Course Prerequisites

Prerequisites List – Core Courses

Course		Prerequisite		
SEMESTER 1				
LH131	ESP (1)	**None**		
BA123	Mathematics(1)	**None**		
BA113	Physics (1)	**None**		
CC111	Introduction to Computers	**None**		
ME 151	Engineering Drawing & Projection	**None**		
BA141	Engineering Mechanics (1)	**None**		
IM111	Industrial Relations	**None**		
SEMESTER 2				
LH132	ESP (2)	**LH131**	ESP (1)	
BA124	Mathematics(2)	**BA123**	Mathematics(1)	
BA114	Physics (2)	**BA113**	Physics (1)	
CC112	Structured Programming	**CC111**	Introduction to Computers	
IM112	Manufacturing Technology	**None**		
BA142	Engineering Mechanics (2)	**BA141**	Engineering Mechanics (1)	
BA118	Chemistry	**None**		**YEAR 1**
SEMESTER 3				
LH231	ESP (3)	**LH132**	ESP (2)	
BA223	Mathematics (3)	**BA124**	Mathematics(2)	
EC210	Solid State Electronics	**BA114**	Physics (2)	
CC213	Programming Applications	**CC112**	Structured Programming	
NE465	Creative awareness	**None**		
EE231	Electrical Circuits (1)	**BA124**	Mathematics(2)	
SEMESTER 4				
BA224	Mathematics (4)	**BA223**	Mathematics (3)	
NE264	Scientific Thinking	**LH231**	ESP (3)	
EC233	Electronic Devices (1)	**EC210**	Solid State Electronics	
EC217	Measurements & Instrumentation	**EE231**	Electrical Circuits (1)	
CC216	Digital Logic Design	**CC111**	Introduction to Computers	
EE232	Electrical Circuits (2)	**EE231**	Electrical Circuits (1)	**YEAR 2**
SEMESTER 5				**YEAR 3**
BA323	Mathematics (5)	**BA224**	Mathematics (4)	

Course		Prerequisite		
EE328	Electrical Power & Machines	**EE232**	Electrical Circuits (2)	
EC334	Analog and Digital – Circuits Analysis	**EE232**	Electrical Circuits (2)	
CC312	Computer Organization	**CC216**	Digital Logic Design	
EC332	Electronic Devices (2)	**EC233** **EE232**	Electronic Devices (1), Electrical Circuits (2)	
EC321	Signals and Systems	**BA224** **EE231**	Mathematics (4), Electrical Circuits (1)	
SEMESTER 6				
BA326	Mathematics (6)	**BA224**	Mathematics (4)	
EC333	Electronic Amplifiers	**EC332** **EC 217**	Electronic Devices (2), Measurements & Instrumentation	
EC341	Electromagnetics	**BA114** **BA224**	Physics (2), Mathematics (4)	
EC322	Introduction to Communication Systems	**BA323** **EC321**	Electronic Devices (2), Signals and Systems	
CC413	Numerical Analysis	**BA224** **CC112**	Mathematics (4), Structured Programming	
EC311	Electronic Materials	**EC210**	Solid State Electronics	
SEMESTER 7				
EC432	Microelectronic Circuits	**EC333**	Electronic Amplifiers	
EC421	Statistical Communication Theory	**EC322** **BA326**	Introduction to Communication Systems, Mathematics (6)	
EC442	Electromagnetic Wave Propagation	**EC341**	Electromagnetics	
CC411	Introduction to Microprocessors	**CC312**	Computer Organization	
IM423	Operation Research	**IM111**	Industrial Relations	
EE418	Automatic Control Systems	**EE328**	Electrical Power & Machines	
SEMESTER 8				
EC434	Analog Signal Processing	**EC432**	Microelectronic Circuits	
EC422	Introduction to Digital Communications	**EC421**	Statistical Communication Theory	
EC443	Electromagnetic Transmitting Media	**EC442**	Electromagnetic Wave Propagation	
NE364	Engineering Economy	**LH231**	ESP (3)	
EE419	Modern Control Engineering	**EE418**	Automatic Control Systems	
EC410	Electronic Measurements	**EC432**	Microelectronic Circuits	
IM400	Practical Training	**None**		**YEAR 4**

Course		Prerequisite		
SEMESTER 9				
EC544	Antennas Engineering	EC443	Electromagnetic Transmitting Media	
EC523	Advanced Communication Systems	EC422	Introduction to Digital Communications	
EC501	Project (1)	None		
*	Elective Course	*		
*	Elective Course	*		
*	Elective Course	*		
SEMESTER 10				
EC546	Microwave Technology	EC434 EC443	Analog Signal Processing, Electromagnetic Transmitting Media	
EC533	Digital Signal Processing	EC434	Analog Signal Processing	
EC503	Project (2)	EC501	Project (1)	
*	Elective Course	*		YEAR 5
*	Elective Course	*		

Chapter 3

Courses Summary Description

Brief description of all courses including the number of credit hours and prerequisites.

EC Department Courses

Course Group: Solid State Electronics and Measurements

EC 210 – Solid State Electronic
Cr.3. Prerequisite: BA 114

Elementary material science concepts: Atomic structure- Bonding and types of solids- the crystalline state -Lattice vibrations. The Hall Effect and Hall effect devices. Quantum mechanics: photons- Particles and waves- the electron as a wave- infinite potential well- Heisenberg's uncertainty principle- Tunnelling phenomenon (potential barrier). The band theory of solids: E-K diagram- energy bands diagram- Electrons and holes- effective mass. Semiconductors: Intrinsic semiconductors- Extrinsic semiconductors(n-type doping- p-type doping- compensation doping)- Electronics and hole Concentrations- Fermi energy level position- Conductivity of a semiconductor- Diffusion and conduction currents equations.

EC 217 – Measurements & Instrumentations
Cr.3. Prerequisite: EE 231

Measurements of errors- Accuracy- Precision- Resolution- Sensitivity. Statistical analysis (Mean- Deviation- Standard Deviation- Variance). Units and standards of measurement. Electromechanical indicating instruments. Analog Instruments (DC Ammeter (Ayrton Shunt)- DC Voltmeter- Ohmmeter (Series type- Shunt Type)- AC- Instruments with Rectifiers(full wave and half wave rectifiers)- Bridge measurements (AC Bridges(Maxwell bridge- Wien bridge- Schering bridge)- DC Bridges(Wheatstone bridge))- Digital instruments for measuring True RMS Voltmeter- Q-meter- oscilloscope techniques.

EC 218 – Measurements & Instrumentations (Computer Engineering Program)*
Cr.3. Prerequisite: EE 231

Measurements of errors- Accuracy- Precision- Resolution- Sensitivity. Statistical analysis (Mean Deviation- Standard Deviation- and Variance). Units and standards of measurement. Electromechanical indicating instruments. Analog Instruments (DC Ammeter (Ayrton Shunt)- DC Voltmeter- Ohmmeter (Series type- Shunt Type)- AC- Instruments with Rectifiers (full wave and half wave rectifiers)- Bridge measurements (AC Bridges(Maxwell bridge- Wien bridge- Schering bridge)- DC Bridges(Wheatstone bridge))- Digital instruments for measuring True RMS Voltmeter- Q-meter- oscilloscope techniques.

EC 311 – Electronic Materials

Cr.3. Prerequisite: EC 210

Free electron model- Electric conductivity- and Dielectric properties: Microscopic electric field Dielectric constant and polarisability- local electric field at an atom. Magnetic materials and Ferro electric Crystals. Diamagnetism and Para-magnetism- Ferromagnetic order. Anti-Ferro magnetic order. Ferromagnetic domains- superconductivity. Destruction of superconductivity by magnetic fields- Meissner effect.

