ASSAM SCIENCE AND TECHNOLOGY UNIVERSITY

GUWAHATI, ASSAM

B. TECH SYLLABUS

FOR

THIRD SEMESTER

APPLIED ELECTRONICS AND INSTRUMENTATION ENGINEERING

(AEI)

SEMESTER III

COURSE STRUCTURE/ AEI/ B TECH

Sl no	Subject code	Subject	Hrs			Credit
			L	T	P	C
Theory						
1	MA131301	Mathematics-III	3	2	0	4
2	AI131302	Electronics Devices and Circuits	3	2	0	4
3	AI131303	Network Theory	3	2	0	4
4	AI131304	Fundamental of Instrumentation	3	0	0	3
5	AI131305	Digital Electronics and logic Design	3	2	0	4
6	HS131306	Sociology	2	0	0	2
Practical						
8	EE131312	Electronic Devices and Circuits Lab	0	0	2	1
9	AI131313	Network Theory Lab	0	0	2	1
10	AI131315	Digital Electronics and logic Design Lab	0	0	2	1
11	AI131317	Mini Project	0	0	2	1
Total			17	08	08	25
Total Contact Hours=33						
Total Credits=25						

Course Title: **MATHEMATICS III**
Course Code: MA131301
L-T-::C **3-2 = 4**

Abstract:

This course of Mathematics is important for almost all the engineering disciplines. It deals with the partial differential equations of first order and 2nd order.

Prerequisites: Mathematics II (MA131201)

Course Outcomes:

The student will

- be able to apply the fundamental concepts of Partial differential Equations.
- get familiarised with the applications of Ordinary Differential Equations and Partial Differential Equations.
- be able to apply different techniques of integration, including partial fractions, integration by parts and recurrence formulae, to solve problems.

Unit	Topic	No of hours	Marks
1	**First order Partial differential equation:** Partial differential equation of first order, Linear partial differential equation, Non-linear partial differential equation, Homogenous and non-homogeneous partial differential equation with constant co- efficient, Cauchy type, Monge's method.	8	25
2	**Second order Partial differential equation:** Second order partial differential equation The vibrating string, the wave equation and its solution, the heat equation and its solution, Two dimensional wave equation and its solution, Laplace equation in polar, cylindrical and spherical coordinates, potential.	8	25
3	**Complex Analysis:** Analytic function, Cauchy-Riemann equations, Laplace equation, Conformal mapping, Complex integration: Line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytic functions.	10	30
4	**Mathematical Series**: Power Series, Taylor's series, Laurent's series, Singularities and zeros, Residue integration method, evaluation of real integrals.	10	20

Recommended books:

1. E. Kreyszig," Advanced Engineering Mathematics:, Eighth Edition, Wiley India.
2. B.V. Ramana, "Higher Engineering Mathematics", McGraw Hil Education.

Course Title: **ELECTRONICS DEVICES AND CIRCUITS**
Course Code: AI131302
L-T-::C **3-2-=4**
Abstract:

The course deals with various properties and characteristics of semiconductor materials and devices with their applications in electronic circuits. It also deals with application of semiconductor devices in designing and analysis of various amplifiers, oscillators etc. Besides these the syllabus also includes small signal analysis of amplifier at low to high frequencies.

Prerequisites: Basic Electrical and Electronic Engineering-I (EE131104)

Course Outcomes:

The student will

1. have the Knowledge of the behaviour, physical properties of semiconductor materials and devices.
2. be able to Learn about the analysis of different types of signals when applied to semiconductor devices.
3. understand the basic electronic circuits using diode, transistors, BJT's and FET.
4. be expertise in basic circuits using discrete components and have firm grasp on the basic working principles of electronic circuits.
5. make students able to design and model different types of electronic amplifiers.

Unit	Topic	No of hours	Marks
1	**Junction Diode Characteristics:** Review of semi conductor Physics – n and p –type semi conductors, Mass Action Law, Continuity Equation, Hall Effect, Fermi level in intrinsic and extrinsic semiconductors, Transport of carriers by drift and diffusion. μ_P, D_P and diffusion length; Open-circuited p-n junction, Graded and Abrupt junction approximations, The p-n junction Energy band diagram of PN diode, The current components in p-n diode, Law of junction, Diode equation, Volt-ampere characteristics of p-n diode, Temperature dependence of VI characteristic, diode as a rectifier (forward bias and reverse bias); Transition and Diffusion capacitances, Breakdown Mechanisms in Semi Conductor Diodes; Review-Zener diode characteristics and applications, Characteristics of Tunnel Diode, Varactor Diode.	7	20
2	Transistor and FET Characteristics: Junction transistor, Transistor current components, Review of CE, CB and CC configurations and comparison of their characteristics, The early effect, Ebers-Moll model; JFET characteristics, Small signal model of JFET; MOSFET characteristics (Enhancement and depletion mode), Comparison of Transistors.	4	15
3	**Transistor biasing:** Biasing of single stage amplifiers- single power supply and bipolar power supply, Stabilization factors, Thermal run away, Thermal stability, Transistor applications; Multiple stage amplifiers- biasing schemes with emphasis on direct coupling.	6	15

