

## B.Sc. in Electrical Engineering Communications & Electronics Study Plan

### ■ University Compulsory Courses 16 C.H Page ( 64 )

### ■ University Elective Courses 9 C.H Pages ( 64 & 65 )

### ■ Faculty Compulsory Courses 32 C.H

Line No.	Code	Course	
224000	CHE400CH	PROFESSIONAL ETHICS FOR ENGINEERS	1
242020	EE202EE	COMMUNICATION SKILLS FOR ENGINEERS	2
901010	MATH101	CALCULUS( 1)	3
901020	MATH102	CALCULUS ( 2)	3
902010	MATH201	INTERMEDIATE ANALYSIS	3
902030	MATH203	ORDINARY DIFFERENTIAL EQUATIONS	3
911010	CHEM101	GENERAL CHEMISTRY( 1)	3
911020	CHEM102	GENERAL CHEMISTRY ( 2)	3
911072	CHEM107B	GENERAL CHEMISTRY LAB	1
921010	PHY101	GENERAL PHYSICS ( 1)	3
921020	PHY102	GENERAL PHYSICS ( 2)	3
921072	PHY107B	GENERAL PHYSICS (LAB)	1
1731150	CS115	C++ PROGRAMMING LANGUAGES	3

### ■ Department Compulsory Courses 75 C.H

Line No.	Code	Course	
241000	EE100	INTRODUCTION TO ELECTRICAL ENGINEERING	3
242070	EE207	ELECTROMAGNETICS ( 1)	3
242100	EE210	CIRCUITS ( 1)	3
242130	EE213	ELECTRICAL CIRCUITS LAB	1
242201	EE220A	INTRODUCTION TO ELECTRONICS	3
242401	EE240	INTRODUCTION TO LINEAR SYSTEMS	3
242601	EE260	SIGNAL AND SYSTEM ANALYSIS	3
243051	EE305	NUMERICAL METHODS FOR ENGINEERS	3
243071	EE307	ELECTROMAGNETICS ( 2)	3
243101	EE310	ELECTRIC CIRCUITS ( 2)	3
243202	EE320B	ELECTRONIC CIRCUITS	3
243221	EE322A	ELECTRONIC CIRCUITS LAB	1
243321	EE332A	ELECTRIC MACHINES	3
243411	EE341	INSTRUMENTATION & MEASUREMENTS	3
243450	EE345	INTRODUCTION TO MICROCONTROLLERS	3
243460	EE346	MICROCONTROLLERS LAB	1
243601	EE360	RANDOM SIGNAL ANALYSIS	3
244201	EE420	DIGITAL ELECTRONIC CIRCUITS	3
244402	EE440B	COTROL SYSTEMS	3
244451	EE445A	MICROCONTROLLERS & EMBEDDED SYSTEMS	3
244501	EE450A	COMMUNICATION SYSTEMS	3
244521	EE452A	COMMUNICATION SYSTEMS LAB	1
244801	EE480A	POWER SYSTEMS	3

244820	EE482	ELECTROMECHANICAL SYSTEM LAB	1
244901	EE490A	ENGINEERING TRAINING	3
245911	EE591	GRADUATION PROJECT ( 1)	1
245920	EE592	GRADUATION PROJECT ( 2)	3
252000	ME200	ENGINEERING DRAWING (A)	1
252150	ME215	ENGINEERING MECHANICS	3
293410	IE341	ENGINEERING ECONOMY	2

### ■ Department Elective Courses 6 C.H

Line No.	Code	Course	
245071	EE507A	ANTENNAS	3
245081	EE508A	INTRODUCTION TO ELECTROMAGNETIC COMPATIBILITY	3
245090	EE509	MICROWAVE ENGINEERING	3
245211	EE521A	SOLID STATE ELECTRONICS	3
245220	EE522	OPTOELECTRONICS	3
245251	EE525A	ELECTRONIC CIRCUIT DESIGN	3
245260	EE526	SEMICONDUCTOR DEVICES	3
245291	EE529A	CMOS CIRCUIT DESIGN	3
245551	EE555A	OPTICAL FIBER COMMUNICATION SYSTEMS	3
245581	EE558A	SATELLITE COMMUNICATION SYSTEMS	3
245650	EE565	DIGITAL SPEECH PROCESSING	3
245660	EE566	DIGITAL IMAGE PROCESSING	3
245700	EE570	COMMUNICATION NETWORKS	3
245950	EE595	SPECIAL TOPICS IN COMMUNICATIONS & ELECTRONICS	3