EC 410 – Electronic Measurements

Cr.3. Prerequisite: EC 432

Ac signal sources- Oscillators- Selection of an Oscillator- Barkhausen criteria. Audio frequency oscillator (Wien bridge oscillator- Phase shift oscillator)- Radio frequency oscillator (Colpitts oscillator- Hartley oscillators)- Crystal oscillator. Signal Generator- Sweep frequency generator- Pulse and Square wave generator- Function Generator- Attenuators. Harmonic analysis- Frequency spectrum of waveform- Harmonic distortion analysis using Fourier transformer. Harmonic Analyzing Instruments- Harmonic distortion analyzer. Wave analyzer- spectrum analyzer. Transducers- classification of transducers- Selecting of Transducer- Strain gauge transducer- Displacement Transducer- Capacitive Transducer- Inductive Transducers- Piezoelectric Transducer- Temperature Transducers- Photoelectric Transducers. Data acquisition system- Signal conditioning circuit- Digital to Analog and Analog to Digital converters. Data acquisition system and Computerized control measurements.

EC510 – Material Engineering

Cr. 2. Prerequisite: EC217 & EC332

Free electron gas model and Fermi Dirac statistics - density of orbit - Introduction to quantum mechanical way of thinking - Modern theory of metals and electric conductivity - Hall effect - Introduction to dielectric (basic formula) - Polarizabilities and electrical properties - Clausius Mossoti relation (gas and solid) - Piezo electrical materials - Introduction to magnetism, classification of material - Introduction to nanotechnology - Bulk ball and nano tube - Nanotechnology and medical field - Future of solar energy in tiny technology - Introduction to superconductors materials

EC511 – Advanced Sensors and Interface

Cr. 3. Prerequisite: EC410, EC434

Measurement of Angular Acceleration, Velocity, and Displacement - Measurement of Linear Acceleration, Velocity, and Displacement - Measurements of Pressure, Force, and Torque - Temperature Sensors - Digital Interfaces – Sampling, Quantization, Dithering, DACs, Hold Operation - ADCs - IEEE488 GPIB, RS232C/D, USB Interfaces - IEEE583 CAMAC, Effect of Transmission Lines and Fiber-Optics Cables - Interface Requirements: Signal Level, Impedance, Frequency Response, Offset, Scaling, Isolation, Loading - Interface Requirements: Output Signals,

Errors: Resolution, Computation, Sampling and Conversion Errors - Micro-Electro-Mechanical (MEM) Sensors

EC512 – Selected Topics in Materials, Sensors, and Measurements
Cr. 3. Prerequisite: EC410, EC434

To be planned by the lecturer and approved by the committee

EC513 - Biomedical Instrumentations and Equipments
Prerequisites: EC341 – Cr. Hrs. 3

Types of medical equipment: diagnostic therapeutic and laboratory equipment, Concepts of medical equipment, electrical safety and patient safety, ECG machine basics, EEG machine basics, EMG machine basics, Biomedical Imaging, X-ray basics, Ultrasound block diagram and cards, Computed tomography CT-scans, Heart rate, pulse-rate, respiration-rate, blood pressure measurements, Principles of defibrillator and pacemaker, Physiotherapy equipment, Surgical diathermy, ventilators, and infusion pump, Electro-surgey machine and hemo-dialysis, Multi para monitor, Incubators and diaverum.

Course Group: Communications

EC 320 : Communication Theory (Computer Engineering Program)*
Cr.3. Prerequisite: BA 224 – EE 231

Introduction to communication theory. Review of Fourier series and Fourier transform as a mathematical tool for spectral analysis. Concept of power and energy spectral densities and correlation between waveforms. Transmission through linear filters and channels. Hilbert transform and Amplitude Modulation techniques.

EC 323 : Introduction to Communication Systems (Electrical Engineering Program)*
Cr.3. Prerequisite: BA 224

Analog communication systems (Amplitude Modulation – Frequency Modulation). Analog Pulse Modulation (Pulse Amplitude Modulation – Pulse Width Modulation – Pulse Position Modulation). Pulse Code Modulation Systems - Digital Modulation - Domestic wire and wireless communication technologies -Industrial communication technology

EC 321 – Signals and Systems
Cr.3. Prerequisite: BA 224 – EE 231

Introduction to communication theory. Fourier transform as a mathematical tool for spectral analysis. Sampling Theory, Convolution of continuous and discrete signals, Correlation, Concept of power and energy spectral densities and correlation between waveforms. Transmission through linear filters and channels. Hilbert transform and Positive pre-envelope and complex envelope. Response of LPF and BPF to signals.

EC 322 – Introduction to Communication Systems
Cr.3. Prerequisite: BA 323 – EC 321

Base band communication of Analog signals. FDM Concepts. Amplitude modulation, mathematical description and spectral characteristics of full carrier AM, DSB-SC, SSB-SC, and VSB. Multiplexing techniques (QAM and FDM). Angle modulation (FM and PM); generation and detection of CW modulation. Sampling theory. PAM, PWM and PPM generation and detection.

EC 421 – Statistical Communication Theory
Cr.*3. Prerequisite:-EC 322*

Review of probability- Random processes: Stationarity, Ergodicity - AWGN channels and band-pass noise - AM/ FM with the presence of noise - Noise effect on analog pulse modulation - Noise effect on PCM – Wireless Fading Channel modeling.

EC 422 – Introduction to Digital Communications
Cr.*3. Prerequisite: EC 421*

Bandpass data transmission - Gram Schmidt orthogonalization procedure, Geometric representation of signals in signal space - Noise effect in signal space, Decision regions and related probability of error - binary modulation techniques (CB-ASK, CB-FSK, CB-PSK) - Optimum FSK, MSK , Non-Coherent Detection, NC-FSK – DPSK

EC 523 – Advanced Communication Systems
Cr.3. Prerequisite: EC 422

Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA). OFDM, OFDMA- Examples of FDMA, TDMA, and CDMA systems, and their applications. Source and channel coding. Channel Capacity

EC 520 – Satellite Communications**
Cr.3. Prerequisite: EC422

Introduction to satellite communications (historical background, comparison between terrestrial and satellite links, advantages and limitations of satellite communication, types of satellite services, Space, Control & Ground Segments, main, overview of satellite construction) – Satellite Orbits: (Orbital parameters, circular orbits, Kepler's laws, basic parameters of elliptical orbits, determination of satellite position & speed) – Satellite Orbits: Orbital parameters and the Two Line Elements (TLEs) as a means to locate satellites – Satellite link budget basics: (Antenna parameters, calculation of EIRP, atmospheric losses, choosing modulation & coding pairs that close the link) – Satellite Link advanced topics (adaptive coding & modulation, overall link performance combining uplink and downlink) – Satellite Payload construction and characterization (coverages, frequency plans, G/T, PFD, Power Transfer Input & Output back-offs) Sample block diagrams & Equipment – Radio System Technology (Multiple Access techniques for satellite "FDMA, SCPC, TDMA (frame structure), CDMA, DSSS) – Earth Stations construction and RF characteristics (EIRP, G/T) – Satellite Broadcast Standards (DVB-S, DVB-S2X, DVB-RCS) – Satellite Networks (Topologies, Onboard switching, inter-satellite links) – Fixed Satellite Services – High Throughput Satellite systems (Spot beams, Hopping beams – Non GSO Satellite Communications (1): Architecture of LEO constellations with examples (Iridium, OneWeb, LightSpeed) – Non GSO Satellite Communications (2): Architecture of MEO constellations (O3B, ICO)

EC 521 – Communication Networks**
Cr.3. Prerequisite: EC 422

Basic Concepts of a Network - Physical Layer - Internet Protocol and subnetting - Network address translation protocol and IPv6 - Routing algorithms - Routing standards - Local Area Network topologies - Wireless LANs - Networking and Internetworking Devices - VOIP - Transport Layer - New trends in networking

EC522 – Acoustics**
Cr.3 Prerequisite: EC341

Acoustic wave and velocity of sound – The one-dimensional wave equation – Impedance of mediums: The one- dimensional wave equation Condensation – Solution of the one dimensional wave equation – freely traveling plane wave – Three-dimensional wave equation and spherical wave: 3D wave equation, the spherical wave equation and freely traveling spherical wave – Sound intensity and power – Energy density and levels: Acoustic power and directivity – Multiple sources and levels (power, intensity – Loudness: loudness level and loudness – Environmental acoustics: Environmental acoustics; weighted SPL – Equivalent SPL and assessment of noise: Combination of levels, Assessment of noise – Analogy between mechanical and electrical circuits – Analogy between acoustical and electrical circuits – Acoustical resonators and filters – Transducers and sensitivity of microphones and Loudspeakers.

