B.E. Electronics and Instrumentation Engineering

Semester-wise Pattern for Students Admitted to B.E. Electronics and Instrumentation Programme									
Year	**First Semester**			**U**	**Second Semester**			**U**
I	BIO	F110	Biology Laboratory	1	MATH	F112	Mathematics II	3
	BIO	F111	General Biology	3	ME	F112	Workshop Practice	2
	CHEM	F110	Chemistry Laboratory	1	CS	F111	Computer Programming	4
	CHEM	F111	General Chemistry	3	EEE	F111	Electrical Sciences	3
	MATH	F111	Mathematics I	3	BITS	F112	Technical Report Writing	2
	PHY	F110	Physics Laboratory	1	MATH	F113	Probability and Statistics	3
	PHY	F111	Mechanics, Oscillations, and Waves	3	BITS	F111	Thermodynamics	3
	BITS	F110	Engineering Graphics	2				
				17				**20**
II	MATH	F211	Mathematics III	3	ECON	F211	Principles of Economics	3
			Humanities Electives	3(min)			or	or
	INSTR	F211	Electrical Machines	4	MGTS	F211	Principles of Management	3
	INSTR	F212	Electromagnetic Theory	3			Humanities Electives	3(min)
	INSTR	F215	Digital Design	4	INSTR	F241	Microprocessors & Interfacing	4
	INSTR	F214	Electronic Devices	3	INSTR	F242	Control Systems	3
					INSTR	F243	Signals & Systems	3
					INSTR	F244	Microelectronic Circuits	3
					BITS	F225	Environmental Studies	3
				20(min)				**22(min)**
Summer	**BITS F221 Practice School – I (for PS Option Only)**							
III			Open/Humanities Electives	3to6			Open/Humanities Electives	3to6
	INSTR	F311	Electronic Instruments & Instrumentation Technology	4	INSTR	F341	Analog Electronics	4
					INSTR	F342	Power Electronics	4
	INSTR	F312	Transducers & Measurement Systems	3	INSTR	F343	Industrial Instrumentation & Control	3
	INSTR	F313	Analog & Digital VLSI Design	3			Discipline Electives	4(min)
			Discipline Electives	5(min)				
				18/21				**18/21**
IV			Open Electives	5to11	BITS	F412	Practice School-II	20
			Discipline Electives	3			or	or
					BITS	F421T	Thesis	16
							or	
							Thesis (9) and Electives (6 to 9)	15to18
				8/14				**15/20**

Discipline Core - 48 Units (14 Courses)

Discipline Electives - 12 Units (4 Courses)

Note: This is an operative pattern for the students who are admitted from August 2011 onwards as approved by the Senate-appointed committee, subject to change if the situation warrants.

List of Core Courses

EEE F111	Electrical Science
INSTR F211	Electrical Machines
INSTR F212	Electromagnetic Theory
INSTR F214	Electronic Devices
INSTR F215	Digital Design
INSTR F241	Microprocessors and interfacing
INSTR F242	Control Systems
INSTR F243	Signals & Systems
INSTR F244	Microelectronic Circuits
INSTR F311	Electronic Instrumentation & Instrumentation Technology
INSTR F312	Transducers and Measurement Systems
INSTR F313	Analog & Digital VLSI Design
INSTR F341	Analog Electronics
INSTR F342	Power Electronics
INSTR F343	Industrial Instrumentation & Control

List of Elective Courses

BITS F312	Neural Network & Fuzzy Logic
BITS F415	Introduction To MEMS
CS F213	Object-Oriented Programming
CS F342	Computer Architecture
CS F372	Operating Systems
CS F451	Combinatorial Mathematics
CS G553	Reconfigurable Computing
ECE F312	EM Fields and Microwave Engineering Laboratory
ECE F314	Electromagnetic Fields & Microwave Engineering
EEE F245	Control System Laboratory
EEE F246	Electrical and Electronic Circuits Laboratory
EEE F311	Communication Systems
EEE F345	Power Apparatus & Networks
EEE F346	Data Communication Networks
EEE F348	FPGA Based System Design Laboratory
EEE F411	Internet of Things
EEE F417	Computer-Based Control System
EEE F422	Modern Control Systems