### ■ Specialization Compulsory Courses 21 C.H

Line No.	Code	Course	
244070	EE407	RADIOWAVE PROPAGATION & ANTENNAS	3
244220	EE422	DIGITAL ELECTRONIC CIRCUITS LAB.	1
244601	EE460A	DIGITAL SIGNAL PROCESSING	3
244620	EE462	DIGITAL SIGNAL PROCESSING LAB	1
245242	EE524B	ELECTRONIC COMMUNICATION CIRCUITS	3
245280	EE528	MICROWAVE ELECTRONICS	3
245512	EE551B	DIGITAL COMMUNICATIONS	3
245520	EE552	DIGITAL COMMUNICATIONS LAB	1
245592	EE559B	INTRODUCTION TO WIRELESS COMMUNICATIONS	3

**TOTAL 159 C.H**

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242130	EE213	ELECTRICAL CIRCUITS LAB	1
242201	EE220A	INTRODUCTION TO ELECTRONICS	3
242401	EE240	INTRODUCTION TO LINEAR SYSTEMS	3
242601	EE260	SIGNAL AND SYSTEM ANALYSIS	3
243051	EE305	NUMERICAL METHODS FOR ENGINEERS	3
243071	EE307	ELECTROMAGNETICS (2)	3
243101	EE310	ELECTRIC CIRCUITS (2)	3
243201	EE320	ELECTRONICS (2)	3
243220	EE322	ELECTRONIC CIRCUITS LAB (2)	1
243320	EE332	ELECTRICAL MACHINES (1)	3
243411	EE341	INSTRUMENTATION & MEASUREMENTS	3
243450	EE345	INTRODUCTION TO MICROCONTROLLERS	3
243460	EE346	MICROCONTROLLERS LAB	1
243601	EE360	RANDOM SIGNAL ANALYSIS	3
244201	EE420	DIGITAL ELECTRONIC CIRCUITS	3
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Line No.	Code	Course	
245372	EE537B	SWITCHED - MODE POWER SUPPLIES	3
245381	EE538A	HIGH VOLTAGE ENGINEERING	3
245393	EE539C	ADVANCED ELECTRIC MACHINES	3
245401	EE540A	INTRODUCTION TO ROBOTICS	3
245412	EE541B	SENSORS & ACTUATORS	3
245460	EE546	POWER SYSTEM CONTROL	3
245860	EE586	POWER SYSTEM PROTECTION	3
245960	EE596	SPECIAL TOPICS IN POWER & CONTROL	3

### ■ Specialization Compulsory Courses 21 C.H

Line No.	Code	Course	
244351	EE435A	POWER ELECTRONICS	3
244361	EE436A	POWER ELECTRONICS LAB	1
244422	EE442B	CONTROL SYSTEMS LAB	1
244471	EE447	DIGITAL CONTROL	3
244830	EE483	POWER TRANSMISSION & DISTRIBUTION	3
245312	EE531B	ELECTRIC DRIVE SYSTEMS	3
245470	EE547	COMPUTER CONTROL	3
245805	EE580E	POWER SYSTEM ANALYSIS	3
245820	EE582	POWER SYSTEMS LAB	1

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## B.Sc. in Electrical Engineering

### Courses' Description

#### EE 100 Introduction to Electrical Engineering (3C,2H,2L)

Engineering profession. Nature & scope of Electrical Engineering. Engineering design & problem solving. Study skills. Library search. Department facilities & resources available. Accreditation criteria. Careers & job prospects. Introduction to electric & logic circuits & the use of SPICE to simulate & solve such circuits. Matlab programming & applications in linear algebra: solving linear & nonlinear equations & ordinary differential equations, plotting of functions & curve fitting, Introduction to statistical data analysis. Experiments to familiarize the students with the introductory lab equipments. (Pre-/Co- Requisites: CIS 100, Co-Phys 102 Department Compulsory)

#### EE 20 Communication Skills for Engineers 2C,2H

Managing technical data & writing for the workplace. namely, memorandums, letters, applications, & research projects. Building presentation skills through several individual & team presentations, focusing on style of delivery, & interaction with audience. Job interview skills. (Pre-/Co- Requisites: 2<sup>nd</sup> Year Standing Faculty Compulsory)

#### EE 207 Electromagnetics I 3C,3H

Vector analysis. Electrostatic fields. Magnetostatic fields. Solution of Laplace's & Poisson's equations. Faraday's law & applications. Maxwell's equations. (Pre-/Co- Requisites: Phys 102, Math 201, Math 203 Department Compulsory)