4	**Compound Configurations:** Study of the differential pair, current sources, voltage sources, the Darlington and Cascode connections.	3	8
5	**Hybrid π small signal equivalent circuit:** Computation of input resistance, output resistance and gain of amplifiers at low to high frequencies; High frequency responses.	5	10
6	**Feedback amplifier:** Feedback concept, Classification of feedback amplifiers, Transfer gain with feedback, General Characteristics of feedback amplifier, Effect of Feedback on input and output characteristics, voltage series, current series, voltage shunt and current shunt amplifiers with discrete components and their analysis.	5	12
7	**Oscillators:** Theory of sinusoidal oscillations, Barkhausen criterion, Phase shift oscillator, Colpitts Oscillator, Hartley oscillator, Wien bridge oscillator, crystal oscillator-Determination of frequency of oscillation and criteria for oscillations to occur.	2	8
8	**Power Amplifiers:** Types and applications of power Amplifiers, Transistor power dissipation, Amplifier classes and efficiency: CLASS A, CLASS B, CLASS C and CLASS AB; Principle of Push pull amplifiers, Push pull drivers, Harmonic distortion and feedback, distortion in push pull Amplifiers, Complementary push pull amplifier.	4	12

Recommended Books:

1. Principle of Electronic Devices and circuit by Malvino Leach (Tata McGraw hill)
2. Electronic Devices and Circuits by David A. Bell (PHI Publications)
3. Microelectronics – Millman and Grabel, Tata McGraw Hill, 1988.
4. P.E. Gray and Campbell L.Searle- Electronic Principles. Published by McGraw- Hill Book Company.
5. Electronic Devices- Ramesh Babu.
6. S.M. Sze- Physics of Semiconductor Devices. Willey Eastern.
7. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits", Tata McGraw Hill, 2nd Edition, (2008).
8. Electronic Devices and Circuits – J.Millman, C.C.Halkias, and Satyabratha Jit Tata McGraw Hill, 2nd Ed., 2007.
9. Electronic Devices and Circuits – R.L. Boylestad and Louis Nashelsky, Pearson/Prentice Hall,9th Edition,2006.
10. Solid state Electronic Device-Streetman and Banerjee
11. Electronic Circuits- Neaman

Course Title: **NETWORK THEORY**
Course Code: AI131303
L-T-::C **3-2 = 4**

Abstract:

This course is designed to get knowledge about network circuits. It includes elementary networking concepts, both DC and AC network analysis etc. which helps in practical needs.

Prerequisites: Basic Electrical and Electronic Engineering-I (EE131104)

Course Outcomes:

The students will

- Be able to analyze simple DC circuits.
- Have the knowledge of different network and circuit theorems.
- Be able to analyze AC steady-state responses and transient response, inductance and capacitance in terms of impedance.
- Be familiarized with the analysis of two port networks and their synthesis.

Unit	Topic	No of hours	Marks
1	**Basics of Electrical Circuits:** Fundamental laws for circuit analysis; Mesh and Nodal analysis of electrical networks; Matrix methods of solving loop and node equations.	2	5
2	**Network Theorems:** Millman's theorem, Reciprocity theorem, Compensation & Tellegen's Theorem.etc.	4	11
3	**Analysis of coupled circuits:** The dot rule & equivalent conductivity coupled forms of magnetically coupled circuits-Series and parallel; Q factor; Analytical procedure for solving coupled circuits, Mutual Inductance, Co efficient of coupling; single tuned and double tuned circuits, Effects of over coupling and selectivity curves; Ideal transformer	4	11
3	**Transient Phenomenon:** Concepts of network transients, Forcing function –impulse, step and ramp function study and solution of simple circuits undergoing transient disturbances, A.C transients, time domain equations and solutions by Laplace transforms.	5	14
4	**Network Topology:** Elementary graph theory as applied to electrical networks, Important definitions related to oriented graph, Solution of network equations by matrix methods, Methods suitable for simulating electric circuits on digital computers, Matrices of graph: Incidence matrix, f-circuit matrix, cut set matrix. Advanced techniques of equation formulation for numerical solutions.	4	11
5	**Two port network:** General principals, ABCD, Z, Y and hybrid parameters. Analysis of network in tandem. Transmission lines. Lumped and distributed models. Characteristic impedance, wave propagation constant, reflection and terminations, attenuation and phase constants.	6	17