EEE F426	Fiber optics & Optoelectronics
EEE F427	Electric Power Utilization and Illumination
EEE F431	Mobile Telecommunication Networks
EEE F433	Electromagnetic Fields & Waves
EEE F434	Digital Signal Processing
EEE F435	Digital Image Processing
EEE F436	Electromagnetic Compatibility
EEE F472	Satellite Communication
EEE F474	Antenna Theory and Design
EEE F475	Special Electrical Machines
EEE F476	Switchgear and Protection
EEE F477	Modeling of Field-Effect Nano Devices
EEE F478	Power Systems Laboratory
EEE G512	Embedded System Design
EEE G626	Hardware-Software Co-Design
INSTR F413	Advanced Process Control
INSTR F414	Telecommunication Switching Systems & Networks
INSTR F415	Digital Control
INSTR F419	Virtual Instrumentation
INSTR F420	Design of Instrumentation Systems
INSTR F422	Instrumentation for Petrochemical Industry
INSTR F432	Medical Instrumentation
INSTR F473	Wind Electrical Systems

Course Descriptions

EEE F111 Electrical Sciences **[3 0 3]**

The course covers basic passive circuit elements, dependent and independent sources, network theorems, circuit analysis techniques, and the response of first and second-order circuits. Introduction to three-phase circuits, magnetic circuits, transformers, basics of rotating machines. Semiconductors - operation of diodes, Zener diodes, bipolar junction transistors, and field-effect transistors. Biasing techniques and applications of diodes and transistors. Introduction to operational amplifiers and applications. Introduction to Digital Electronics.

INSTR F211 Electrical Machines **[3 1 4]**

Transformer: Constructional features, equivalent circuit and phasor diagram - regulation and efficiency, parallel operation. Three-phase transformer connections; Harmonic in transformers; Testing; Phase conversion; Autotransformer. D.C Machines: Construction, armature windings, armature voltage, and torque equations, classification. D.C generators, performance characteristics; D.C motors - torque/speed

characteristics, speed control, and braking. Testing and efficiency. Induction machines: Constructional features and rotating magnetic field. Circuit model and phasor diagram

Steady-state characteristics. Testing, starting, and speed control. Time harmonics and space harmonics. Wound rotor induction motors, Single phase induction motors - classification and equivalent circuit. Synchronous machines: Constructional features; synchronous generators and motors; equivalent circuit and phasor diagram; power and torque characteristics and capability curves. Parallel operation. Salient pole synchronous machine - phasor diagram and determination of synchronous reactances; starting and speed control of synchronous motors. Special machines- universal motors, Induction generators

INSTR F212 Electromagnetic Theory [3 0 3]

Review of mathematics - scalar and vector fields, calculus of scalar and vector fields in Cartesian and curvilinear coordinates, Dirac delta function; Electrostatics - electric field, divergence & curl of the electric field, electric potential, work and energy in electrostatics, conductors, electric dipole; Electrostatics in Matter - polarization and field of a polarized object, electric displacement, linear dielectrics; Magnetostatics - Lorentz force law, Biot- Savart law, divergence & curl of the magnetic field, magnetic vector potential, magnetic dipole; Magnetostatics in the matter - magnetization and field of a magnetized object, the H-field, linear & non-linear magnetic media; Electrodynamics – electromotive force, electromagnetic induction, Maxwell's equations in free space, plane wave solutions of Maxwell's equations in free space.

INSTR F214 Electronic Devices [3 0 3]

Crystal structure and growth of semiconductor, electrical conduction in solids, Elementary quantum physics (Photoelectric effect, uncertainty principle, Schrodinger wave equation and tunneling), energy bands in solids, charge carriers in semiconductors, excess carriers in semiconductors, Fabrication of p-n junctions, equilibrium conditions, forward and reverse biased junctions, metal-semiconductor junctions Bipolar junction transistors, field-effect transistors (JFET, HEMT, MOSFET), Special diodes (varactor diode, solar cell, LEDs, Tunnel diode and HBT), dielectric materials and insulation (Polarization mechanisms, frequency dependence, dielectric strength, and insulation breakdown).

INSTR F215 Digital Design [3 1 4]

Boolean Algebra & logic minimization; combinational logic circuits: arithmetic circuit design, Design using MSI components; Sequential Logic Circuits: flip flops & latches, registers, and counters, Finite state machine; HDL Implementation of Digital circuits; Digital Integrated Circuits; Programmable logic devices; Memory organization; Algorithmic State machine; Introduction to computer organization; The course will also have laboratory component on digital design.