#### EE 210 Electric Circuits I 3C,3H

Units & definitions. Experimental laws & simple circuits. Useful techniques of circuit analysis. Inductance and capacitance. Source-free RL & RC circuits. Application of the unit step forcing function. RLC circuits. Sinusoidal forcing function. Phasor concept. Sinusoidal steady-state response. (Pre-/Co-Requisites: EE 100, Co-Math 203 Department Compulsory)

#### EE 212 Electric Circuit Analysis 3C,3H

Units & definitions. Experimental laws & simple circuits. Useful techniques of circuit analysis. Inductance & capacitance. Source-free RL & RC circuits. Application of the unit step forcing function. RLC circuits. Sinusoidal forcing function. Phasor concept. Sinusoidal steady-state response. (Pre-/Co- Requisites: Phy 102, Co-Math 203 Non-EE Students)

#### EE 213 Electric Circuits Lab 1C,3L

Resistors and resistive circuits. Potentiometers. Superposition principle. Thevenin's theorem & maximum power transfer. RLC current & voltage characteristics. Frequency response of RL, RC & RLC circuits. Series & parallel resonant circuits. Lab project. (Pre-/Co- Requisites: EE 210 Department Compulsory)

#### EE 220 Introduction to Electronics 3C,3H

Semiconductor materials. Intrinsic, N-type & P-type semiconductors. Carriers. Density of state & Fermi function. Distribution of carriers. Drift & diffusion currents. Einstein's relationship. p-n junctions: depletion region, forward & reverse biasing, I-V relationship. Diode circuits & applications. Bipolar junction & field-effect transistors: theory, dc biasing, dc & ac loadlines, symmetrical swing. Small-signal transistor models.

(Pre-/Co- Requisites: Co-EE 210 Department Compulsory)

#### EE 240 Introduction to Linear Systems 3C,3H

Gaussian elimination. The theory of simultaneous linear equations. Orthogonal projections & least squares. Determinants. Complex-valued vectors & matrices. Eigenvalues & eigenvectors. Singular value decomposition. computer applications. (Pre-/Co- Requisites: EE 100, Math 201 Department Compulsory)

#### EE 260 Signal and System Analysis 3C,3H

Discrete & continuous time systems: classifications, convolution & impulse response. Orthogonal expansions & Fourier series. Fourier transform. Laplace transform. Z-transform. System function. Frequency response. Sampling theorem. Discrete-time Fourier transform. Discrete Fourier transform. Computer applications. (Pre-/Co- Requisites: EE 210, Co-EE 240 Department Compulsory)

#### EE 303 Fundamentals of Electrical Engineering 3C,3H

Electrical quantities. Circuit principles. Basics of DC & AC analysis. Polyphase circuits. Transformers. Semiconductor diodes. Bipolar transistors. Field effect transistors. Thyristors. Operational amplifiers. (Pre-/Co- Requisites: Math 102, Phys 102 Non-EE Students)

#### EE 304 Electric Drives 3C,3H

Introduction to electric drives, DC drives. AC drives: induction motors, synchronous motors, reluctance & stepping motors. Servomotor drives. (Pre-/Co- Requisites: EE 212 or EE 303 Non-EE Students)

#### EE 305 Numerical Methods for Engineers 3C,3H

Machine epsilon. Round-off error. Linear systems of equations. Gauss elimination & iterative methods. Eigenvalue methods. Spline interpolation. Numerical integration. Ordinary & partial differential equations. Nonlinear equations. Zeros of polynomials. One dimensional optimization. Least squares data fitting. Singular value decomposition. Random number generators. (Pre-/Co- Requisites: CS 115, Math 203 Department Compulsory)

#### EE 306 Electrical Engineering Lab 1C,3L

DC circuits. Diodes, transistors, thyristors & operational amplifiers. Transformers. DC motors. Synchronous motors. Single- & three-phase & induction motors. (Pre-/Co- Requisites: EE 304 Non-EE Students)

#### EE 307 Electromagnetics II 3C,3H

Maxwell's equations. Plane waves: propagation, reflection & refraction. Transmission lines. Waveguides & resonant cavities. Introduction to antennas. (Pre-/Co-Requisites: EE 207 Department Compulsory)

#### EE 310 Electric Circuits II 3C,3H

Average power & RMS values. Polyphase circuits. Complex frequency. Frequency response. Magnetically coupled circuits. General two-port networks. Solving circuit problems using Laplace transform. Introduction to electric filters. (Pre-/Co- Requisites: EE 210, EE 260 Department Compulsory)

#### EE 320 Electronic Circuits 3C,3H

Small signal analysis of BJT and FET amplifiers. Multistage amplifiers. Frequency response of single &

multistage amplifiers. Darlington pair amplifiers  
Differential amplifiers. Operational amplifier theory &  
applications: summation, subtraction, integration &  
differentiation. Filters. Oscillators.

