and Principle of operation of BJT. Transistor Action. Transistor Current Equations, 'α' and 'β' parameters. Transistor Characteristics. Early Effect. Ebers-Moll Model and Justification of Transistor Characteristics. Concept of Amplification and Switching Action.
Transistor Biasing Circuits. Stability of operation and Stability Factor

Small signal r_e-parameter model and h-parameter model of the BJT. Introduction to π- model. Analysis of amplifiers with small signal models. Current Gain, Voltage Gain, Power Gain, Input Impedance and Output Impedance. Introduction to Miller's Theorem. Cascaded Amplifier. Coupling between stages, Frequency Response and Band Width of an amplifier.
Darlington Connection, Cascode Connection and Difference Amplifier Connection of Transistors.

MODULE 3: Field Effect transistors, JFET and MOSFET: (5 Lectures)

Basic construction and physical behaviour of JFET and MOSFET. Study of current flow through JFET and MOSFET. JFET and MOSFET Characteristics- Drain Characteristics and Transfer Characteristics. Biasing circuits for JFET and MOSFET. Small Signal Model of JFET. Analysis of JFET amplifier.

JFET and MOSFET switches.

MODULE 4: Effect of Negative and Positive Feedback in Amplifiers: (5 Lectures)

Effect of Negative Feedback in amplifiers and its advantages. Analysis of different feedback configurations.

Positive Feedback. Bark Hausen Criteria for oscillation. Analysis of RC Oscillator, LC Oscillator and Crystal Oscillator.

MODULE 5: Integrated Circuit Electronics: (10 Lectures)

Internal Circuit Diagram of OPAMPs, TTL Gates and CMOS Gates.

Functional Block Diagram and Ideal Characteristics of OPAMP, Open-Loop Gain, Input and Output Impedance, Bandwidth, CMRR, Slew Rate, Input Offset Voltage and Current.

Closed Loop application of OPAMP, - Non-Inverting and Inverting Configurations. Concept of Virtual Ground. Non-inverting and Inverting Amplifiers. Adders, Subtractors, Difference Amplifiers and Instrumentation Amplifier. Integrators and Differentiators. Log Amplifier. OPAMP Sinusoidal Oscillators.

Non-Linear Applications – Comparator, Schmitt trigger, Zero Crossing Detector, A stable Multivibrator.

Active Filters, LPF, HPF, BPF and Notch Filters.

Introduction to Timer IC 555 and it' s applications.

Textbooks/References:

1. Integrated Electronics - Millman & Halkias (PHI).
2. OPAMPS and Linear Integrated Circuits- Ramakant A. Gayakwad (PHI)
3. Electronic Devices and Circuits – David J Bell. (Oxford)

Course Code	Course Title	Hours per week L-T-P	Credit C
IE181304	**Transducers**	**3-0-0**	**3**

COURSE OUTCOMES: Outcomes: On completion of this course the students should be able

CO1:
Analyse static and dynamic characteristics of a measurement system
CO2:
Explain the working principles of resistive, inductive, capacitive and piezoelectric transducers
CO3:
Explain the working principles of transducers used for temperature measurement.
CO4:
Select special transducers for measurement of various physical parameters.

MODULE 1: General concepts and terminology of measurement systems: (10 Lectures)
Transducer Principles & classification; static and dynamic characteristics of a measurement system; Statistical analysis of measuring data, Error, Probability Density Function, Gaussian Distribution and its application in error analysis, Chi Square Test, Significance Test, Goodness of fit, Curve Fitting--- Least Square Method.

MODULE 2: Resistive transducers: (6 Lectures)

a) Potentiometers: Principle, signal conditioning.
b) Strain gauges: types, principle, signal conditioning circuits, applications in measurement of pressure, force, torque and vibration etc

MODULE 3: Inductive transducers: (4 Lectures)
Principle, signal conditioning, applications etc of LVDT & Synchros

MODULE 4: Capacitive transducers: (4 Lectures)
Air gap and dielectric types and their applications.

MODULE 5: Temperature Measuring Transducers: (8 Lectures)
RTD, Thermistors, Thermo couple & IC temperature sensor --- their working, materials used, signal conditioning, Characteristics, Installation and compensation and applications.

MODULE 6: Piezoelectric transducers: (4 Lectures)
Piezoelectric crystal and its properties; Sensitivity coefficients; Materials, Application.

MODULE 7: Special transducers: (4 Lectures)
LDR, Radiation pyrometer, Fibre optic sensor, Smart sensors, Hall effect sensors, Magnetostrictive transducers.