INSTR F241 Microprocessors and Interfacing [3 1 4]

Programmers model of processor, processor architecture; Instruction set, modular assembly programming using subroutines, macros, etc.; Timing diagrams; Concept of interrupts: hardware & software interrupts, Interrupt handling techniques, Interrupt controllers; Types of Memory & memory interfacing; Programmable Peripheral devices and I/O Interfacing; DMA controller and its interfacing: Design of processor-based system. This course will have a laboratory component.

INSTR F242 Control Systems [3 0 3]

Modeling and classification of dynamical systems, Properties, and advantages of feedback systems, time-domain analysis, frequency-domain analysis, stability and performance analysis, State-space analysis, controller design.

INSTR F243 Signals & Systems [3 0 3]

This course is intended to provide comprehensive coverage of Signals and Systems, a fundamental subject of Electrical Engineering. The topics covered are Continuous-time and discrete-time signals and systems, convolution, properties of linear time-invariant (LTI) systems, Fourier series, Fourier transform, Z transforms, Laplace transform; System analysis, frequency response, analog filters, Sampling, and reconstruction.

INSTR F244 Microelectronic Circuits [3 0 3]

Basic microelectronic circuit analysis and design, biasing in discrete and integrated circuit amplifiers, an overview of modeling of microelectronic devices single and two-transistor amplifier configurations with passive and active loads; current mirrors & current sources; single-ended and differential linear amplifiers, differential and multistage amplifiers; 2 stages CMOS OPAMP, the frequency response of amplifiers; negative feedback in amplifiers, R-C frequency compensation.

INSTR F311 Electronic Instrumentation & Instrumentation Technology [3 1 4]

Electronic indicating, display, recording and analysis instruments, signal generators, frequency synthesizer, counters, elements of design, grounding and shielding, electronic circuits manufacturing technology, metrology, standards in quality management, instrumentation in a hazardous area, industrial communication techniques.

INSTR F312 Transducers and Measurement Systems [3 0 3]

Importance and types of measurement, generalized measurement system, functional elements, static & dynamic characteristics, primary sensing elements, passive transducers, active transducers, inverse transducers, fiber optic transducers, MEMS-based transducers, measurement techniques for motion, seismic, pressure, flow, temperature, level, humidity, pH, viscosity; signal conditioning techniques using the bridge, op-amp, instrumentation amplifier, carrier, chopper, charge, isolation amplifier, data converters, filters, modulators; data acquisition systems.

INSTR F313 Analog & Digital VLSI Design [3 0 3]

Moore's Law, Y chart, MOS device models including Deep Sub-Micron effects; an overview of fabrication of CMOS circuits, parasitic capacitances, MOS scaling techniques, latch-up, matching issues, common centroid geometries in layout. Digital circuit design styles for logic, arithmetic, and sequential blocks design; device sizing using logical effort; timing issues (clock skew and jitter) and clock distribution techniques; estimation and minimization of energy consumption; Power delay trade-off, interconnect modeling; memory architectures, memory circuits design, sense amplifiers; an overview of testing of integrated circuits. Basic and cascaded NMOS/PMOS/CMOS gain stages, Differential amplifier and advanced OPAMP design, matching of devices, mismatch analysis, CMRR, PSRR, and slew rate issues, offset voltage, advanced current mirrors; current and voltage references design, common-mode feedback circuits, Frequency response, stability and noise issues in amplifiers; frequency compensation techniques.

INSTR F341 Analog Electronics [3 1 4]

Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, the concept of negative feedback and virtual short; Analysis of simple operational amplifier circuits; Effects of real operational amplifier parameters on circuit performance. Linear applications of operational amplifiers: Instrumentation and Isolation amplifiers; Current and voltage sources; Active filters. Nonlinear applications of operational amplifiers: Comparators, Linearization amplifiers; Logarithmic amplifiers, multifunction modules & circuits, true RMS converters, Precision, and signal conditioning circuits, Waveform Generation: sinusoidal and non-sinusoidal signal generation; Wave shape converters. Timer 555 based circuits, Phase lock loop circuits & applications, IC regulators, Output stage and large signal amplifiers, Power amplifiers, Tuned amplifiers, Analog and Digital interface circuits: A/D, D/A Converters.

