INTERDISCIPLINARY GROUP

Courses (all are 3 Credit courses)
EEE 6002: Selected Topics in Electrical and Electronic Engineering Course contents to be decided by the course teacher with the approval of the Board of Postgraduate Studies (BPGS) of EEE Dept. (NB: This course can be taken by a student only once in any program)
EEE 6101: Nonlinear System Analysis Numerical methods. Graphical methods. Equations with known exact solution. Analysis of singular points. Analytical methods. Forced oscillation systems. Linear differential equation with varying coefficient. Stability of nonlinear systems.
EEE 6103: Artificial Neural Networks Biological nervous system: the brain and neurons. Artificial neural networks. Historical backgrounds. Hebbianassociator .Perceptrons: learning rule, illustration ,proof, failing Adaptive linear (ADALINE) and Multiple Adaptive linear (MADALINE) networks . Multilayer perceptions: generating internal representation Back propagation, cascade correlation and counter propagation networks. Higher order and bidirectional associated memory .Hopfield networks: Lyapunov energy function. attraction basin. Probabilistic updates: simulated annealing, Boltzman machine. Adaptive Resonance Theory (ART) network ART1, ART2, Fuzzy ART mapping (ARTMAP) networks. Kohonen's feature map, learning vector Quantization (LVQ) networks. Emerging topics: Convolutional neural network, Deep neural networks. Applications of neural nets.
EEE 6301: Power Semiconductor Circuits* Static switching devices, characteristics of SCR, BJT, MOSFET, IGBT, SIT, GTO, MCT. Classifications of static power converters and their application. Control circuits for static power converters. Pulse width modulation; PWM control of static power converters. Switch mode DC to DC converters, resonant converters, Fourier analysis of static converter waveforms, HD, THD, pf, ZVS and ZCS of static converters. Hysteresis current of AC drives. ***This course also belongs to the EEPS group**
EEE 6302: Design of Power Semiconductor Circuits and Drives* Design of SCR communication circuits, base and gate drive circuits of static switching devices, snubber circuits, switching losses and heat sink. Input/output filter design of static power converters. Design of protection circuits for static power converters. Scalar and vector control of AC machines using static power converters. Design of microcomputer controllers for static power converter switching. ***This course also belongs to the EEPS group**

Courses (all are 3 Credit courses)
EEE 6701: Nonlinear Control Systems General introduction: the phase plane: method of isoclines: Linenard's method: Pelts method: common nonlinearities: transient response from phase trajectory: describing function and their applications. Relay servo mechanism. Lyapunov's method.
EEE 6702: Sampled Data Control System Z Transform and modified Z transform: root-locus and frequency method of analysis of sampled data systems. Compensation, discrete and continuous method. Physical realization of discrete compensations.
EEE 6704: Advanced Control Theory State space description of dynamic systems: relationship between state equations and transfer function: continuous and discrete time linear system analysis and design using state transition method. Controllability and observability. State feedback and output feedback. Pole assignment using state feedback and output feedback. H_∞ control. Optimal control-dynamic programming. Pontryagin's minimum principle. Separation theorem. Stochastic control. Adaptive control.
EEE 6705: Biomedical Signal Processing Origin of bio-potentials. Linear and nonlinear modeling of bio-systems. Cardiac Signal Processing: Electrocardiogram (ECG): origin, acquisition techniques, noise reduction, arrhythmia classification, heart rate variability analysis, phonocardiogram (PCG) signal analysis, photoplethysmography (PPG) signal analysis. Brain Signal Processing: Electroencephalogram (EEG): origin, recording system, disease detection from EEG, human-computer interaction. Neuromuscular Signal Processing: Electromyogram (EMG), motor unit action potential, twitch, neuromuscular activity classification, disease classification. Medical imaging: Ultrasound, X-ray, MRI and CT. Medical image Processing: segmentation, enhancement, denoising, morphological operations, edge detection, compression, 3D volumetric image processing, computer aided disease detection from medical images.
EEE 6003: Solar Photovoltaic Systems* Solar cell technologies. PV modules. Balance of system components: batteries and charge controllers, inverters, sun tracker. MPPT and its various methods. System design and integration. Location issues and Irradiance modeling; Stand-alone system design; Grid integration issues; Grid-connected system design; Economics of solar PV: Solar energy cost; Grey energy; Energy payback time; Yield factor. ***This course also belongs to the EEPS group**