Textbooks/References:

1. Measurement Systems: Application and Design – Doeblin E.O., McGraw Hill.
2. John P. Bentley, Principles of Measurement Systems, Pearson Education, 4th Edition, 2005.
3. Instrument transducers – An introduction to their performance and design – Neubert MKP, Clarendon Press.
4. Transducers and Instrumentation – Murthy D.V.S., P.M.I. New Delhi.
5. Sensors and Transducers – Patranabis D., Wheeler.
6. Instrumentation Devices and Systems – Ranga, Sarma, Mani; T.M.H.
7. Instrumentation Measurement and Analysis- B C Nakra, K K Chaudhry

Course Code	Course Title	Hours per week L-T-P	Credit C
EI181305	**Digital Electronics**	**3-0-0**	**3**

Prerequisites: Basic idea of Electrical and electronics circuits

Course Objectives:

- To understand number representation and conversion between different representation in digital electronic circuits.
- To understand and implement logical operations using combinational logic circuits.
- To understand and implement logical operations using sequential logic circuits.
- To understand characteristics of memory and their classification.

Course Outcomes:

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

CO1: Perform conversion of n-bit codes from one form to another form.

CO2: Design a logical circuit using the minimum number of gates for a given logical expression.

CO3: Use and demonstrate a given digital combinational circuit.

CO4: Use different types of flip-flops and design a sequential logic circuit.

CO5: Design ROM, RAM and PLA for a given application.

MODULE 1: Number system (4 Lectures)

Representation of Binary numbers, octal and hexadecimal numbers, complements, signed binary numbers, Binary codes, code conversion, floating point numbers and arithmetic and the conversion process.

MODULE 2: Boolean algebra and logic gates (4 Lectures)

Basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms-SOP & POS. Logical operations, truth tables, logic gates, logic levels and pulse waveforms.

MODULE 3: Simplification of Boolean functions (6 Lectures)

The map method- the Karnaugh map, minimal SOP & POS, Don't care conditions, multiple output minimization, tabular method, Quine-Mcclusky method, determination and selection of prime implicants.

MODULE 4: Combinational Logic circuits (9 Lectures)

Introduction: Logic synthesis: Introduction, universal property of NAND and NOR gates, AND-OR networks, NAND & NOR networks, EX-OR networks.

Adders & substractors, parallel binary adders, magnitude comparator, decoders & encoders, Multiplexer & demultiplexers, parity generators & checkers. ROM, RAM and PLA.

MODULE 5: Sequential Logic Circuits **(9 Lectures)**

S-R, J-K, D and T Flip Flops, Excitation table, Triggering of FFs & Latches, one shot A stable Multivibrator. Registers: - Shift – Registers, Ripple Counters, Synchronous Counters. Ring Counters, Timing Sequences, Design Procedure.

MODULE 6: Digital integrated Circuit **(4 Lectures)**

Introduction, special characteristics (Fan-Out, Power dissipation, Propagation delay, figure of merit, noise level) Introduction to TTL, ECL, MOS, and CMOS circuit.

MODULE 7: A/D and D/A converters **(4 Lectures)**

Introduction and examples of ADC and DAC circuits.

Text Books:

1. Digital Design – M. Marris Mano.
2. Logic Design Theory – NN Biswas
3. Digital Fundamental – TL Floyd
4. Digital Electronics- R. P. Jain.

Reference Books:

1. Logic Design Theory – NN Biswas
2. Digital Fundamental – TL Floyd

Course Code	Course Title	Hours per week L-T-P	Credit C
MC181306	**Constitution of India**	**2-0-0**	**0 (PP/NP)**

Course Objectives: Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

MODULE 1: History of Making of the Indian Constitution:

a) History
b) Drafting Committee, (Composition & Working)

MODULE 2: Philosophy of the Indian Constitution:

a) Preamble
b) Salient Features

MODULE 3: Contours of Constitutional Rights & Duties:

a) Fundamental Rights
b) Right to Equality
c) Right to Freedom
d) Right against Exploitation
e) Right to Freedom of Religion
f) Cultural and Educational Rights
g) Right to Constitutional Remedies □ Directive Principles of State Policy □ Fundamental Duties.

MODULE 4: Organs of Governance:

a) Parliament
b) Composition
c) Qualifications and Disqualifications
d) Powers and Functions
e) Executive
f) President
g) Governor
h) Council of Ministers
i) Judiciary, Appointment and Transfer of Judges, Qualifications
j) Powers and Functions

MODULE 5: Local Administration:

a) District's Administration head: Role and Importance,
b) Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation.
c) Pachayati raj: Introduction, PRI: Zila Pachayat.
d) Elected officials and their roles, CEO Zila Pachayat: Position and role.
e) Block level: Organizational Hierarchy (Different departments),
f) Village level: Role of Elected and Appointed officials,
g) Importance of grass root democracy

MODULE 6: Election Commission:

a) Election Commission: Role and Functioning.
b) Chief Election Commissioner and Election Commissioners.
c) State Election Commission: Role and Functioning.
d) Institute and Bodies for the welfare of SC/ST/OBC and women.