INSTR F342 Power Electronics [3 1 4]

Need for power conversion; Power electronic converters: classifications and scope; Power semiconductor switches: diodes, SCR , GTO and transistors (BJT, MOSFET and IGBT): Ratings, static and dynamic characteristics, drive and switching aid circuits and cooling; DC to DC conversion: Buck, Boost and Buck-Boost converters: circuit configuration and analysis with different kinds of loads; Choppers: single quadrant and two-quadrant operation with DC motor load and steady-state analysis; Rectifiers: single-phase and three-phase operation, power factor, harmonics and effect of source inductance; Dual converters; Drive concept: Four quadrant drive and load characteristics, selection of motor, control and stability of electric drives, feedback control of drives; DC motor drive; Inverters: single-phase and three-phase bridge inverters and PWM inverters; Single phase AC voltage regulators and cycloconverter; Induction motor drive - Variable frequency operation of 3-phase induction motor, stator voltage control and V/f control methods; Non-drive application of power electronic converters: UPS, active power line conditioner, electronic ballast and induction.

INSTR F343 Industrial Instrumentation and Control [3 0 3]

Importance of process control, elements of process loop, mathematical modeling, dynamic closed-loop characteristics, controller principles & tuning, direct digital loop, hydraulic controllers, pneumatic controllers, electronic controllers, complex & multivariable control schemes, final control elements, P& I diagrams, PLCs, Distributed Control Systems (DCS), AI techniques: expert systems, neural networks, fuzzy logic, genetic algorithms & applications.

BITS F415 Introduction to MEMS [3 1 4]

Overview, history and industry perspective; working principles; mechanics and dynamics, thermofluid engineering; scaling law; microactuators, microsensors, and microelectromechanical systems; microsystem design, modeling, and simulation; materials; packaging; microfabrication: bulk, surface, LIGA, etc; micromanufacturing; microfluidics; micro-robotics; case studies.

CS F213 Object Oriented Programming [3 1 4]

Object orientation concepts, theories, and principles; fundamental concepts of the object model: classes, objects, methods and messages, encapsulation and inheritance, interface and implementation, reuse and extension of classes, inheritance, and polymorphism; overloading and overriding; static and dynamic

binding; multithreaded programming; event handling and exception handling; the process of object-oriented requirements specification, analysis, and design; notations for object-oriented analysis and design; case studies and applications using some object-oriented programming languages. Object-Oriented Design Patterns: Behavioral, Structural, and Creational.

CS F342 Computer Architecture [3 1 4]

Processor performance criteria, performance benchmarks, arithmetic circuits, CPU design – instruction set architecture, instruction execution, Single and Multicycle implementation, Pipeline design, Hazards, methods of overcoming hazards, Branch prediction, Memory subsystems including cache optimization, Instruction level Parallelism.

CS F372 Operating Systems [3 0 3]

Introduction to operating systems; Various approaches to the design of operating systems; Overview of hardware support for Operating systems; Process/thread management: synchronization and mutual exclusion, inter-process communication, CPU scheduling approaches; Memory management: paging, segmentation, virtual memory, page replacement algorithms; File systems: design and implementation of file systems; Input/Output systems; device controllers and device drivers; Security and protection; Case studies on design and implementation of operating system modules.

EEE F346 Data Communication Networks [2 0 2]

Communication Concepts; Data and Voice Communications; Hardware Systems and Configurations; Network Topologies and Design Aspects; Protocols; Networking Software; Local Area Networks; Network Security and Management; Emerging Trends in Communications.

EEE F426 Fiber Optics & Optoelectronics [3 0 3]

Theory of optical fibers; image transmission by fibers; technology of fiber production; fiber testing; characterization of optical fibers; detectors and sources for fiber optic systems; active fibers; applications of optical fibers; optoelectronic devices and applications.

EEE F431 Mobile Telecommunication Networks [3 0 3]

Fundamentals of mobile telecommunications, with an overview of first-generation (analog) systems and more detailed coverage of second-generation (digital) technologies; technology basics including descriptions of wireless network elements, spectrum allocation, frequency re-use, characteristics of the transmission medium; over-the-air (OTA) interface characteristics; capacity, coverage, speech coding, channel coding and modulation techniques of TDMA and CDMA technologies; network characteristics; architecture, signaling, element management of IS-41 and GSM networks; call processing; call setup and release, handoff, roaming, advanced services; mobile data communications; circuit and packet-switched data services, third-generation (wideband data) mobile communications system requirements/ architecture.