*(Pre-/Co- Requisites: EE 220 Department Compulsory)*

### **EE 321 Fundamentals of Electronics 3C,3H**

Diode circuit analysis (DC&AC). Bipolar junction  
transistors: theory, circuits & applications. Field effect  
transistors: theory, circuits & application. Introduction to  
operational amplifiers & applications.

*(Pre-/Co- Requisites: EE 212 or EE 303 Non-EE  
Students)*

### **EE 322 Electronic Circuits Lab 1C,3L**

Diode circuits. DC & AC characteristics of BJT & FET  
amplifiers. Single- & multi-stage amplifiers & their  
frequency response. Operational amplifiers &  
applications. Filters. Oscillators. Lab project.

*(Pre-/Co-Requisites: EE 213, EE 320 Department  
Compulsory)*

### **EE 332 Electric Machines 3C,3H**

Transformers: performance characteristics, three-phase  
connections, autotransformers. DC machines:  
performance equations, generator & motor  
characteristics, starting & speed control of motors.  
Synchronous machines: generator & motor operation.  
Three-phase induction motors: operation, performance  
calculations, starting & speed control. Single phase  
induction motors. Small synchronous motors. Universal  
motors.

*(Pre-/Co- Requisites: EE 207, EE 310 Department  
Compulsory)*

### **EE 341 Instrumentation and Measurements 1C,3L**

Units, Dimensions, & standards; Measurement errors;  
Statistical analysis of experimental data; Operational  
amplifier circuits in instrumentation; Transducers:  
mechanical, thermal, optical; Measurements of basic  
electrical quantities: electromechanical indicating  
instruments, electronics multi-meters, digital multi-  
meters, ac bridges; Digital-signal conditioning: analogue-  
to-digital converters, digital-to-analogue converters,  
sample-and-hold circuits, data acquisition hardware,  
IEEE 488 instrumentation bus; Oscilloscopes: vertical  
deflection system, horizontal deflection system, digital  
storage oscilloscopes; Spectrum analyzers. *(Pre-/Co-  
Requisites: EE 320, EE 260 Department Compulsory)*

### **EE 345 Introduction to Microcontrollers 3C,3H**

Basics of digital logic systems. Boolean algebra.  
Combinational circuits. Flip-flops & sequential circuits.  
Sequential system design & timing diagrams. Computer  
organization. Memory. Hardware description language.  
Microcontroller & assembly language programming.

*(Pre-/Co- Requisites: EE 100 Department Compulsory)*

### **EE 346 Microcontrollers Lab 1C,3L**

Experiments using TTL family via implementation of logic  
functions using &, OR, & NOT. Implementation of logic  
functions using MSI chips such as encoders, decoders,  
multiplexers, & EPROMS. Software and hardware  
experiments with a microcontroller system. Assembly  
language programming & simple input/output  
interfacing. Lab project. *(Pre-/Co- Requisites: EE  
345 Department Compulsory)*

### **EE 360 Random Signal Analysis 3C,3H**

Probability principles & set theory. Random variables.  
Operations on random variables. Various distribution  
functions. Random processes: temporal & spectral  
characterization. Response of linear time-invariant

systems to random inputs. *(Pre-/Co- Requisites: EE  
260 Department Compulsory)*

### **EE 407 Radiowave Propagation & Antennas 3C,3H**

Antenna principles & types; Antenna parameters (gain,  
beamwidth, aperture, impedance, polarization); ideal &  
practical dipoles; Friis transmission formula & radar  
equation; Plane earth propagation; Knife-edge  
diffraction; Biological effects of radiation; Satellite  
communications; Urban propagation; Noise in  
communication systems. *(Pre-/Co- Requisites: EE 307  
Communications & Electronics Compulsory)*

### **EE 420 Digital Electronic Circuits 3C,3H**

Diodes & transistors as switches. Switching & speed  
limitations. RTL. DTL. TTL, ECL, & MOS logic gates.  
Interfacing & expansion of logic circuits. Comparators &  
Schmitt triggers. Multivibrators. Timing circuits. A/D &  
D/A converters. Sample & hold circuits. *(Pre-/Co-  
Requisites: EE 320 Department Compulsory)*