6	**Network Synthesis:** Driving point impedances and admittances. Poles and Zeros- their significance. Determination of time domain behaviour from pole-zero plots. Frequency characteristics of networks from network functions. Magnitude and phase plots. Elements of realizability theory. Hurwitz polynomial. Positive real functions. Basic technique used in syntheses of networks. Synthesis of one port network with two kinds of elements-LC, RC or RL.	8	22
7	**Filter Theory:** Filter fundamentals. Low pass, high pass, band pass filters. Pass and stop bands, Band reject filters.	3	9

Recommended books:

1. Engineering Circuit Analysis—W.H Hayt Jr & J.E Kemmerly (Mc Graw Hills)
2. Electric Circuits – J.A Edwinster (Mc Graw Hills)
3. Computer aided network design – Donald A. Calahan (TMH)
4. A course in electric circuit analysis – Soni & Gupta
5. Network Theory. Analysis and Synthesis (PHI) - Smrajit Ghosh

Course Title: **FUNDAMENTALS OF INSTRUMENTATION**
Course Code: AI131304
L-T-::C **3-0 = 3**
Abstract:

This course deals with the basic and necessary elements required in the designing of an instrumentation system along with various errors that are encountered in a measurement process and the methods that are employed for minimization of these errors. Besides this, the course also includes the studies on the characteristics of an instrumentation system that is very much necessary for proper analysis of the system**.**

Prerequisites: Mathematics II (MA131201)

Course Outcome:

1. Understand and thereby analyze and evaluate the various parameters of a measurement system.
2. Acquire basic idea about the instrumentation system.
3. Enable students to design an instrumentation system
5. Develop the ability to analyze the outcomes of an instrumentation system from the statistical point of view.
4. Know about the various errors involved during a measurement process and techniques that could be used for minimization of these errors.

Unit	Topic	No of hours	Marks
1	**Review of Units, Systems, Dimensions and Standards**: Introduction, Absolute units, Fundamental and Derived units, Dimensions, C.G.S and M.K.S system of units, S.I units.	2	5
2	**Basic concept of measurement:** Measurement system, Block diagram representation, example, Static and dynamic characteristics, Compensation, dynamic calibration, Generalized instrumentation system, block diagram representation, Selection criteria of instruments.	13	30
3	**Errors & Uncertainties in measurement**: Definition, classification, data quality, equipment errors, interference errors, dynamic response errors, operational errors.	5	20
4	**Statistical estimates of measurement data:** Mean, median, mode, measures of dispersion, mean deviation, standard deviation, variance, probable error, Error distribution functions- error tables (Gaussian) and applications, confidence level, significance test, Chi- squared statistical test, Regression analysis of data, Graphical representation and curve fitting of data, best fit curves.	13	30
5	Methods of minimization of errors due to noise in measured data, input output configuration, filtering, averaging and correlation.	3	15

Recommended books:

1. Doeblin EO : Measurement system Application and Design- Mc Graw Hill
2. Barry E Jones - Instrumentation, Measurement & Feedback TMH
3. Coock N H Physical Measurement & Analysis Addision Wesley 1965
4. Doeblin E. O. – System Dynamics – Modeling & Response Mc Graw Hill
5. Holman J. P - Experimental Methods for Engineers – Mc GrawHill Int. Std. Edn. 1966.

Course Title: **DIGITAL ELECTRONICS AND LOGIC DESIGN**
Course Code: AI131305
L-T-::C **3-2= 4**
Abstract:

Digital Electronics is a required course for engineering degree program. The purpose of the course is to teach principles of digital electronics. The material covers a variety of topics including Boolean algebra, basic gates, logic circuits, flip-flops, registers, arithmetic circuits, counters and computer memory.

Prerequisites: Basic Electrical and Electronic Engineering-I (EE131104)

Course Outcomes:

- Have knowledge of number systems and codes
- Know about basic postulates of Boolean algebra and the correlation between Boolean expressions
- Have the knowledge of different methods for simplifying Boolean expressions (eg. K-map)
- Know the formal procedures for the analysis and design of combinational circuits and sequential circuits
- Know the concept of memories, programmable logic devices and digital ICs.