Textbooks/References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Code	Course Title	Hours per week L-T-P	Credit C
EI181313	**Analog Electronics Lab**	**0-0-2**	**1**

Course Objectives:

1. To understand the basic concept of various electronic devices, circuits and their application.
2. To develop ability among students to design and implement electronic circuits.

Course Outcomes:

After completing this course, the students will be able

1. To determine the dc and ac parameters of semiconductor devices.
2. To analyze the performance of different types of rectifier with and without filter.
3. To plot frequency response of BJT and JFET amplifier.
4. To analyze effect of negative and positive feedback on the performance of amplifier.

LIST OF EXPERIMENTS

1. Study of Rectifier and Filter
2. Common Base Characteristics and Evaluation of H-Parameters.
3. Common Emitter Characteristics and Evaluation of H- Parameters.
4. Study of R-C Coupled Common Emitter Amplifier and Effect of Feedback.
5. Study of JFET Characteristics and Common Source Amplifier.
6. Study of OPAMP Inverting and Non-Inverting Amplifiers.
7. Study of OPAMP Summing and Difference Amplifiers and Instrumentation Amplifier.
8. Study of OPAMP Phase-Shift Oscillator and Wien Bridge Oscillator.
9. Study of OPAMP Active Filters.
10. Study of Non-Linear Opamp Applications.

Course Code	Course Title	Hours per week L-T-P	Credit C
EI181315	**Digital Electronics Lab**	**0-0-2**	**1**

Course outcomes:

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

CO1:
verify and analyze the outputs of combinational logic circuits and relate theoretical concepts with experimental analysis.
CO2:
verify and analyze the outputs of sequential logic circuits and relate theoretical concepts with experimental analysis.
CO3:
organize and write an engineering report after performing an experiment on digital circuits.

LIST OF EXPERIMENTS

1. Realization of basic gates by using universal gates
2. Realization of XOR gate
3. Combinational Logic Design using 74xx ICs
4. Arithmetic Circuit- construction and testing using 74xxICs: Half/Full Adder
5. Construction of 1- bit comparator using 74xxICs.
6. code converters – Binary to Gray & Gray to binary.
7. Verification of Truth Table of SR Flip-Flop
8. Verification of Truth Tables of JK, D, T Flip-Flops
9. 3-Bit synchronous counter design
10. Decade Counter design

Course Code	Course Title	Hours per week L-T-P	Credit C
IE181317	**Instrumentation Lab-I**	**0-0-3**	**1.5**

COURSE OUTCOMES:

CO1:
Analyse different types of transducers/sensors data.

CO2:
Apply their knowledge in conducting experiments.

CO3:
Interact Effectively on a social & interpersonal level with fellow students to receive clear procedural instructions.

CO4:
Share task responsibilities to complete assignments and ethically Develop professional and technically sound reports.

LIST OF EXPERIMENTS

1. **LVDT**
   a) To draw the characteristics of a LVDT
   b) To determine the sensitivity of the system
2. **Torque Transducer**
   a) Study of the torque transducer.
   b) To use torque transducer having strain gauges as sensors & to determine its I/O characteristics.
3. **Load Cell**
   a) T study the Colum type Load Cell
   b) To calculate the sensitivity of load cell
4. **Orifice**
   a) To study the flow of air through an orifice and hence determine the flow rate with the help of U-Tube manometer.
   b) To plot the flow versus pressure difference characteristics for different flow rates**.**
5. **Rotational Potentiometer**
   a) To study the input output characteristics of rotational Potentiometer
6. **Thermocouple**
   a) To determine the sensitivity and time constant of a thermocouple [iron constantan or copper constantan] for step input.
   b) To compare its response with that for ramp input.
7. **I/P-P/I Converter**

   To determine-
   a) Linearity of I/P converter

b) Hysteresis of I/P converter
c) Accuracy of I/P converter
d) Linearity of P/I converter
e) Hysteresis of P/I converter
f) Accuracy of p/i converter.

8. PV cell

a) To draw the characteristic curve of a PV cell

9. LDR

a) Study of light dependent register

10. Optical Weight sensor

a) To Obtain the voltage VS weight graph

Text books:

1. Principle of industrial Instrumentation; D Patranabis
2. Introduction to instrumentation engineering; AK Sahwany

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