EC 524 – Optical Communications **
Cr.3. Prerequisite: EC 422

General optical communication system – Advantages of optical fibre communications – Optical Fibre Waveguide: Ray theory in optical fibres – Fibre acceptance angle and numerical aperture – Fibre types: step index, graded index, single mode, multimode – Electromagnetic theory in optical fibres – Normalized frequency of the optical fibre – Linearly polarized modes in optical fibres – Transmission Characteristics in Optical Fibres: Polarization – Attenuation: absorption, scattering, macro-bending and micro-bending – Transmission Characteristics in Optical Fibres: Dispersion: definition and types, Bit rate calculation, Material and waveguide dispersion – Dispersion: Dispersion management in single-mode optical fibres. Intermodal dispersion – Overall dispersion – Fibre Fabrication – Fibre Cable Design – Fibre Connection: Couplers – Fibre Connection: Fibre splicing – Joint loss: Fresnel reflection – Optical Sources: Requirements of Light Sources, Concept of light emission, spontaneous emission, stimulated emission, LED operation – Laser: Operation and types, Injection laser diode – Optical source limitations – Wavelength Converter. Optical Amplifiers – Light Detectors: Requirements – Photodetectors: Quantum efficiency and responsivity of photodiodes – Optical Transmitter and Receiver: Optical transmitter circuits , Optical receiver circuits – Optical Fibre Systems: Devices requirement, Optical fibre communication systems - Digital system - Planning consideration – Optical Fibre Communication Systems: System Adjustment: power budget and rise time budget – Introduction to Free-Space Optical Communications and Visible Light Communications – Introduction to Ultraviolet Communications and Underwater Communications.

EC 525 – Information Theory and Coding **
Cr.3. Prerequisite: EC 422

The concept of information theory and coding, Channel capacity, time rate of information – Entropy, Relative Entropy and Mutual Information – Channel Capacity of Special Channels: Discrete Noiseless Channel – Channels with Symmetric Noise-Structure – Binary Symmetric Channel – Binary Erasure Channel – Channel BW Versus S/N Ratio Trade Off with examples on different communication systems – Jensen's inequality and its consequences – Data processing inequality – Entropy maximization - Gaussian sources - Maximum Entropy and Spectral Estimation – Data Compression – Hamming codes and Cyclic codes – Entropy Rates of a Stochastic Process: Markov chains - Entropy rate of a random walk on a weighted graph – Hidden Markov models – Turbo Codes - Iterative decoding – low-density parity-check (LDPC) code - Tanner graph - Belief propagation – Capacity of a MIMO channel -Performance of different coded modulation in AWGN channels – Network coding.

EC 526 – Wireless and Mobile Communications **
Cr.3. Prerequisite: EC 422

Difference between conventional mobile and cellular mobile - Overview on different cellular generations - Cellular radio design principles - Concept of frequency reuse/cellular block diagram - Co channel interference/adjacent channel interference - Multipath propagation - Speech coding in GSM - Channel coding and interleaving in GSM - GSM mobile station block diagram - Multiple access techniques - Control channels in GSM - Location updating\ security management.

EC 527 – Applied Telecommunications **
Cr.3. Prerequisite: EC 322

Fundamentals of radio-frequency propagation – Principles of radio-frequency positioning, observations, and their associated error sources – Introduction to Global Navigation Satellite System (GNSS), describes the fundamental theory and concepts of GNSS – GPS coordinate and time systems and transformers – Kepler orbit theory – GPS satellites, signal structure and propagation, atmospheric effects on GPS signals – GPS observables and differencing concepts – GPS receiver architecture – Receiver signal processing overview – signal acquisition – Signal tracking overview: introduction to digital tracking loops, signal monitoring and navigation message decoding – Introduction to self-contained inertial sensorsand augmentation of RF methods with self-contained sensors – GPS/INS Integration – Assisted GPS and cellular telephone location techniques.

EC 528 – Advanced Communication Networks **
Cr.3. Prerequisite: EC521

Switching Concepts – IP Routing Essentials – Routing Protocol Overview: static vs. dynamic routing, EIGRP and OSPF – WAN Concepts: Traditional WAN Connectivity, T1/T3 and E1/E3, PSTN and ISDN, Frame Relay and ATM – Modern WAN Connectivity, Packet-switched Ethernet, Multiprotocol Label Switching (MPLS) – Enterprise Network Architecture – Congestion control and QoS – VPN and IPsec Concepts, Technology, and types – Multimedia Networking: Streaming Stored Video, UDp, HTTp streaming, adaptive streaming DASH – Content Distribution networks CDN, voice over IP (VOIP) – Protocols for Real-Time Conversational Applications, RTP, SIP – Cloud Computing Evolution – Key Innovations in Core Network – Software Defined Networking (SDN) – Network Function Virtualization NFV – Virtualization of 5G network – Network slicing to enable 5G verticals.

EC 529 – Advanced Wireless Networks **
Cr.3. Prerequisite: EC526

Evolution of cellular systems, introduction to 5G, ITU Standardization, IMT-2020, 3GPP, spectrum requirements – 5G usage scenario– Key Innovations in Radio Access: 5G enablers, Milli-meter Waves, Massive MIMO – Radio Access for V2X communication, D2D communication, NB-IoT, 5G Fixed Wireless Access (FWA) – Radio Access 5G C-RAN Architecture – RAN Splitting in 4G o RAN Splitting in 5G (Various options) – Channel Propagation in Milli-meter Wave Communication – Key Innovations in Core Network: Network Slicing in 5G Networks – Network Slicing in RAN – Benefit of cloud based infrastructure – Understanding SDN and NFV – Virtual Network Function – 5G Transport Network Requirements: Front haul/Mid-Haul/Backhaul Requirements – Content delivery networks architecture – ML in wireless cellular networks – 5G Radio Planning: radio resource management, access design and dimensioning.

EC 550 – Selected Topics in Communications **
Cr.3. Prerequisite: EC 422

To be planned by the lecturer and approved by the committee

EC 551 – Telecommunication Systems Engineering**
Cr.3. Prerequisite: EC 422

Principles- Technologies- system architectures- standards of GSM- GPRS- UMTS- WLAN- 802.16 and WiMAX - QoS in telecommunication systems - Internet Telephony - Resource allocation and management - Sensor networks.

EC552 - Computer Vision and Image Analysis **
Prerequisites: BA223, CC413 – Cr. Hrs. 3

Introduction to computer vision., Image modalities -pin hole camera model, Camera optics, Image filtering (Smoothing), Edge detection, corners, gaussian pyramid, Corners and descriptors, Image Warping, Homography, Geometric model fitting, Multiview geometry, Dense Stereo.

EC 553 – Media and Entertainment Engineering **
Cr.3. Prerequisite: EC 422 – EC 434

Introduction to Multimedia Concept – Spatial Redundancy in Images – Lossless & Predictive Coding (entropy coding) – Audio Fundamentals, Coding, and Standards: Introduction to Voice and Speech Quantization & Transform coding – Image and Video Coding Techniques– Video Compression Fundamentals and Compression Standards – Internet Streaming Media– Multimedia Presentation & Content Description: Real Time Streaming Protocol - "internet VCR controls", Inter-media synchronization –Multimedia File Formats – Image-Based Content Retrieval– Introduction to Video Indexing and Retrieval– Modern Media Storage Technologies – Modern Display Technologies – Advanced Multimedia Systems and Immersive Technologies..