### **EE 422 Digital Electronic Circuits Lab 1C,3L**

Transistor as a switch. TTL logic specifications.  
Interfacing of logic gates. Comparators & Schmitt  
triggers. Monostable & astable multivibrators. 555  
timers. A/D & D/A converters. Sweep voltage  
generators. Sample & hold circuits. Lab project. *(Pre-  
/Co- Requisites: EE 420 Communications & Electronics  
Compulsory)*

### **EE 435 Power Electronics 3C,3H**

Power semiconductor devices: types, drive circuits,  
protection circuits, & power loss calculation. AC-DC  
converters: uncontrolled & fully-controlled single-phase  
& three-phase rectifiers, half-controlled rectifiers. AC-AC  
converters: cycloconverters, ac voltage controllers. DC-  
AC converters: single-phase & three-phase inverters.  
DC-DC converters: step-down, step-up, and step-  
down/up converters. *(Pre-/Co- Requisites: EE 320, EE  
332 Power and Control Compulsory)*

### **EE 436 Power Electronics Lab 1C,3L**

Single-phase fully-controlled bridge rectifier with  
static/rotating loads. Single-phase half-controlled bridge  
rectifier. Three-phase controlled bridge rectifier. Single-  
phase ac voltage controller. Frequency converter.  
Single-phase bridge inverter with static/rotating loads.  
Three-phase bridge inverter. Step-down converter. Step-  
up converter. Step down/up converter. Lab project.  
*(Pre-/Co-Requisites: EE 322, EE 435 Power & Control  
Compulsory)*

### **EE 440 Control Systems 3C,3H**

Transfer functions. Block diagrams. Signal flow graphs.  
State-space description. Mathematical modeling of  
physical systems. Time-domain analysis. Root locus  
techniques. Frequency-domain analysis and design.  
*(Pre-/Co- Requisites: EE 260 Department Compulsory)*

### **EE 442 Control Systems Lab 1C,3L**

Measurement of motor characteristics: armature  
connection & field connection. Transient response of  
motors. Closed-loop position & speed control systems.  
Dead band & transient characteristics. Passive network  
compensation. Stabilization with tachogenerator  
feedback: frequency response measurement. Lab  
project. *(Pre-/Co- Requisites: EE 440 Power and Control  
Compulsory)*

### **EE 445 Microcontrollers & Embedded Systems**

**3C,2H,2L**

Basic architecture & assembly language of a  
microcontroller. Principles of microprocessor serial &

parallel interfacing. Timers, A/D & D/A relevant chips. Software & hardware interrupt handling routines. Application of top-down design to microcontroller software development in assembly language & a high level language. Evaluation of hardware & software trade-offs. Laboratory experiments on the software & hardware of the microcontroller & a final comprehensive lab project. (Pre-/Co- Requisites: EE 322, EE 346) Department Compulsory

**EE 447 Digital Control 3C,3H**

Review of discrete-time systems & the Z-transform. Sampled data systems. Stability. Jury & Schure-Cohn criterion. Controllability & observability. Gain compensation. Direct design methods. Feedback control systems. Dynamic programming. (Pre-/Co- Requisites: EE 440) Power & Control Compulsory

**EE 450 Communication Systems 3C,3H**

Equivalent low-pass models. Amplitude modulation & demodulation. Coherent & non-coherent detection. Angle modulation & demodulation. Noise representation & analysis: SNR analysis of AM & FM systems. Sampling, quantization & pulse code modulation. TDM & Pulse modulation techniques: PAM, PPM, PWM. (Pre-/Co- Requisites: EE 360) Department Compulsory

**EE 452 Communication Systems Lab 1C,3L**

Tuned circuits & crystals. AM modulators. AM demodulators. Super-heterodyne radio receiver. FM modulators. FM demodulators. Simulation using Matlab/Simulink. Lab project. (Pre-/Co- Requisites: EE 322, EE 450) Department Compulsory

**EE 460 Digital Signal Processing 3C,3H**

Review of discrete time signals & systems. Z transform review. Pole & zero placement. Allpass systems & applications. Minimum phase systems. Structure of FIR systems. Design of FIR filters by windowing. Design of discrete time IIR filters from continuous time filters. Impulse invariance & bilinear transformation design methods. Autocorrelation function & the spectral density of discrete-time signals. Stochastic models (AR, MA and ARMA). The Yule-Walker equation. (Pre-/Co- Requisites: EE 305, EE 360) Communications & Electronics Compulsory

**EE 462 Digital Signal Processing Lab 1C,3L**

The lab uses Matlab as the simulation package & experiments will be conducted on the available DSP boards. Familiarization experiments with the DSP kit. Experiments include FIR & IIR filter design, quantization effects, & spectral estimation. Real signals are sampled & processed including speech and images. Lab project. (Pre-/Co- Requisites: EE 460) Communications & Electronics Compulsory

