

## 4th Year Odd Semester

### **EEE 4200 Seminar**

Contact hours/week: 2 Credits:1

Students will work in groups or individually to prepare review articles on the corresponding topic of their thesis/project and will present before audience.

### **EEE 4209 Embedded System Design**

Contact hours/week: 3 Credits: 3

Embedded Processing – Evolution, Issues and Challenges; System and Processor Architecture: von Neumann, Harvard and their variants; Memory Architecture and Devices; Input-Output Devices and Mechanisms; Instruction Set and Addressing Modes; Interfacing of Memory and Peripheral Devices – Functional and Timing Issues; Application Specific Logic Design using Field Programmable Devices and ASICs; Analog to Digital and Digital to Analog Converters; Bus I/O and Networking Considerations; Bus and Wireless Protocols; Embedded Systems Software: Constraints and Performance Targets; Real-time Operating Systems: Introduction, Scheduling in Realtime Operating Systems; Memory and I/O Management: Device Drivers; Embedded Software Development: Flow, Environments and Tools, System Specification and Modelling, Programming Paradigms, System Verification; Performance Analysis and Optimisation: Speed, Power and Area Optimisation; Testing of Embedded Systems System Design Examples using Microcontrollers, PLC, and FPGA.

### **EEE 4210 Embedded System Design Sessional**

Contact hours/week: 3/2 Credits: 0.75

Sessional based on the theory of course EEE 4209.

### **EEE 4217 Mobile Cellular Communication**

Contact hours/week: 3 Credits: 3

**Introduction:** Concept, evolution and fundamentals, analog and digital cellular systems.

**Cellular Radio System:** Frequency reuse, co-channel interference, cell splitting and components

**Mobile Radio Propagation:** Propagation characteristics, models for radio propagation, antenna at cell site and mobile antenna.

**Frequency Management and Channel Assignment:** Fundamentals, spectrum utilization, fundamentals of channel assignment, traffic and channel assignment.

**Handoffs and Dropped Calls:** Reasons and types, forced handoffs, mobile assisted handoffs and dropped call rate.

**Diversity Techniques:** Concept of diversity branch and signal paths, diversity types, Alamouti space-time block coding; carrier to noise and carrier to interference ratio performance.

**Digital Cellular Systems:** Global system for mobile, OFDM. GSM, AMPS, GPRS, EDGE, W-CDMA, generations of mobile communication, Packet switching and data communication

### **EEE 4243 Power system Operation and Control**

Contact hours/week: 3 Credits: 3

Principles of power system operation : SCADA, convention and competitive environment. Unit commitment, static security analysis, state estimation, optimal power flow, automatic generation control and dynamic security analysis.

### **EEE 4241 Power system protection**

Contact hours/week: 3 Credits: 3

Philosophy of switchgear and protection. Circuit breakers, principle of arc extinction in DC and AC circuit breakers. Recovery voltage, rate of rise of recovery voltage and other transient phenomena. Switching surges. Disconnection of unloaded transformer and transmission line. Speed of circuit breaker. Construction, operation, rating and testing of bulk oil and minimum oil breaker, SF6 circuit breaker, ABCB, ACB, and VCB. Selection of circuit breaker.

Travelling wave in transmission line. Surge absorber, lightning arrester, horn gap, its rating and testing. Protective relaying: Relay voltage rating, high, medium and low. Basic protective zone. Relaying Scheme. Electromechanical Relays: Principal, general equation. overcurrent, balanced current, overvoltage, distance, directional, positive sequence, negative sequence and differential relays and their applications. Static relays: Introduction to solid state device in the construction of static relays. Different type of static relays. Generator protection. Transformer protection, Buchholz's relay. Protection of bus bar, transmission line, feeder etc. Relay testing.

### **EEE 4242 Power system protection Sessional**

Contact hours/week: 3/2 Credits:0.7

Sessional based on the theory of course EEE 4241.

### **EEE 4245 Electrical Machine III**

Contact hours/week: 3 Credits:3

**Special Machines:** Series universal motor, permanent magnet DC motor, unipolars and bipolar brush less DC motors, stepper motor and control circuits. Reluctance and hysteresis motors with drives circuits, switched reluctance motor, electro static motor, repulsion motor, synchros and control transformers. Permanent magnet synchronous motors.

**Acyclic Machines:** Generators, conduction pump and induction pump.

**Magneto Hydrodynamic Generators:** Fuel cells, thermoelectric generators, flywheels, vector control, linear motors and traction.