EC 554 – Wireless Optical Communications**
Cr. 3. Prerequisite: EC422

Optical Transmitter – Optical Receiver – Attenuation (Loss) – Modulation Techniques – Error control coding – Free-Space Optical Communications – Outdoor Visible Light Communications (car-to-car Communications, ground-to-train communications) – Channel Modelling and

Modulation Techniques for Outdoor Visible Light Communications – Indoor Visible Light Communications: Applications (Li-Fi) – Ultraviolet Communications – Underwater Optical Communications – Satellite Optical Communications – Channel Modelling and Modulation Techniques for Satellite Optical Communications – Multiple-Input Multiple Output (MIMO) Optical Wireless Systems – Next Future Trend in OWC.

EC 555 – Software Defined Radio and Networking**
Cr.3. Prerequisite: EC422

Principles of Software Defined Radio (SDR) process – Graphical Block-Based Programming in GNU Radio Companion – Basic Software Defined Radio programs in GNU radio programs – Software Defined Radio Development: FM Radio Receiver Communication – Signal Tracking and Transmission (Playback) in Software Defined Radio – HDSDR Software Defined Radio Environment – SDN vs Traditional -Data and Control Plane in SDN - Networking components in SDN – Network Programmability – SDN Architecture – Mininet Basics – SDN Applications Without Using Controller – Custom Mininet Topologies – Controller – OpenFlow Protocol – OpenFlow Flow Table – OpenFlow Ports – OpenFlow Messages.

EC 556 – Communication Security**
Cr.3. Prerequisite: EC422

The topics to be covered include semantic security, attack analysis, network security protocols, network access authentication, wireless security, broadcast and multicast key distribution, system security, trusted platform, IoT security and privacy, physical layer security, anti-jamming, advanced cryptography, multi-party computation, zero-knowledge proof system, and special topics on privacy of blockchain, smart contract and securing machine learning.

EC557 - Principles of Medical Sensor Networks and Devices**
Prerequisites: EC521 – Cr. Hrs. 3

Physiological signals, noise in medical instrumentation, Medical sensor principles, medical signals, Interface of sensor circuits, Medical sensor classification and measurement, Application of sensors: ECG, EMG, blood oxygen, Neuro-electrophysiology, Medical devices: non-invasive and invasive devices and implants, Regulatory & Ethical Considerations, Prognostics, diagnostics and therapeutics, Rehabilitation engineering, Bedside transitional sensors/devices, tele-medicine devices.

EC558 - Deep Learning for Signal Processing **
Prerequisites: BA223, CC413 – Cr. Hrs. 3

Introduction ., Linear Models, Multilayer Perceptron, Convolution Neural Networks, Convolution Neural Networks Architectures (Image Classifications), Convolution Neural Networks Light Architecture, Convolution Neural Network Visualization, Recurrent Neural Networks , Vanishing Gradients, Recurrent Neural Networks applications in NLP, Graph Convolutional Network , Attention and Transformers, Autoencoder ., Generative Adversarial Networks, Deep learning application in wireless communication, Deep learning applications in signal processing , Deep learning application in Biomedical Engineering.

* Courses for other departments

** Elective Course

Course Group: Electronics

EC 134 – Fundamentals of Electricity and Electronics (Computer Science Program)*
Cr.3. Prerequisite: BA 113

This course provides an introduction to the basic concepts of electricity and electronics concepts. This is useful in understanding the operations of robotics. The topics of interest include the basics of electricity and electrical circuit's components. It covers also the basic DC and AC circuits' analysis, power and resonance, and transformers. The electronic topics include semiconductors diodes and transistors. The course covers practical and applications of the studied topics in the operations of amplifiers and oscillators.

EC 233 – Electronic Devices (1)
Cr.3. Prerequisite: EC 210

P-N junction diode- current components- junction capacitance- junction diode- as a circuit element- special types of P-N junctions. P-N junction diodes- current components- junction capacitance- junction diode as a circuit element.

EC 238– Electronics (1) (Computer Eng. Program + Mechatronics Eng. Program)*
Cr.3. Prerequisite: EE231

Semiconductors - p-n junction - diode current components - junction capacitance - junction diode as a circuit element - special p-n junctions - bipolar junction transistor and field effect transistor: structure- operation – I-V characteristics - large and small analysis.

EC 237 – Electronics Engineering (Electrical & control Engineering Program)*
Cr.3. Prerequisite: EE 231

Semiconductors - p-n junction - diode current components - junction diode as a circuit element - special p-n junctions - bipolar junction transistor and field effect transistor: structure, operation – I-V characteristics – Sinusoidal and Square-Wave Oscillators.

EC 332– Electronic Devices (2)
Cr.3. Prerequisite: EE232 – EC 233

Operation of BJT - DC Analysis - BJT Base Width Modulation - AC Analysis of BJT - Common Emitter, Collector, and Base Amplifiers - BJT as a Switch - Operation of JFET - DC and AC Analysis - MOS-Structure - Operation of MOSFET - Depletion/Enhancement Mode MOSFETs - DC Analysis of MOSFET - Channel Length Modulation - Body Effect - MOSFET Capacitances - AC Analysis of MOSFET - Common Source, Drain, and Gate Amplifiers - MOSFETs Amplifiers using Active Loads - Schockley, Diac, SCR, Triac, UJT, and PUT Circuits

EC 333– Electronic Amplifiers
Cr.3. Prerequisite: EC 332 – EC 217

Revision on Single Stage BJT Amplifiers - Cascode - MOSFET Common Source, Source Follower and Common Gate Amplifier – Cascode and Folded Cascode Amplifier - Frequency Response of MOSFET Circuits - Feedback Amplifiers - Feedback Topologies - Stability - Ring Oscillator and LC Oscillators - Voltage Controlled Oscillators - Power Amplifier - Tuned Amplifiers

EC 334– Analog and Digital Circuits Analysis
Cr.3. Prerequisite: EE232

Review of basic circuit theorems - Two-Port Networks - The transfer function -Phase and Time Responses - Bode Plot - Phase and Group Delays - Computer-Aided Analysis Packages - Integrated Digital Logic Families, Definitions (Propagation Delay, Fan-in, Fan-out) - RTL, DTL, TTL Logic Families - Analysis of TTL gates - ECL Family and Examples - CMOS Digital Circuits and Logic Families Comparison

EC 339– Electronics (2) (Computer Eng. Program + Mechatronics Eng. Program)*
Cr.3. Prerequisite: EC 238

Electronic amplifier theory- power amplifiers- Differential amplifiers- Operational amplifiers-filters and Oscillators.

EC 432– Microelectronic Circuits
Cr.3. Prerequisite: EC 333

Differential Amplifiers - Current Mirrors - Noise in Electronic Circuits - Operational Amplifiers - Phase Locked Loops - Switched Capacitor Circuits - IC Fabrication Steps

EC 434– Analog Signal Processing
Cr.3. Prerequisite: EC 432

Linear and nonlinear wave shaping- sinusoidal and relaxation oscillators- sweep generators- analog filters.

EC 533– Digital Signal Processing
Cr.3. Prerequisite: EC 434

ADC's and DAC's, DFT, FFT and DCT, the Z-transform, discrete time transfer function, realization topologies, FIR filter design using windowing, Optimal method, frequency sampling method , least path norm method using MATLAB . IIR filter design, stability, bilinear transform, least path norm method using MATLAB. Applications of DSP e.g. data compression Data acquisition systems….etc

EC 534– Analog and Digital Signal Processing (Mechtronics Engineering Program)*
Cr.3. Prerequisite: EC 331

Simple analog wave shaping circuits- Sinusoidal and square wave generators. Design of RC active filters- ADC's and DAC's. Discrete transforms. Digital filter design.