**EE 480 Power Systems 3C,3H**

Basic Concepts & Per Unit Impedances. Phase shift in transformers. Series impedance of transmission lines. Capacitance of transmission lines. Current & voltage relations of transmission lines. Admittance model & network calculations. Impedance model & network calculations. Power flow solutions. Symmetrical fault analysis. (Pre-/Co- Requisites: EE 305, EE 332) Department Compulsory

**EE 482 Electromechanical Systems Lab 1C,3L**

DC machines. Three-phase induction motors. Transformers. Three-phase transformer methods of connection. Synchronous machines. Transmission lines. Voltage and frequency control of power systems. Models for sequence networks. Power system protection.

Computer simulation & analysis. Lab project. (Pre-/Co- Requisites: EE 213, EE 480) Department Compulsory

**EE 483 Power Transmission and Distribution 3C,3H**

Overhead power lines: construction, sag & tension analysis. Underground power cables. Circuit breakers. Fuses. Disconnect switches. Substation design. Earthing. (Pre-/Co- Requisites: EE 480) Power and Control Compulsory

**EE 490 Engineering Training 3C.H**

The student has to spend at least 8 weeks of electrical engineering training at recognized companies and establishments during the summer semester. (Pre-/Co- Requisites: Passing 117 credit hours) Department Compulsory

**EE 507 Antennas 3C, 3H**

Antenna parameters. Radiation integrals. Wire antennas. Arrays. Broadband & traveling wave antennas. Aperture antennas. Reflector antennas. Microstrip antennas. (Pre-/Co- Requisites: EE 407) Communications & Electronics Elective

**EE 508 Introduction to Electromagnetic Compatibility 3C,3H**

Causes & effects of interference. Electrical dimensions. EMC units. EMC regulations. Non-ideal behavior of components including: wires, printed circuit boards, resistors, capacitors, inductors, & switches. Bio-electromagnetics. (Pre-/Co- Requisites: EE 307, EE 320) Communications & Electronics Elective

**EE 509 Microwave Engineering 3C,3H**

Review of Electromagnetics theory. Transmission lines & waveguides. Microwave network analysis. Impedance matching. Passive microwave devices. Stripline & microstrip line circuits. Microwave filters. Microwave laboratory experiments. Design project. (Pre-/Co- Requisites: EE 307) Communications & Electronics Elective

**EE 521 Solid State Electronics 3C,3H**

Fundamentals of solid-state theory. Continuity equations. Steady state solution. p-n junction characteristics. p-n diode equations & ideality factor. Schottky junctions. Ohmic contacts. Physics of field effect transistors: MOSFET & JFET. Physics of bipolar junction transistors (BJT). (Pre-/Co- Requisites: EE 320) Communications & Electronics Elective

**EE 522 Optoelectronics 3C,3H**

Semiconductor materials for optoelectronic devices. Electronic properties in semiconductors. Optical properties. Absorption. Spontaneous emission. Stimulated emission. Light emitting diodes. Lasers. Photoconductors & photodiodes. Responsivity. Phototransistors. (Pre-/Co- Requisites: EE320) Communications & Electronics Elective

**EE 524 Electronic Communication Circuits 3C,3H**

Large-signal analysis. Network noise analysis. Tuned amplifiers. Intermodulation distortion. RF oscillators. Super-heterodyne receivers. Phase-locked loops. Frequency synthesizers. Mixers, modulators & demodulators. RF power amplifiers. (Pre-/Co- Requisites: EE 320, EE 450) Communications & Electronics Compulsory

**EE 525 Electronic Circuit Design 3C,3H**

Feedback amplifiers. Oscillators. Power amplifiers. Current mirrors & active loads. Differential amplifiers.



Active filters. Internal structure of operational amplifiers. Integrated analog circuits and applications.

(Pre-/Co- Requisites: EE 320 Communications & Electronics Elective)

### **EE 526 Semiconductor Devices 3C,3H**

Basic properties of semiconductor devices. Selected topics in semiconductor materials: statistics, & transport. Aspects of transport in homo- and hetero-junctions. Charge control in different FETs: transport, modeling. Bipolar transistor models (Ebers-Moll, Gummel-Poon): heterostructure bipolar transistors. Special devices. (Pre-/Co- Requisites: EE 320 Communications & Electronics Elective)