### **EEE 4247 Renewable Energy**

Contact hours/week: 3 Credits: 3

Importance of renewable energy, sources. Statistics regarding solar radiation and wind speed. Insulation: geographical distribution, atmospheric factors, measurements. Solar cell: principle of operation, spectral response, factors affecting conversion efficiency, I-V characteristics, maximum power output. PV modules and arrays: stationary and tracking. PV systems: stand alone, battery storage, inverter interfaces with grid. Wind turbine generators: types, operational characteristics, cut-in and cut-out speed, control, grid interfacing, AC-DC-AC link. Wind and Tidal energy conversion.

### **EEE 4263 Optoelectronics**

Contact hours/week: 3 Credits: 3

Light : Nature of light, Polarization, superposition, interference, diffraction, sources, blackbody radiation.

Modulation of light : Elliptical polarization, Birefringence, quarter wave plate, optical activity, electro-optic effect, Kerr modulators, scanning and switching, magneto-optic devices, acousto-optic effect, nonlinear optics.

Display devices: Luminescence, photoluminescence, cathodoluminescent, LED materials, LED construction, response time, plasma displays, LCD, numerical display.

Lasers : Emission and absorption, Einstein relation, optical feedback, laser losses, line shape function, modes, classes of laser, laser applications, distance measurements, holography.

Photo detectors : Thermal detectors, photon devices, vacuum photodiodes, Noise, Image intensifier, junction detectors, detector arrays.

Optical communication system: Fiber optic communication, integrated optics.

Noncommunication applications: Optical fiber sensors, Light guiding fiber.

### **EEE 4261 Biomedical Engineering**

Contact hours/week: 3 Credits: 3

Medical terminology, cell physiology, membrane potential, action potential, Rhythmic excitation of heart. Transducers used in medical diagnostics.

Biomedical Instrumentation: Normal Electrocardiograph, ECG simulator, Watch filter, ECG amplifier, pulse beat monitor, pace maker, galvanic skin resistance detector, respiratory and suction apparatus. Electronic stethoscope.

Electronic clinical thermometer, blood flow and pressure monitoring recorders, metabolic rate measurement. Special topics: Bio-telemetry, application of ultrasonic and laser in biology and medicine. Clinical X-ray equipment. Fluoroscopy. Infrared heating.

### **EEE 4262 Biomedical Engineering Sessional**

Contact hours/week: 3/2 Credits: 0.75

Sessional based on the theory of course **EEE 4261**.

### **EEE 4267 Transducers and Instrumentation**

Contact hours/week: 3 Credits: 3

Introduction : Functional elements of Instrumentation system, classification, standards and calibration of different

instruments, use of personal computer in instrumentation.

Static performance of Instruments : Errors and uncertainties, propagation of uncertainties, Accuracy, Precision,

Resolution, Linearity etc., Impedance loading and matching, selection of instruments.

Transducer elements : Analog and digital transducer, Active and passive transducer.

Construction, operating

principle and characteristics of Resistive , Inductive and capacitive transducer, Strain Gauge, Light dependent

transducer, LVDT, Piezoelectric, Hall effect transducer, Thermistor, Thermocouple, RTD, Proximity transducer.

Data Acquisition and display : Amplifiers, Compensators, Filters, A-D and D-A converter, Data transmission

elements, Display and recording elements.

Motion measurement : Relative and absolute motion, Linear and rotational motion measurement.

Force measurement : Pneumatic and elastic force, measurement of time varying force.

Pressure measurement : High, moderate and low (Vacuum) pressure measurement.

Torque and power measurement : transmission dynamometers, non-contact dynamometers.

Temperature measurement : Measurement of ambient temperature, temperature monitoring and control,

measurement of high temperature, use of RTD, Pyrometers.

Flow measurement : Linear resistance element flow meter, Ultrasonic flow meter, electromagnetic flow meter. Hot

wire anemometer, Laser Doppler anemometer.

Acoustic measurement : Sound pressure and power level, Loudness, sound level meter.

Microphones, Piezoelectric

crystal type microphone, Electrodynamics type microphone, Carbon microphone.

Computer aided instrumentation : Example of a few open loop and closed loop control system using different

transducers and personal computer.

### **EEE 4268 Transducers and Instrumentation Sessional**

Contact hours/week: 3/2 Credits: 0.75

Sessional: Sessional based on theory of course EEE 4267.

### **EEE 4265 Processing and Fabrication Technology**

Contact hours/week: 3 Credits: 3

**Monolithic Fabrication Processes and Structures:** Substrate materials: Crystal growth and wafer preparation.

Basic MOS process, Basic Bipolar process, Photolithographic process, pattern generation, pattern transfer, mask alignment, soft and hard baking, Photomask fabrication. Thermal oxidation, oxide quality, oxide thickness characterization.