EC 530– Micro – Electromechanical Systems MEMS **
Cr.3. Prerequisite: EC 434

MEMS technology- revolution and advantages of MEMS technology. Description of the MEMS applications- and its fabrication techniques. Studying the nature of the piezoelectricity and piezoresistivity. Description of the microsensors- microactuators- different system issues and the scaling effect. Finally describing the Microassembly and an overview on Microrobotics.

EC 531 – Embedded Systems**
Cr.3. Prerequisite: CC411

A course that integrates embedded operating systems, computer hardware and embedded programming, real time processes for use in control and instrumentation. Introduces the process of designing and implementing software/hardware systems to implement instrumentation, control and communications/DSP protocols for real-life systems. This includes the development, debugging and verification processes.

EC 532 – Power Electronics**
Cr.3. Prerequisite: EC 434

A course which integrates power semiconductors and industrial electronics for energy conversion and process control. It also links areas such as renewable energy, high voltage/high current semiconductors, power supplies and industrial process control.

EC 535 – Digital VLSI Design **
Cr.3. Prerequisite: EC 432 – CC 216

Design of VLSI digital circuits- Stick diagrams- design rules- CAD system- speed and power considerations- floor planning- layout techniques

EC 536 – VLSI Fabrication and Testing of Integrated Circuits **
Cr.3. Prerequisite: EC 432

Choice of technology- different fabrication processes of VLSI integrated circuits: crystal growth- thermal oxidation- chemical etching- diffusion and ion implantation- epitaxy and chemical-vapor deposition- metallization- and process integration. Testing techniques. Design for testability.

EC 537 – Biomedical Engineering **
Cr.3. Prerequisite: EC 434

Biological Currents: Law of diffusion, Drift equation, Einstein relationship, Examples of two ion, Goldmann's equation, Nernst equation, Tissue equivalent circuit, Depolarization of living cells, Biopotentials in the heart, Electrocardiograms, Electrode charge distributions, Electrode equivalent circuit, Electrode impedance measurement, Thermal transducer: Semiconductor Thermistor, Wheatstone bridge circuits, Conductor Thermistor, Strain Gauges: Blood volume measurement, Strain gauge silicon wire, signal conditioning (linearization), Differential Capacitive Transducer , Biopotential Amplifiers, Transistor differential amplifiers, Operational amplifier analysis, Biopotential measurement interference, Equivalent circuits for power line interference, Common mode Rejection Ratio, Common mode Voltage Reduction, ECG Lead connection, Electroencephalographs, EEG Active filters, Pacemakers.

EC 538 – Selected Topics in Electronics**
Cr.3. Prerequisite: EC 432

A Selection from modern topics in electronics.

EC 539 – Photonic Devices **
Cr.3. Prerequisite: EC 233

Introduction to the most significant devices employed in all-optical communications and networks. Introducing and identifying all-optical switching, routing and networking. Light production and the processes that occur during light propagation. Optical sources: light emitting diodes (LEDs) and

lasers. Optical detectors: photoconductors, photodiodes and phototransistors. Photonic devices that can employ different functions within the network or link: gratings and optical amplifiers. Fibre Bragg Gratings (FBGs): Construction, types, characteristics and applications. In-line amplifiers: Erbium doped fibre amplifier (EDFA), and waveguide amplifiers: semiconductor optical amplifier (SOA) comparisons, operations, characteristics and applications.

EC560 – Hardware for Baseband Communications**
Cr. 3. Prerequisite: EC432

Active Filters - Ladder Filters - Integrator-Based Filters - Continuous-Time Filters & Frequency Tuning - Highpass & Bandpass Filters - Gm-C Filters - Switched Capacitor Filters: Aliasing, S.C. Integrator & Practical Considerations - High-Speed Link Environment and Overview - Basic Transmitters and Receivers - Equalization Techniques - Link Performance Analysis - Equalizer Design: CTLE, FIR I, FIR II, Decision Feedback

EC561 - Biomedical Systems Modelling and Simulation**
Prerequisites: EE419 – Cr. Hrs. 3

Modelling of physiological signals and noise, Differential equations and numerical methods, State space models, Modelling of the cardio-respiratory system, Modelling nerve action potentials, Feedback systems and control systems, System stability, and time-frequency domain analysis, Model validation, Finite element analysis, immune system, Engineering tools for simulations of dynamic systems, Linear model of blood flow, Skeletal muscle contraction, Electromyogram, Numerical methods and geometry for graphics, Real-time data acquisition and signal processing.

EC562 – Mixed-Signal Circuit Design**
Cr. 3. Prerequisite: EC432

Data Converter Performance Metrics - Static & Dynamic Testing - DAC Design - Nyquist Rate ADC - Nyquist Rate ADCs:Sampling - Nyquist Rate ADCs:Track & Hold - Nyquist Rate ADCs:Architecture & Design - Comparator Design - Interpolating/Folding/Multi-Step ADCs - Multi-Step & Pipeline ADCs - Pipeline ADCs - Oversampled ADCs

EC563 – Photovoltaic System **
Cr. 2. Prerequisite: EC233

Introduction to the theory and design of photovoltaic systems, including silicon and non-silicon solar cells, semiconductors and crystal structures, materials and solar cell theory, crystalline, multi-crystalline and amorphous solar cells, thin-film solar cells, p-n junction and other solar cell structures, concentrator solar cells, solar cell modules and photovoltaic systems.

EC 564 - Biomedical Signal Processing**
Prerequisites: EC321 – Cr. Hrs. 3

Acquisition and sampling of Bio-signals and medical images, Digital filtering and denoising techniques, Medical image enhancement techniques, segmentation techniques for medical images, windowing techniques for bio-signals, Application of Laplace and Fourier transforms to medicals systems, Application of Discrete Fourier transform for medical signals, Short term Fourier transform and its application to medical images and bio-signals, Discrete cosine Transform applications in

medical image processing, Feature extraction techniques, decision making system and medical expert systems, Image restoration and reconstruction.

EC 565 - Selected Topics in Biomedical Engineering**
Prerequisites: BA223, CC413 – Cr. Hrs. 3

To be planned by the lecturer and approved by the committee

EC566 – High Speed Integrated Circuit Design**
Cr. 3. Prerequisite: EC535

Binary Adders Architectures – Binary Multipliers Architectures - Comparators (Magnitude Comparator and Equality Comparators) - SRAM and ROM - Counters - Application of choice (Microprocessor/Microcontroller Architecture, Encryption Algorithm, Digital Communication Transceiver Backend, …).

EC567 – Image Signal Processing**
Prerequisite: EC321 – Cr. Hrs. 3

Introduction to Image Processing - Digital Image fundamentals - Digital Image fundamentals - Image Transforms - Image Enhancement - Image Filtration - Image Filtration - Edge detection - Image restoration - Image segmentation - Color fundamentals - Color fundamentals - Color Image Processing - Morphological image processing - Image compression.

EC568 – Selected Topics in Signal Processing and Systems**
Cr. 3. Prerequisite: EC432

To be planned by the lecturer and approved by the committee

EC569 – Nanoelectronics**
Cr. 3. Prerequisite: EC332

Why Nano?, Atomic Structure, Crystal structure, Miller Indices—Surface reconstruction, reciprocal space. Electronic Structure, Schrodinger equation, Orbital space and Band Structure, Charge Based Devices, pn Junction Diode, Zener Diode. Device Characteristics and Analysis, Quantum Transport, Density of States, Charge Based Devices, Field Effect Transistor, Resonant Tunneling Diode, Spin Based Devices, Ferromagnetic Materials, Giant Magnetoresistance Devices. Magnetic Tunnel Junction Devices, Spin Transfer Torque Devices. Circuits and Systems, Memories, CMOS Inverter, SRAM, DRAM, Flash Memory. Nanofabrication, Chemical Safety and Environmental Protection, Substrate, Oxidation and Annealing, Photolithography Electron Beam Lithography, Nanoimprint Lithography, Physical Vapor Deposition, Chemical Vapor Deposition .