### **EE 528 Microwave Electronics 3C,3H**

Gunn diode, Tunneling diodes, Schottky barrier diode, microwave bipolar junction transistors & metal semiconductor field-effect transistors. Power added efficiency. Maximum oscillation frequency. Device parameters and optimization. Microwave integrated circuits. (Pre-/Co- Requisites: EE 307, EE 320 Communications & Electronics Compulsory)

### **EE 529 CMOS Circuit Design 3C,3H**

Analog design with MOS technology. MOS operational amplifier. Wideband amplifiers. Multipliers & modulators. CMOS oscillators. Voltage-controlled oscillators. (Pre-/Co- Requisites: EE 420 Communications & Electronics Elective)

### **EE 531 Electric Drive Systems 3C,3H**

DC-motor drives using controlled AC-DC converters. DC-motor drives using DC-DC converters. Frequency-controlled Induction-motor drives. Slip energy recovery. Synchronous motor drives using inverters & cycloconverters. Variable reluctance drives: switched reluctance & stepper-motor drives using bridge inverters.

(Pre-/Co- Requisites: EE 435, EE 440 Power and Control Compulsory)

### **EE 537 Switched-Mode Power Supplies 3C,3H**

Types of switched-mode power electronic converters. Feedback control design of switched-mode power supplies. Pulse width modulation controllers. Modelling & simulation of switched-mode power supplies using PSpice and Matlab-Simulink. (Pre-/Co- Requisites: EE 435, EE 440 Power and Control Elective)

### **EE 538 High Voltage Engineering 3C,3H**

Generation and measurement of high voltage. Electrostatic field & field stress control. Electrical breakdown in gases, solids & liquids. Non-destructive insulation test techniques. Overvoltages & insulation coordination.

(Pre-/Co- Requisites: EE 480 Power and Control Elective)

### **EE 539 Advanced Electric Machines 3C,3H**

Linear Electric machines: comparison with rotating machines. Linear induction motors: simplified electromagnetic field theory, force equation, characteristics. Superconducting ac generators & motors. Variable reluctance motors: performance & characteristics. Printed circuit motors.

(Pre-/Co- Requisites: EE 332 Power and Control Elective)

### **EE 540 Introduction to Robotics 3C,3H**

Introduction. Basic mathematics: transformation, position & orientation, rotation mathematics, Euler angles. Kinematics & inverse kinematics. Jacobians & inverse Jacobians relations. Dynamics of robots & manipulators. End effectors. Sensors with applications. Robot trajectory & task planning. Linear control of

robots. Nonlinear control (feedback linearization). Robot programming & control software design.

(Pre-/Co- Requisites: EE 447 Power and Control Elective)

### **EE 541 Sensors and Actuators 3C,3H**

Sensors performance terminology. Thermal sensors: metal temperature detectors, thermistors, thermocouples, bimetal switches, electronic temperature sensors. Mechanical sensors: potentiometric, capacitive, inductive, ultrasonic, piezoelectric, strain gauges, proximity & limit switches, digital encoders, Hall-effect sensors. Optical sensors: photoconductive cells, solar cells, photodiodes, spectral response. Actuators: electrical, pneumatic, & hydraulic. Application examples. (Pre-/Co- Requisites: EE 320, EE 332, EE 440 Power and Control Elective)

### **EE 546 Power System Control 3C,3H**

Flow of power in an AC system. Flexible AC transmission systems. Static VAR types & basic characteristics. Static VAR compensator applications to electric power systems: static shunt compensators & statcom. Application examples. (Pre-/Co- Requisites: EE 440, EE 480 Power and Control Elective)

### **EE 547 Computer Control 3C,3H**

Computer role in processes. Digitization. Difference Equations. Discrete form of controllers & their applications in systems. Computer control configurations. Computer Interfacing. Computer instructions for program driven & interrupt driven high-level languages. Real-time operating systems. Interfacing sensors in computer control applications. Command generation in machines & processes. Applications for robot arm motion. Sequential control using programmable logic controller.

(Pre-/Co- Requisites: EE 445, EE 447 Power and Control Compulsory)

### **EE 551 Digital Communications 3C,3H**

Quantization. Delta modulation. Noise analysis in PCM & DM systems. Base band digital systems: digital signaling over channels without & with inter-symbol interference & additive gaussian noise. Error probability analysis. Passband digital systems: signal & system models of ASK, PSK, DPSK, FSK & QAM. Signal space representation & receiver model. Error probability analysis of digital modulation techniques for coherent & non-coherent detection. Power spectra of digital signals. Introduction to Information Theory. Introduction to Error control coding. (Pre-/Co- Requisites: EE 450 Communications & Electronics Compulsory)

