BITS-Pilani, Hyderabad Campus: Course Description

B.E.(Hons.) Electronics and Communication Engineering

Core Courses:

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

Course covers basic passive circuit elements, dependent and independent sources, network theorems, circuit analysis techniques and 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.

EEE 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 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 magnetic field, magnetic vector potential, magnetic dipole; Magnetostatics in 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.

EEE 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

EEE 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 (varactordiode, solar cell, LEDs, Tunnel diode and HBT), dielectric materials and insulation (Polarization mechanisms, frequency dependence, dielectric strength and insulation breakdown).

EEE 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.

EEE 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 laboratory component.

EEE 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.

EEE F243 Signals & Systems [3 0 3]

This course is intended to provide a 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 transform, Laplace transform; System analysis, frequency response, analog filters, Sampling and reconstruction.

EEE 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 stage CMOS OPAMP, frequency response of amplifiers; negative feedback in amplifiers, R-C frequency compensation.

EEE F311 Communication Systems [3 1 4]

Analysis and design of communication systems; analog and digital modulation and demodulation, frequency conversion, multiplexing, noise and distortion; spectral and signal-to-noise ratio analysis, probability of error in digital systems, spread spectrum. Introduction to the basic principles of the design and analysis of modern digital communication systems. Topics include source coding, channel coding, baseband and pass band modulation techniques, receiver design, and channel equalization.

ECE F314 Electromagnetic Fields & Microwave Engineering [3 0 3]

Electromagnetic waves; Maxwell's equations; Poynting theorem and wave equations; propagation of EM waves; transmission lines; microstrip lines; wave guides; cavities and antennas; microwave generators, microwave amplifiers; measurement at microwave frequencies.

EEE F341 Analog Electronics [3 1 4]

Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, 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. Non- linear applications of operational amplifiers: Comparators,; Linearization amplifiers; Logarithmic amplifiers, multifunction modules & circuits, true rms convertors, 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.

ECE F344 Information Theory & Coding [3 1 4]

Random variables and random processes; Information sources and source coding theorem, Kraft inequality, Shannon-Fano codes, Huffman codes, Arithmetic Codes, Lempel-Ziv-Welch algorithm, universal source codes; channel capacity: channel capacity; noisy channel coding theorem for discrete memoryless channels; channel capacity with feedback; continuous and Gaussian channels; error control coding: linear block codes and their properties, hard-decision decoding, convolution codes and the Viterbi decoding algorithm, iterative decoding; turbo codes and low density parity- check codes; rate distortion theory: rate distortion function, random source codes; joint source channel coding and the separation theorem; cryptography: basic concepts on cryptography and crypto analysis, security issues; private-key encryption algorithms- stream ciphers, block ciphers, Shannon's theory; introduction to number theory - modular arithmetic, exponentiation and discrete logarithms in Galois field; public-key encryption algorithms- Diffie-Hellman public-key distribution scheme, RSA public-key cryptosystem; Message authentication, hashing functions, digital signatures.

ECE F434 Digital Signal Processing [3 0 3]

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.

Elective Courses:

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; microfludidics; microrobotics; case studies.

BITS F463 Cryptography [3 0 3]

Objectives of cryptography; ciphers – block and stream; mathematical foundations – modular arithmetic, finite fields, discrete logarithm, primality algorithms; RSA; digital signatures; interactive proofs; zero– knowledge proofs; probabilistic algorithms; pseudorandomness.

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; 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 design of operating systems ; Overview of hardware support for 0perating 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.

CS F451 Combinatorial Mathematics [3 0 3]

CS G553 Reconfigurable Computing [5]

Overview of Programmable Logics. FPGA fabric architectures. Logic Elements and Switch Networks. Design and Synthesis of Combinational and Sequential Elements. Placement and Routing. Pipelining and other Design Methodologies. Fine-grained and Coarse- Grained FPGAs. Static and Dynamic Reconfiguration. Partitioning. Hardware/Software Portioning and Partial Evaluation. Systolic Architectures.

ECE F312 EM Fields and Microwave Engineering Laboratory [0 1 1]

ECE 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.

ECE F416 Digital Communication [3 0 3]

Introduction, the modeling and characterization of information sources, algorithms for source coding and

encoding of analog output sources; Information transmission through AWGN channels using digital modulation methods and BER estimation; Digital communication through band limited Gaussian noise channels; channel coding and decoding; Wireless communication channels: its characterization and modulation schemes for such channels; emerging trends in the above field.

ECE F418 Modern Communication Technologies [3 0 3]

Modern communication systems overview, Digital modulation techniques, Channel capacity and coding, Digital link improve techniques, Digital receiver design and performance analysis, Wireless communication systems: wireless channel models and link improvement techniques, multiple access schemes. Basic concept of mobile network, Optical Communication Systems: Transmitters, receivers and other optical Communication subsystem, Optical wireless systems.

ECE F431 Mobile Telecommunication Networks [3 0 3]

ECE 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.

EEE F245 Control System Laboratory [0 1 1]

Experiments and simulations on concepts related to conventional and advanced control systems.

EEE F246 Electrical and Electronic Circuits Laboratory [0 2 2]

Experiments in Electrical sciences, Electronic devices, motors, transformer windings, machine windings, electronic circuits and signals, systems etc.

EEE 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 modelling; 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, stabilty and noise issues in amplifiers; frequency compensation techniques.