EC570 – Radio-Frequency Integrated Circuit Design**
Cr. 3. Prerequisite: EC434

Communication Concepts - Transceivers Architectures - RF Amplifiers and Tuned Amplifiers - Two Port Network and Review on Scattering Parameters - Power Gain and Stability Factor - Distortion Metrics - Intercept Point, Gain Compression and Blocking - Noise in Communication Systems - MOSFET LNA Design - Mixer's Circuit Design - Oscillators and VCO Design - Phase Locked Loop - TypeII Phase Locked Loop

***** **Courses for other departments**
****** **Elective Course**

Course Group: Electromagnetics and Antennas

EC 341 – Electromagnetics
Cr.3. Prerequisite: BA 114 – BA 224

Review of vector analysis- electromagnetic fields: Coulombs law- electric field and flux density- Gauss's law- electric potential- conductors and semi-conductors- dielectric and capacitance- polarization- magnetic field and flux density- Biot Savart law- Ampere's law- magnetic potential- Maxwell's equations and magnetization vectors- Faraday's law- displacement vector- analogy between electrostatics & magneto static- boundary conditions.

EC 342 – Electromagnetic Wave Propagation
Cr.3. Prerequisite: EC 341

Wave equation- Uniform plan waves- Wave propagation in free space- perfect dielectric- lossy and good conductors- skin effect- surface impedance. Normal incidence- reflection coefficient and standing wave pattern. Input impedance- oblique incidence reflection coefficients for horizontal and parallel polarization Brewster angle- and types of polarization. Fundamental parameters of antennas. Linear wire antenna (infinitesimal- small- finite length & half-wavelength dipole). Ground wave propagation. Troposphere wave propagation. Ionosphere wave propagation.

EC 443 – Electromagnetic Transmitting Media
Cr.3. Prerequisite: EC 342

Transmission line: Types- parameters- voltage and current equations- matched and mismatched lines. Use of Smith chart- single- double- and triple stub matching- quarter wave length transformers- Baluns. Multiple reflection of EM waves between infinite parallel plates- rectangular waveguides. TE and TM modes. Cutoff frequency and propagation parameters. Power transmitted- wall losses- and dielectric losses. Circular waveguides- TE and TM modes. Cutoff frequency and propagation parameters. Power transmitted- wall losses- and dielectric losses. Cavity resonators- modes quality factor- effect of dielectric loss. Circular cavity.

EC 444 – Antennas Engineering
Cr.3. Prerequisite: EC 443

Linear array theory: uniform linear arrays (two-element and N-elements arrays)- types of uniform linear arrays (broadside- end fire- electronic scanning). Non uniform linear arrays (binomial- Chebycheff)- planar arrays- circular arrays. Aperture on conducting and on free space. Horn antennas- E-sectoral- H -sectoral - and pyramidal horns. Parabolic reflectors. Loop antennas. Travelling wave antenna. Rhombic antenna.

EC 545 – Advanced Antennas Systems **
Cr.3. Prerequisite: EC 443

Rectangular Microstrip antenna (definition- analysis- design- radiation pattern- directivity). Circular Microstrip antenna (definition- analysis- design- radiation pattern- directivity). Wide band antennas (analysis of spiral antenna- conical antenna- and cylindrical antenna). Helical antenna (analysis- design-

radiation pattern- directivity). Inverted F antenna (analysis- design- radiation pattern- directivity). Log Periodic Antenna (analysis- design- radiation pattern- directivity). Analysis of Lens antenna. Introduction to Smart antenna.

EC 546 – Microwave Technology
Cr.3. Prerequisite: EC 443 – EC 434

Comprehensive knowledge of microwave hardware. This includes passive and active components. The study extends to the design and analysis of all generating and amplifying devices and Microwave Mixers. Investigating the Microwave Integrated Circuits and Introducing the Nanotechnology, Top Down and Bottom up Technologies and Carbon Nanotube Transistors. Also exploring the different measuring techniques used at such frequency range as well as the related measuring techniques, Microwave Network, and Spectrum Analysis.

EC547 – Smart Antennas
Cr.3. Prerequisite: EC443

Overview on smart antennas. Antnna array fundamentals. Matrix algebra fundamentals. Array correlation matrix. Fixed weight beamforming Criteria. Some of adaptive beamforming techniques. Least mean square. Sample matrix inversion. Recursive least squares. Conjugate gradient method. Some of DOA Estimation Methods. Bartlett and Capon DOA estimate. Linear prediction DOA estimate. Acconting the mutual coupling among an array of dipoles. Compensating the undesired EM effects using transformation matrix.

**** Elective Course**

Course Group: Project Courses

EC 501 – Projects (1)
Cr.3. Prerequisite: None

The final year project extends over two semesters, EC501 is part one of the project. Topics will depend on student's and supervisor's interest. They flay include data acquisition and interpretation-computer models and simulation or design and experimentation. Students are required to give a seminar to discuss the project idea, steps and submit a report.

EC 503 – Project (2)
Cr.6. Prerequisite: EC 501

The final year project extends over two semesters, EC503 is part two of the project. Topics will depend on student's and supervisor's interest. They flay include data acquisition and interpretation-computer models and simulation or design and experimentation. Students are required to give a seminar to discuss the project results and submit a final report.

Course Group: Basic & Applied Sciences

BA 113 – Physics (1)
Cr.3. Prerequisite: None

Electrostatics + Coulomb's law- Electric field – Motion of charged particles in a uniform electric field– Electric flux and Gauss law –Electric Potential energy and electric potential – Capacitors(parallel plate capacitors, energy stored) – Capacitors in series and parallel–Electric current –Ohm's law – resistivity – Power in the circuits –Resistors in series and parallel – Kirchhoff's rules – R.C circuit –Magnetism (Force on a charge in magnetic field) Force on a current –carrying conductor in magnetic field. Biotsavart law and its application – Amper's law and its applications – Electromagnetic Induction –Magnetic flux –Faraday's law- Mutual Induction – Self Induction – Interference of light – Young's double slit experiment – Polarization of light waves

BA 114 – Physics (2)
Cr.3. Prerequisite: BA113

Heat and work –The states of the working fluid –Reversibility and Reversible work –The first law of thermodynamics – The non-flow energy equation– The working fluid; Liquid, vapour and gas – Properties of steam – The use of steam tables. The Perfect Gas & its properties – Reversible non-flow processes: Constant volume, constant pressure, constant temperature (isothermal), adiabatic and polytrophic process for steam and perfect gas – The second law of thermodynamics – The heat engine – Entropy –The T-S diagram a: For vapour; for perfect gas –Static and dynamic properties of fluids. Kinematics of fluid flow. Equation of continuity – The steady-flow energy equation) – Bernoulli's equation – Heat Transfer – Conduction, Convection and radiation; the composite wall and the electrical analogy; Heat flow through a cylinder and a sphere.

BA 118 - Chemistry
Cr.2. Prerequisite: None

Introduction – Electrochemical Reactions, Electro chemical cells, Introduction, Electrochemical Reactions, Electro chemical cells, Electrochemical Series, Polarization, Passivity, Definition of Corrosion, Metals and Corrosive Environments, Forms of corrosion, uniform, Galvanic and D.A.C., Pitting corrosion , S.C.C and I.G.C., Atmospheric Corrosion Erosion Corrosion, Coating protection and Inhibitors, Cathodic Protection, Classification of Fuel, Properties of liquid fuel, Combustion of fuel, Purpose of Lubrication, Classification of Lubricants, Properties of Lubricating Oils, choice of Lubricant, Additives, Introduction to Impurities in Water, Purification and Treatment of Water.