Unit	Topic	No of hours	Marks
1	**Binary Systems, Boolean algebra and logic circuits:** Digital Computers, Digital Systems, Binary numbers, Number base conversions, Octal and Hexadecimal Numbers, Complements, Signed binary numbers, Binary codes-BCD, Gray, XS-3 codes and their conversions, Binary storage and Registers, Binary logic, Axioms and basic theorems of Boolean algebra, Truth table, logic functions and their realization, Basic Logic gates.	5	14
2	**Integrated Circuit Logic Families:** Digital IC technology, TTL logic family, MOS technology, Digital MOSFET circuits, CMOS driving TTL, Gate properties fan-in, fan-out, propagation delay and power-delay product.	4	11
3	**Simplification of logic functions:** Standard representation (canonical forms) of logic functions - SOP and POS forms, Min terms and max terms, integrated circuits, Karnaugh map of 2, 3, 4 and 5 variables, Simplification by algebra and by map method, Function simplification when functions are incompletely specified, Synthesis using AND, OR and INVERT and then to convert to NAND or NOR implementation.	6	17
4	**Combinational logic circuit design:** Combinational logic circuits and building blocks, Binary adders and subtractors, Encoders, decoders, multiplexers, demultiplexers, comparators, parity generators etc., Realization of logic functions through decoders and multiplexers.	9	25

5	**Introduction to sequential circuits:** Flip-flops - truth table and state table, The S-R, J-K, T and D flip-flop, Race condition, Sequential circuits, clock, counter and registers, Ripple counter, synchronous counters, up/down counters, modulo-N counter, Design of counters – state diagram.	9	25
6	**Some functional devices:** SSI, MSI LSI and V LSI devices. RAM and ROM - their uses. Some commonly used digital ICs.	3	8

Recommended books:

1. Logic and Computer Design Fundamentals by M. Morris Mano and Charles R. Kime. Pearson Education.
2. Fundamentals of Digital Circuits by A. Anand Kumar. PHI.
3. Digital Electronics by Raja. Scitech Publications.
4. Modern Digital Electronics by R. P. Jain. Mc Graw Hill Education.

HS131306	**SOCIOLOGY**	L = 2 T = 0 C = 2
Module-I	Sociology in the Industrial Perspective: Concept of sociology/ Sociology as a science?/ Sociology of work and industry/ Perspectives for sociological analysis of work/ Class conflict in industry/ Social impact of industrialization	12 Hours
Module-II	Work and Social Change: Nature of modern societies/ Emergence of industrial capitalism/ Technology and social change/ The information society after the industrial society/ Postmodernity/ Globalization and convergence/ Significance of the service sector today/ Work restructuring and corporate management	12 Hours
Module-III	Work Experiences in Industry: The concept of alienation/ Work satisfaction/ Technology and work experience/ Social background of workers/ Work orientations/ Stress and anxiety of the worker/ Work and leisure/ Unemployment/ Conflicts in the workplace	12 Hours
	Total	36 Hours

Reference Books

1. Miller and Form, Industrial Sociology (London: Harper & Row, 1968)
2. N. R. Sheth, Social Framework of Indian Factory (Bombay: Oxford University Press, 1968)
3. Gisbert, Fundamentals of Industrial Sociology (New Delhi: Oxford University Press, 1971)
4. P. Gisbert, Fundamentals of Industrial Sociology (New Delhi: Oxford University Press, 1971)
5. Tony J. Watson, Sociology, Work and Industry (New York: Routledge, 2004 reprint)

Course Title: **ELECTRONICS DEVICES AND CIRCUITS LAB**.
Course Code: AI131312
L-T-P: C **0-0-2=1**

Abstract:

This course provides an overview of the principles, operation and application of the analog building blocks like diodes, BJT, FET etc for performing various functions. The course intends to provide basic experimental experiences in physical operation and circuit applications of semiconductor devices and to develop the skills in simulation and design of electronic circuits using P-Spice.

Prerequisites: Basic Electrical and Electronic Engineering-I (EE131104), Electronics Devices and Circuits (AI131302).