**Cleaning:** Surface cleaning, organic cleaning and RCA cleaning.

**Diffusion:** Mathematical model, constant source diffusion, limited source diffusion, two-step diffusion, sheet resistance. Diffusion systems: Boron, Phosphorous, Ion implementation.

**Etching:** Wet chemical etching, silicon and GaAs etching, anisotropic etching, selective etching, dry physical

etching, ion beam etching, sputtering etching and reactive ion etching.

**Film Deposition:** Evaporation, sputtering, CVD, Epitaxy.

**Isolation:** p-n junction isolation, mesa isolation and oxide isolation, BJT based microcircuits, p-channel and nchannel

MOSFETs, complimentary MOSFETs and silicon on insulator devices. Testing, bonding and packaging.

Interconnection, contacts, packaging and testing.

### **EEE 4281 Antennas and Propagation**

Contact hours/week: 3 Credits: 3

**Fundamental of Antennas:** Vector Potential Functions, Electric and Magnetic Fields for Electric and Magnetic

Current Sources, Solution of Vector Potential Wave Equation.

**Antenna Arrays:** Two-Element Array, N-element Linear Arrays: Broad-side, End-fire, Phased, Binomial, Dolph-

Tchebyschef and Super-directive Arrays, Determination of Array Factor and Patterns, Planar and Circular Arrays.

**Travelling-Wave and Broad-band Antennas:** Long wire, V, Rhombic and Helical Antennas, Yagi, Uda array,

Frequency Independent and Log-periodic Antennas.

**Aperture, Reflector and Lens Antennas:** Huygens's Principle, Rectangular and Circular Apertures, Microstrip Antennas. Babinet's Principle, Sectoral, Pyramidal and Conical Horns, Parabolic and Cassegrain Reflector Antennas, Lens Antennas.

**Antenna Measurement:** Antenna ranges, Radiation Pattern, Gain and Directivity, Polarization.

**Radio wave propagation:** Ground wave propagation, Ionospheric propagation, Propagation losses.

### **EEE 4282 Antennas and Propagation Sessional**

Contact hours/week: 3/2 Credits: 0.75

Sessional based on the theory of course EEE 4281.

### **EEE 4283 Radar and Satellite Communication**

Contact hours/week: 3 Credits: 3

**Radar:** Introduction to Radar, Radar Equation CZ, Operating Principle of Radar with Block Diagram, CW and FM

Radar, Tracking Radar, Antennas for Radar, Radar Receivers, Radar Transmitting System, Duplexer, Usable

Frequencies for Radar, Radar Applications.

**Satellite Communication:** Overview of Satellite System Engineering. Spacecraft, Introduction, to Spacecraft

Subsystem. (AOCS), Telemetry, Tracking and command (TT&C). Spacecraft Antennas, Basic Antenna Types and

Relationships Spacecraft, Antennas in Practice, Frequency Reuse Equipment Reliability and Space Qualification,

Reliability redundancy. Multiple Access. Earth station Technology : Earth Station Design, Earth Station Design for

Low System Noise Temperature, Large Earth Station Antennas.

Satellite Television Broadcasting Networks, VSAT technology.

### **EEE 4285 Optical Fiber Communication**

Contact hours/week: 3 Credits: 3

Introduction : Historical perspective, basic system, nature of light, advantages and applications of fiber optic.

Optics review : Ray theory and applications, lenses, imaging, numerical aperture, diffraction.

Light wave fundamentals : Electromagnetic waves, Dispersion, polarization, resonant cavities, reflection at plane

boundary, critical angle.

Integrated optic waveguides : Slab waveguide, Modes in symmetric and asymmetric waveguide, coupling,

Dispersion and distortion, Integrated optic components.

Optic fiber waveguide : Step index fiber, graded index fiber, attenuation, pulse distortion and information rate,

construction of optic fiber, optic fiber cables.

Light sources : LED, LD, distributed feedback LD, optical amplifiers, fiber laser, vertical cavity surface emitting laser diode.

Light detectors : Photo detection, photo multiplier, semiconductor photodiode, PIN photodiode, avalanche photodiode.

Couplers and connectors : Connector principle, end preparation, splices, connectors, source coupling.

Network distribution and fiber components: Directional couplers, star couplers, switches, isolator, wave-length

division multiplexing, fiber bragg grating.

Modulation: LED modulation, LD modulation, Analogue and digital modulation, modulation formats, optic heterodyne receivers.

Noise and detection : Thermal shot and noise, SNR, error rates, receiver circuit design.

System design: Analogue and digital system design, few real life problems and examples.