BA 123 – Mathematics (1)
Cr.3. Prerequisite: None

Basic rules of Differentiation–Trigonometric functions and their derivatives –Inverse trigonometric functions and their derivatives – Logarithmic function and its derivative. Logarithmic function and its derivative – Derivatives of hyperbolic and inverse hyperbolic functions – Parametric differentiation, Implicit differentiation –Limits and L'Hospital rule –Partial Differentiation – Taylor's and Maclaurin's expansions – Curve sketching: Critical, maximum, minimum and inflection points – Curve sketching (rational functions) and physical application (velocity and acceleration) –Conic sections : Parabola, Ellipse and Hyperbola

BA 124 – Mathematics (2)
Cr.3. Prerequisite: BA123

Integration by parts –Integration of rational functions – Integration of Trigonometric powers – Integration by trigonometric substitution –Integration of quadratic forms and the Reduction formulas –Areas and Volumes –Length of the curve –Average of a function –Numerical integration – Matrix Algebra –Eigenvalues and Eigenvectors –Cayley – Hamilton theorem.

BA 141 – Engineering Mechanics (1)
Cr.3. Prerequisite: None

Introduction to mechanics: general principles. Force system: rectangular components of a force, parallelogram law. Equilibrium of a particle: springs and cables. Force system resultant: moment of a force, transability of a force, free body diagram. Equilibrium of a rigid body: condition of rigid body equilibrium, equation of equilibrium, two and three force member. Structural analysis: simple trusses, the method of joint, zero force members, method of sections, frames and machines. Friction and Moment of inertia.

BA 142 – Engineering Mechanics (2)
Cr.3. Prerequisite: BA141

Kinematics of particles –Rectilinear kinematics – General curvilinear motion – Motion of projectile – Kinetics of a particle– Newton's laws of motion– equations of motion –Work and energy of a particle – Principle of work and energy – Work and energy for a system of particles – Motion of a rigid body – translational and rotational motion – General plane motion – Relative motion analysis –Relative motion analysis using rotating axis – Kinetics of a rigid body – Rotation about a fixed axis: translation, general plane motion.

BA 223 – Mathematics (3)
Cr.3. Prerequisite: BA124

First order ordinary differential equations (Separable, Homogeneous, Exact, Linear and Bernoulli's equations) –Second order ordinary differential equations with constant coefficients (General solution of homogeneous and Non-homogeneous equations: Method of undetermined coefficients– The Method of variation of parameters)–Second order ordinary differential equations with variable coefficients:[Cauchy- Euler Equation] – Laplace transforms(First Shifting Theorem – Derivatives of Transforms – Transform Integration – Unit Step Function – Second Shifting Theorem – Convolution Theorem) – Inverse Laplace Transforms – Applications(Solution of ODEs using Laplace Transforms – Solution of integral equation (Volterra Integral Eq.) using Laplace Transforms–Solution of R-L circuit using the Laplace Transforms)–Fourier series of functions of period 2P, Fourier series for even and odd functions, half range expansions and for harmonic functions.

BA 224 – Mathematics (4)
Cr.3. Prerequisite: BA223

Vectors in 2D and 3D Space –Vector Algebra– Vector and scalar functions – Vector differential calculus – Vectorintegral calculus –Theorems, physical interpretation of the integrals theorems – Complex algebra – Complex functions – Complex differentiation – Complex integration – Poles and zeros of analytical functions – Residue theorem, and application to real integrals.

BA 323 – Mathematics (5)
Cr.3. Prerequisite: BA 224

Solving ODE using power series methods - Gama functions- Beta functions - Bessel functions- Legendre's Polynomials- Partial D.E., Method of separation of variables - Heat equation- Wave equation- Conformal Mapping: complex functions as mapping-Linear Factional mapping– Schwarz – Christoffel mapping.

Course Group: Computer Engineering (CC)

CC 111 – Introduction to Computers
Cr.3. Prerequisite: None

Introduction to computers and computing - topics of interest include the impact of computers on society, ethical issues, and hardware /software applications, including internet applications, system unit, storage and input/output devices, numbering systems, system and application software - presentation skills - program development - programming languages - flow charts - Visual Basic - web page design using HTML and communications and networks.

CC 112 – Structured Programming
Cr.3. Prerequisite: CC 111

An introduction to C-language Programming is provided in this course, Variable/Constant definitions, Basic Programmes, Sequential Programming, Conditional Programming, Looping and repetitions, Functions, Arrays.

CC 213 – Programming Applications
Cr.3. Prerequisite: CC 112

An advanced C-language Programming is provided - two dimensional arrays – strings – pointers – recursion – structures – bitwise operators – input and output interfacing as well as text and binary files are covered in details. Projects are required from students to increase their skills in C programming.

CC 216 – Digital Logic Design
Cr.3. Prerequisite: CC 111

Number systems - binary arithmetic and codes - logic gates - Boolean algebra and logic simplifications - Design and realization of combinational circuits - Functions of combinational circuits logic - Flip-Flops - analysis design and realization of counters - analysis and realization of shift registers - Computer aided engineering.

CC 312 – Computer Organization
Cr.3. Prerequisite: CC 216

Computer interconnection structures - computer components - computer function interconnection structures - bus interconnection. - Internal and external memory - computer memory system overview - semiconductors main memory - cache memory - magnetic tape - optical memory - Input / Output - I/O modules - programmed I/O - interrupt-driven I/O - direct memory Access -

Operating system - Operating systems overview – scheduling - memory management - The central processing unit - Computer Arithmetic - characteristics and functions of instruction sets - addressing modes - processor organization - the instruction cycle - instruction pipelining - Control unit Micro-operation - hardware implementation - Control Functions.

CC 411 – Introduction to Microprocessors
Cr.3. Prerequisite: CC 312 or CC216

Numbering and coding Systems – Internal Organization of Computers–Reduced Instruction Set computer (RISC) architecture Vs Complex Instruction Set computer (CISC) architecture - Evolution from 8080 to 80486. Pipelining- 8086 Registers- Program Segments- Logical Address-Physical Address- Little Endian Convention- Stack- Flag Register- Addressing Modes- Control transfer Instructions- Data Types and Data Definition-Arithmetic and Logic instructions and Programs-8088 Microprocessor-8284 and 8288 supporting chips- Local bus Vs System Bus- DMA- Memory Capacity-Memory Organization- ROM(PROM-EPROM-EEPROM –Flash memory-Mask ROM) - RAM (SRAM, DRAM, NV-RAM)- Memory Address Decoding- 8088 I/O Instructions- 8255 PPI Chip

CC 413 – Numerical Analysis
Cr.*3. Prerequisite: CC 112 and BA224*

Introduction to numerical methods and their applications - solve science and engineering problems - convergence - error analysis of numerical methods.

CC 524 – Neural Networks
Cr.3. Prerequisite: CC 112 – BA 323

Introduction to basic concepts of neural networks -The basic neuron - The multilayer perceptron - Artificial neural networks – applications - learning – architecture - Competitive neural networks - Kohonen self-organizing networks - Adaptive reasoning theory (ART) - Hopfield neural networks - Neural networks implementation - Neural networks applications - Introduction to MATLAB environment - Single perceptron - Multilayer perceptron - Competitive networks - Kohonen networks - ART networks - Hopfield networks using MATLAB.

CC 527 – Computer Aided Design
Cr.3. Prerequisite: EC 333

To introduce fundamental algorithms and techniques for computer aided integrated circuit design - covers aspects of design flow - physical design - logic optimization - timing analysis and verification - synthesis for testability.