EEE F433 Electromagnetic Fields & Waves [3 0 3]

Maxwell's equations; application of circuit theory and field theory; Maxwell's equations in free space and time-varying fields; plane waves in dielectric and conducting media; solution of wave equations; the Poynting vector; the Poynting theorem; Poynting vector in conducting media and circuit application; wave

polarization; linear, elliptical and circular polarization; wave reflection, refraction and diffraction; transmission lines and resonators; Smith chart, and its applications in stub matching and impedance matching; discontinuities; antennas and radiation; half-wave dipole antenna; loop antenna; helical antenna; directive arrays; frequency-independent antennas; reflector and lens antennas; horn antennas; antenna arrays; Friis formula; antenna practices and antenna measurements.

EEE F434 Digital Signal Processing [3 1 4]

Introduction; design of analog filters; design of digital filters (IIR and FIR); structures for the realization of digital filters; random signals and random processes; linear estimation and prediction; Wiener filters; DSP processor architecture; DSP algorithms for different applications.

EEE F435 Digital Image Processing [3 0 3]

This is the first course on digital image processing. It begins with an introduction to the fundamentals of digital images and discusses the various discrete transforms, which are extensively used in image processing. It then goes on to discuss the different image processing techniques such as image enhancement, image restoration, and image compression. Finally, it briefly touches upon automatic image classification and recognition.

EEE F472 Satellite Communication [3 0 3]

Review of microwave communications and LOS systems; the various satellite orbits like GEO, MEO, LEO; the satellite link analysis and design; the communication transponder system like INSAT, INELSAT, etc; the earth segment and earth station engineering; the transmission of analog and digital signals through satellite and various modulation techniques employed; the multiple access techniques like FDMA, TDMA, CDMA, DAMA, etc; the INSAT program; salient features of INSAT –systems and services offered; satellite services offered by INTELSAT, INMARSAT and future satellites like IRIDIUM, etc; future trends in satellite communications.

INSTR F412 Analysis Instrumentation [3 0 3]

Generalized configuration of an analysis instrument. Off-line analysis instruments: emission spectrometers, UV/VIS/IR absorption spectrophotometers, flame emission, and atomic absorption spectrophotometers, X-ray fluorescence spectrometer, and diffractometer, NMR and mass spectrometers, pH-meters, gas chromatographs, electrochemical instruments, analytical electron microscopes. On line analyzers: Sampling systems for gases and liquids, fluid density monitors, consistency and viscosity analyzers, thermal conductivity gas analyzers, paramagnetic oxygen analyzers, chemical composition analyzers, on-line instruments for measuring standard parameters, e.g. vapors pressure, distillation characteristics, cloud point, pour point, flash point, etc. Recent developments.

INSTR F413 Advanced Process Control [3 0 3]

Process identification and adaptive control; Model predictive control structures; Model-based control structures; State estimation; Synthesis of control systems-some case studies; intelligent control.

INSTR F414 Telecommunication Switching Systems & Networks [3 0 3]

Introduction, electromechanical switching, pulse dialing, and DTMF dialing, stored program control, space division switching, speech digitization, and transmission, time-division switching, fundamentals of traffic engineering, telephone networks, signaling, data networks, layered architecture and protocols, LANs, packet switching networks, TCP/IP, ISDN, ATM networks.

INSTR F432 Medical Instrumentation [3 0 3]

Basic components of biomedical instruments, bio-electric signals & recording electrodes, transducers, recording, and display devices. Patient care and monitoring systems, cardiovascular measurements-blood pressure, blood flow, cardiac output, heart sounds, etc.; instrumentation for respiratory and nervous systems, analysis of EEG, ECG, EMG, EOG and action potentials, non- invasive diagnostic measurements - temperature, ultrasonic diagnosis, CAT scan techniques, sensory measurements-motor response, analysis of behavior, etc. biotelemetry, biofeedback, clinical laboratory instruments, X-ray diagnosis. Recent advances in biomedical instrumentation- microprocessor-based systems, lasers & optical fiber-based systems.