### **EE 552 Digital Communications Lab 1C,3L**

Digital waveform generators. Waveform analysis. Pulse amplitude modulators & demodulators. Sample & hold circuits. Delta modulation. PCM. ASK, FSK, PSK, DPSK systems. (Pre-/Co- Requisites: EE 452, Co-EE 551 Communications & Electronics Compulsory)

### **EE 555 Optical Fiber Communication Systems 3C,3H**

Components, advantages & classifications of fiber communication systems. Dielectric slab wave-guide. Step index fiber. Graded index fiber. Attenuation & dispersion. Light sources. Optical modulation. Photodetectors. Optical detection. Noise in the optical receiver. Heterodyne detection. Bit error rate analysis of direct detection & heterodyne detection systems. Lab experiments. Design project. (Pre-/Co- Requisites: EE 307, EE 551 Communications & Electronics Elective)

### **EE 558 Satellite Communication Systems 3C,3H**

Overview of satellite communication. Earth station technology. Earth-orbiting & geostationary satellites. Channel characterization & link budget calculations. Transponders & transponder model. Channelization. Frequency plans. Propagation & interference considerations. Satellite access techniques. Introduction to satellite networks. (Pre-/Co- Requisites: EE 551 Communications & Electronics Elective)

**EE 559 Introduction to Wireless Communications 3C,3H**

Overview of wireless communications. Cellular systems: principles, trunking, grade of service & traffic capacity, power control, & handovers. Characterization of wireless channels: large scale & small scale propagation mechanisms, path loss, multipath & fading. Digital modulation techniques for wireless channels. Power efficiency, nonlinear amplifiers, diversity. Performance in multipath fading channels. Multiple access: fixed (FDMA, TDMA, CDMA) & random (ALOHA, CSMA) access methods. (Pre-/Co- Requisites: EE 551 Communications & Electronics Compulsory)

**EE 565 Digital Speech Processing 3C,3H**

Production & classification of speech sounds. Acoustics of speech production. Analysis & synthesis of pole-zero speech models. Short-time Fourier transform analysis & synthesis. Filter-bank analysis & synthesis. Sinusoidal analysis/synthesis. Speech Coding. Speech enhancement. (Pre-/Co- Requisites: EE 460 Communications & Electronics Elective)

**EE 566 Digital Image Processing 3C,3H**

Introduction. Image digitization. Human vision system & color imaging. Image enhancement & histogram techniques. Image edge/line detection. Image transformations & filtering. Image denoising. Geometric operations. Image segmentation. Introduction to image compression. (Pre-/Co- Requisites: EE 460 Communications & Electronics Elective)

**EE 570 Communication Networks 3C,3H**

Introduction to queuing theory. Physical data link & network layers. Network topologies. Basic performance evaluation methods. Circuit & packet switching. Local area networks. (Pre-/Co- Requisites: EE 450 Communications & Electronics Elective)

**EE 580 Power System Analysis 3C,3H**

Power system economics. Load & energy forecasting. Computer based load flow calculations & control. Economic operation of power systems. Power system stability. Power system control. Power system planning & reliability calculations. (Pre-/Co- Requisites: EE 480 Power and Control Compulsory)

**EE 582 Power Systems Lab 1C,3L**

Transmission line performance under different operating conditions. Real & reactive power flow & control for a transmission line. Characteristics of different types of relays. Power system protection using relays. Measurement of sequence components. Balanced & unbalanced faults. Power system transients & stability. Lab Project. (Pre-/Co- Requisites: EE 482, Co-EE 580 Power and Control Compulsory)

**EE 586 Power System Protection 3C,3H**

Relay operating principles. Current and voltage transformers. Generator protection. Motor protection. Transformer protection. Bus protection. Transmission line protection. Computerized protection of power systems. (Pre-/Co- Requisites: EE 580 Power & Control Elective)

**EE 591 Graduation Project I 1C,1H**

Project preparation & theory in the semester preceding the graduation semester.

(Pre-/Co- Requisites: Passing 114 credit hours Department Compulsory)

**EE 592 Graduation Project II (3C,2H,2L)**

Practical implementation of the project as prepared for in Graduation Project I.

(Pre-/Co- Requisites: EE 591 Department Compulsory)

**EE 595 Special Topics in Communications (3C,3H) and Electronics**

Content has to be approved by the Electrical Engineering Department Council.

(Pre-/Co- Requisites: EE 450 Communications & Electronics Elective)

**EE 596 Special Topics in Power (3C,3H) and Control**

Content has to be approved by the Electrical Engineering Department Council.

(Pre-/Co- Requisites: EE 480 Power and Control Elective)