Course Group: Electrical Engineering (EE)

EE 231 – Electrical Circuits (1)
Cr.3. Prerequisite: BA 124

Basic dc circuit elements, series and parallel Networks - Ohm's law and Kirchhoff's law - Nodal Analysis - Mesh Analysis - Source Transformation Method - Superposition Theory - Thevenin's Theorem and Norton Theorem + 7Th week exam - Introduction of Magnetic Circuits - Analysis of Magnetic Circuits - Alternating current Fundamentals and AC generation - RMS value, average

value, form factor and crisp factor - Phasor concept - Relation between voltage and current in resistor, capacitor and inductor - Sinusoidal response of RLC circuit - Series Resonance

EE 232 – Electrical Circuits (2)
Cr.3. Prerequisite: EE 231

Alternating current fundamentals and AC generation - RMS value, average value, form factor - RLC circuits analysis (series, parallel, node voltage)RLC circuits analysis (mesh current, Thevenin equivalent) - Star delta transformation – Resonance - Complex Power Calculations - Maximum Power Transfer - Three Phase Systems and Balanced Y-Y Circuit Y- □ , □ -Y, □ -□ Phase systems - Power Calculation in three Phase System - Unbalanced Three Phase Circuits - Natural Response of parallel RLC circuits - Natural Response of series RLC Circuit - Step Response of Parallel RLC Circuits - Step Response of Series RLC Circuits

EE 328 – Electrical Power and Machines
Cr.3. Prerequisite: EE 232

Review on electric circuits & Magnetic circuits - The law of motor and generator action -.DC Motors - DC Generator - Core Loss and transformer basics - Transformer model and regulation - Transformer ratings and testing.AC rotating field.3-phase induction motor - Synchronous machines - Single phase and small motors - Electric power system - Plant distribution system - Protective devices and distribution of electricity in buildings - System protection & PF correction.

EE 418 – Automatic Control Systems
Cr.3. Prerequisite: EE328

Introduction to control system - Differential equation of physical systems - Block diagram models using MATLAB - Signal flow graph models using MATLAB - Test input signals - Performance of 1st and 2nd order system - Effect of 3rd pole and a zero on the 2nd order system + 7Th week exam - Stability concept – Routh - Hurwitz stability criterion - Root locus techniques - Approach to System Design - Advantages of Feedback - Analog PID Controller - Lead Compensator Design + 12Th week exam - Lag Compensator Design - Lead – Lag Compensator and PID Tuning - Case Study

EE 419 – Modern control Engineering
Cr.3. Prerequisite: EE 418

Frequency response, polar plot-Bode plot - Frequency response Bode plot- Nyquist - .Frequency response Applications using Matlab tool box - Lead compensation by frequency response - Lag compensation by frequency response - Introduction to state-space - Methods of state space representation - Solution of state equation - Controllability – observability - State variable feedback - Introduction to digital control systems - The z- transform - Time response of digital systems Stability analysis for digital systems - Case Studies and Applications(Two level tank system, motor speed control)

EE 512 – Automated Industrial Systems (1)
Cr.3. Prerequisite: EE418

Automation hierarchical levels and components– Detecting sensors and actuating elements, relay logic and their applications– Introduction to PLC.S– Types of PLCs and construction – Hardware configuration and descriptions– Programming and testing basic functions– Programming and testing advanced functions– Industrial Applications using PLCs.

Course Group: Industrial and Management Engineering (IM)

IM 111 – Industrial Relations
Cr.2. Prerequisite: None

Types of industries and production techniques – Management and organization structure – Production planning and control – Industrial cost estimation techniques – Industrial economy and breakeven analysis – Accidents at work – rules and regulations – Hazards classification, prevention, and personal safety – Fire hazards identification and prevention – Chemical hazards and prevention – accident reporting – Quality control– Science, engineering, and technology .

IM 112 – Manufacturing Technology
Cr.2. Prerequisite: None

Forming operations – Heat treatment operations – Cutting tools – Mechanics of metal cutting and turning operations – Cutting fluids – Sand casting – Centrifugal casting, die casting and aspects of the casting process – casting defects -Gas and Electric arc welding – Electric resistance and pressure welding and aspects of the welding process-welding defects – Standards of measurements – Measuring Instruments – Measuring methods.

IM 423 – Operations Research
Cr.3. Prerequisite: 90 Credit Hours.

Introduction to linear programming – Development of linear programming models – The graphical and simplex method – Transportation and assignment methods – Network models and analysis (minimal spanning tree, shortest route, and maximal flow) – Critical path method – Probabilistic approach, project evaluation and review technique (PERT) – Project crashing.

IM 535 – International Operations Management
Cr.3. Prerequisite: 126 Credit Hours.

International business environment – Cultural and legal environment – Political environment – Economic environment facing business – International trade theories – Governmental influence on trade – Regional economic integration – Factor mobility and foreign direct investment – The foreign exchange market – The determination of exchange rates – Global manufacturing and supply chain management.

Course Group: Language, Humanities and Social Science (LH)

LH 131 - ESP I
Cr.2. Prerequisite: None

Orientation - Personal Computing - Portable Computers - The process of academic writing - An overview of paragraph writing - Suffixes - Programming and Languages - Graded workshop - Unity and Coherence - Writing workshop - Computer Software - Computer Networks - Graded workshop - Computer Viruses- Computers in the Office.

LH 132 - ESP II
Cr.2. Prerequisite: LH 131

Orientation - Computers in Education - Paragraph writing (Concrete Support I) - Computers in Medicine - Essay writing (Analysis) - Graded workshop - Robotics - Summary writing - Virtual Reality - Machine Translation - Graded workshop - CVs & letters of application - Interviewing skills - Multimedia.

LH 231 - ESP III
Cr.3. Prerequisite: LH 131, LH 132

Orientation - Overview of technical report writing - Background reports - Process reports - Instructions and manuals - Primary research reports - Feasibility reports - Report format - Dictionary skills - Paraphrasing - Summarizing - Further practice on summarizing and paraphrasing - Discussion of report outlines - Presentation skills (CD viewing I) - Quotations and source documentation - Report writing workshop - Use of visual aids in technical writing - Presentation skills (CD viewing II) - Report writing workshop - Mini presentations - Report writing workshop - Rehearsals - End of term presentations.

Course Group: Mechanical Engineering (ME)

ME 151 - Engineering Drawings & Projection
Cr.2 Prerequisite: None

Drawing practices and techniques –Geometrical constructions - Dimensioning and free hand sketching – Methods of projection – Orthogonal projection — Sectioning and conventions – Intersection of geometrical surfaces and development – Standard metal sections and metal structures – Pictorial projection (Isometric) – Surface intersections – Perspective projection – An introduction to Computer Aided Drafting using AutoCAD.

Course Group: Non-Engineering (NE)

NE 264 – Scientific Thinking
Cr.3. Prerequisite: None

Introduction about Nature of Scientific Thinking &Thinking Patterns Development; Meaning & Construction of Science + Scientific Values & attitudes; Science, non-science & other-than science +Science, Engineering & Technology; Properties of science; Mental operations used in science and Scientific Guessing; Types of deductions and Representation; Research methods in natural sciences, definitions; Experiments, Observations, Scientific postulates and their conditions; Verification of

scientific postulates; General methods of problems solving; Creative and critical Thinking; Fluency types; Flexibility, Originality and Basics of Brain Storming.

NE 465 – Creative awareness
C.r3. Prerequisite: None.

Introduction to fine Arts – Art in our lives – The Basic Meaning of Art- Design elements: Shape and Form – Design elements: Space – Design elements: Texture and pattern –Design elements: Color–Color theory–The Principles of Design: Balance– Emphasis- Contrast–Repetition–The Principles of Design : Proximity– Proportion- Harmony– Unity & Variety–Ethics of engineering

NE 364 – Engineering Economy
Cr.3. Prerequisite: 54 Credit Hours

Introduction and overview – Cost concepts and the economic environment – Principles of money, time relations – Concept of economic equivalence – Cash flow diagrams interest formulas and uniform series – Cash flow diagrams uniform gradient series and geometric sequence – Nominal and effective interest rates continuous compounding and continuous cash flows – Applications of engineering economy methods of investment assessment – Comparing alternatives useful life is equal to the study period – The imputed market value technique – Depreciation historical methods and cost recovery systems.