Course Outcomes:

The students will

3. Understand the fundamentals of operation of the main semiconductor electronic devices circuit models and connection to the physical operation of the device.
4. Be able to demonstrate an understanding of BJT and FET transistors, DC biasing techniques of single stage and multi stage BJT amplifier and small signal modelling.
5. Be able to analyze and design basic electronic circuits, particularly with application to diodes, MOS field-effect transistors, bipolar junction transistors.
6. Able to design and conduct experiments, as well as to organize, analyzes, and interprets data.

7. Be able to use lab equipment to conduct experiments involving electronic devices and circuits.

Unit	Experiment	No of hours
1	To study the forward static characteristics of diode.	3
2	To study the static characteristic of a Zener diode.	3
3	To study a simple shunt type voltage regulator circuit based on a Zener diode and find the voltage regulation of the circuit.	3
4	To study half-wave and full-wave rectifier circuits.	3
5	To plot the static collector characteristics of a bipolar junction transistor in the common emitter configuration.	3
6	To plot the static collector characteristics of a bipolar junction transistor in the common base configuration.	3
7	i) To plot the static drain characteristics of a n-channel Power MOS field effect transistor in the common source configuration. ii) To plot the transfer characteristic of the given power MOSFET.	3
8	To study the biasing technique of single stage BJT amplifier (Fixed bias)	3
9	To study the biasing technique of single stage BJT amplifier (Collector to base bias)	3
10	To study the biasing technique of single stage BJT amplifier (Voltage divider bias)	3
11	To study the biasing technique of single stage BJT amplifier (using bi-polar power supply)	3
12	To study the biasing technique of two stage direct coupled BJT amplifier.	3
13	To study the small signal characteristics of BJT amplifier.	3

Course Title: NETWORK THEORY LAB
Course Code: AI131313
L-T-P: C **0-0-2=1**
Abstract:

This course is designed to get knowledge about different passive components and use of these components. Also the uses of different laboratory equipment like CRO's, Function generator are included. This course also include designing of different types of filters and resonance circuits.

Prerequisites: Basic Electrical and Electronic Engineering-I (EE131104), Network Theory (AI131303)

Course Outcomes:

The students will

- Understand the physics associated with voltage, current, resistance, energy and power.
- Identify various components and equipment used for laboratory work.
- Capable to design some filter of different band width.
- Capable to construct circuits, perform experiments, analyse data and prepare report.

Unit	Experiment	No of hours
1	To study the following passive circuit components: i) Resistors ii) Capacitors iii) Magnetic core material.	3
2	i) To study the characteristics of a R-C low pass filter ii) To design a R-C low pass filter	3
3	i) To study the characteristics of a R-C high pass filter ii) To design a R-C high pass filter	3
4	i) To study the characteristics of an R-C Integrating Circuit. ii) To design a simple R-C integrator	3
5	i) To study the characteristics of an R-C Differentiating Circuit. ii) To design a simple R-C differentiator.	3
6	To study the phenomenon of series resonance in a RLC circuit.	3
7	To study the phenomenon of parallel resonance in a RLC circuit.	3
8	To analyse black box.	3

Course Title: DIGITAL ELECTRONICS AND LOGIC DESIGN Lab
Course Code: AI131315
L-T-P: C 0-0-2=1
Abstract:

This Laboratory course is designed to impart knowledge about different ICs to the students. like Ex-OR, NAND, OR, AND, Decoder, Flip-flops etc. Applications of all these ICs are included in this laboratory.

Prerequisites: Basic Electrical and Electronic Engineering-I (EE131104), Digital Electronics and Logic Design (AI131305).

Course Outcomes:

The students will

- Know how to operate electronic test equipment like CROs, signal analysers, digital multi-meters, power supplies, and frequency meters, and programmable memories, programmers to analyse and test digital circuits.
- Know design, implementation and testing of digital circuits derived from theoretical concepts.
- Know troubleshooting of digital circuits
- Capable to compare the actual performance of a digital circuit with the theoretical performance.

Unit	Experiment	No of hours
1	To study the TTL and CMOS families of digital integrated circuit.	3
2	To implement a Boolean expression TTL/CMOS, SSI.	3
3	To implement Half Adder and Full Adder.	3
4	To study parallel adder and implement function using IC7483.	3
5	To study a BCD to 7-segment LED display decoder.	3

6	To study IC 74151 and implement function using IC 74151.	3
7	To study the J-K, D and T flip flops.	3
8	To study a simple two bit ripple counter.	3

Course Title: MINI PROJECT

Course Code: AI131317
L-T-P: C **0-0-2=1**

THE MINI PROJECT WILL BE ALLOTTED BY THE DEPARTMENT.

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