EEE F345 Power Apparatus & Networks [3 0 3]

Essential fundamentals of power networks: overview of power systems and changing landscape; sources of electrical energy and environmental consequences; the Indian power industry; fundamental principles of power networks; magnetic prerequisites. Apparatus in power networks: transformers; synchronous generators; transmission lines, cables, HVDC; loads and power quality. Analysis and operation: power flow; rotor angle and voltage stability; control of large interconnected power networks. Protection: fault calculations, relay co-ordination and circuit breakers; transient overvoltages, protection by surge arrestors, and insulation co-ordination. Management of vertical utilities, utility deregulation and open access: operational economics of the power industry, privatization; deregulation and energy markets.

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 F348 FPGA Based System Design Laboratory [0 2 2]

Introduction to Field Programmable Gate Arrays, Overview of FPGA design tools, Implementation of Data Flow Graph in FPGA, Analysis of performance tradeoffs (Pipelining, Retiming, Unfolding), Bus protocols (SPI, I2C), FPGA based DSP System Design , ADC/DAC interface, Real time signal processing system design.

EEE F417 Computer Based Control System [3 0 3]

Introduction to process control and Computer based control, elements of computer based control loop, digital sensors and their applications, field buses and specifications, types of digital and intelligent controllers, types of industrial control valves and their selections, PID vs Fuzzy and Neural Techniques of control, programmable logic controllers, SCADA and its applications, distributed ontrol systems comparison between PLC, DCS, Fuzzy. ANN,

industrial network hierarchy, industrial standards for networking, application of PLC in power system and process industries.

EEE F422 Modern Control Systems [3 0 3]

State variable characterization of linear continuous - time and discrete - time systems, controllability,
observability, stability; sampled data systems; Z transforms; non-linear systems; phase plane and describing function methods; calculus of variations; optimal control.

EEE F432 Medical Instrumentation [3 0 3]

Basic components of bio-medical 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 behaviour etc. biotelemetry, biofeedback, clinical laboratory instruments, X-ray diagnosis. Recent advances in biomedical instrumentation- microprocessor based systems, lasers & optical fiber based systems.

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]

Introduction to multidimensional signal processing-- 2-D convolution and filtering, discrete-time Fourier , filter design 2-D sampling and reconstruction transform, human visual system, Brightness perception , Temporal properties of vision, 2-D Block transforms-- Walsh-Hadamard, Karhunen Loeve, Discrete Hartley, Filter Banks and Wavelets etc. , Image Compression , Image Enhancement , Medical Image Processing , 3D techniques.

EEE F474 Antenna Theory and Design [3 1 4]

Introduction into antenna theory and practice, Radiation integrals and auxiliary potential functions; basic EM theorems in antenna problems, Antenna characteristics, Infinitesimal dipole; wire and loop radiating elements, Wire antennas – dipoles, monopoles, Arrays – analysis and design, Reflector antennas, Broadband antennas, Micro-strip patch antennas , Smith Chart

EEE F475 Special Electrical Machines [3 1 4]

Construction, principle of operation and performance of synchronous reluctance motors, stepping motors, switched reluctance motors, permanent magnet brushless D.C. motors, permanent magnet synchronous motors.

EEE F476 Switchgear and Protection [3 1 4]

Working applications of various switchgears and protective elements. Switches and fuses, Elementary principles of Circuit Breakers, Description and Operation of different types of circuit breakers, Electromagnetic and Static Relays, operation, construction and characteristics,

Generator Protection, Transformer Protection, Feeder and Bus-Bar Protection, Neutral Grounding, Protection against over voltages.

EEE F477 Modelling of Field-Effect Nano Devices [3 0 3]

Physical principles and MOS transistor phenomena, developing models including effective mobility, temperatures effects, and source/drain resistances. Smalldimensional effects, impact ionization, velocity saturation drain-induced barrier lowering (DIBL), ballistic operation, polysilicon depletion, quantum effects, gatetunneling currents, gate-induced drain leakage (GIDL) , fundamentals of low-power (low-voltage) CMOS design issues; the threshold voltage shift (due to SCE) , increased leakage power, sources of power , SOI MOS, (PDSOI, FDSOI) , multigate (MG) MOSFET, electrostatic integrity and short channel control, quantum mechanical origin, basics of BSIM CMG, compact models for multigate MOSFETs , mobility in multiple gate devices, improvement of the mobility, crystallographic orientations, strained Si channels.

EEE F478 Power Systems Laboratory [0 2 2]

Experiments on relays, circuit breakers, transmission lines, switch gear and protection, energy generation
methods, and application of artificial intelligence techniques, electric energy utilization including illumination, electrical drives etc.

EEE G512 Embedded System Design [3 1 4]

Introduction to embedded systems; embedded architectures: Architectures and programming of microcontrollers and DSPs. Embedded applications and technologies; power issues in system design; introduction to software and hardware co-design.

EEE G626 Hardware Software Co-Design [4]

FPGA and ASIC based design, Low-Power Techniques in RT Embedded Systems On-chip networking. Hardware Software partitioning and scheduling, Co-simulation, synthesis and verifications, Architecture mapping, HW-SW Interfaces and Re-configurable computing.

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 analysers, thermal conductivity gas analysers, paramagnetic oxygen analysers, chemical composition analysers, on-line instruments for measuring standard parameters, e.g. vapour pressure, distillation characteristics, cloudpoint, pour point, flash point etc. Recent developments.