Courses (all are 3 Credit courses)
EEE 6004: Medical Imaging Overview of various imaging modalities, applications, review of linear systems theory, Fourier transform and numerical optimization, image operations: denoising and enhancement, image quality, Radiography: physics, conventional X-ray, digital X-ray, concepts, data acquisition, digital mammography; Computed Tomography: parallel beam, fan beam, cone beam, artefacts, iterative CT algorithms: algebraic, descent, EM, radiation effects; Ultrasound imaging: physics, data acquisition, modes, Doppler affect, attenuation, speckle noise, 3D and 4D ultrasound, elastography; MRI : physics, data acquisition, modes, noise effect, EMI, parallel MRI; functional MRI; The Gamma Camera, Tissue Attenuation, Positron Emission Tomography (PET); Optical coherence tomography (OCT); Regulatory issues; Emerging Technologies
EEE 6005: Biometric Security Overview of biometric systems and security, Authentication, Identification; Fundamentals of image processing, pattern matching, feature extraction and dimensionality reduction, performance analysis; Biological characteristics: Fingerprint, vein, face, iris, palm, periocular, retina, use of ECG and EEG; Behavioural characteristics: Keystroke dynamics, gait, signature, voice, emotion, facial expression; Multimodal biometrics; Continuous biometric authentication; Biometric sample quality; Privacy and template protection; Presentation attacks: artefacts and possibilities for mimicking; regulations and Biometric standards; emerging techniques, ethical issues.
EEE 6007: Electrical Transport Phenomena in Biological Systems Mechanical Driving Forces: Introduction to fluid flow; Conservation of momentum; Inviscid and viscous flows; Convective transport; Dimensional analysis. Electrical Driving Forces: Maxwell's equations; E and B field in bio-systems; Ion transport; Quasi-electrostatics, Poisson's and Laplace's equations, Poisson-Boltzmann equation. Chemical Driving Forces: Conservation of mass; Diffusion, Steady and unsteady diffusion; Diffusion with chemical reactions; Diffusion based analysis of DNA binding proteins, Binding assays, Receptor ligand models, Electrical analogy of cell surface binding. Electrokinetics: Debye layer; Zeta potential; Electroosmosis; Electrophoresis; Application of electrokinetics, Electrophoretic mobility of various biomolecules, Molecular sieving; Dielectrophoresis, Dielectrophoretic manipulation of cells; Debye layer repulsion forces; Van der Waal's forces; Colloid stability theory.
EEE 6008: Computational Methods for Inverse Problems Introduction to inverse problems, ill-posedness, regularization methods, linear and non-linear optimization methods for inverse problems: Gauss-Newton method, conjugate-gradient method, Landweber method, deterministic vs probabilistic approach to inverse problems, compressed sensing as an inverse problem, applications in engineering, online toolboxes on inverse problems.

Courses (all are 3 Credit courses)
EEE 6009:Energy Planning*   Energy and its types. Energy Landscape in Bangladesh. Global Energy Perspectives: World Energy Consumption. Sources of Energy: fossil types – coal, oil, gas, and other hybrids. Sources of Energy: Renewables – wind, solar, tidal, hydro. Nuclear power and its Future. Long term forecast of energy requirements and availability: Bangladesh and global perspectives. Energy Economics and econometric models. Climate Change and the Energy scenario. Carbon management and Low emission Technologies. Future Trends: hydrogen economy, smart storages, future strategy. Energy Strategy, Innovation, and Entrepreneurship. Energy Pricing issues. Energy Policy in Bangladesh.   ***This course also belongs to the EEPS group**
EEE 6010: Internet of Things   Introduction; IoT networks: architectures, characteristics, infrastructures and standards; IoT Platforms: mobile, cloud-based; Protocols and programming; QoS, multiple access techniques, energy management and security; Intelligent IoT; IoT spectrum; IoT Hardware and sensors; Applications: smart city, smart grid, smart healthcare, V2X.
EEE 6011: Semiconductor Detector for Image Sensors   Introduction to Image Sensors; High energy photon detection, Advantages of semiconductor detectors; Imaging Systems: Xerographic mode detection and Flat panel detection; Mode of Conversion: Direct and Indirect approach, Imaging performance: Sensitivity, Resolution, Quantum efficiency, Noise and Lag; Photoconductor properties for high energy photon detection; Dielectric relaxation, Carrier Schubwegs, Shockley-Ramo Theorem; Photon interaction mechanisms in Photoconductor; Ionization Energy; Potential photoconductors; Atomic Structure of a-Se: Density of states, Optical Properties of a-Se; Charge trapping and absorption limited sensitivity; cascaded system model, noises in digital imaging sensors, signal and noise propagations, Detective Quantum Efficiency; Modulation Transfer Function; Dark current and its reduction mechanisms in semiconductor detectors, Recombination and ghosting in semiconductor detectors; Practical a-Se multilayer detector; avalanche detector; Sensing and storage elements, Clinical applications of complete systems.

Courses (all are 3 Credit courses)
EEE 6608: Machine Learning and Pattern Recognition*   Introduction to algorithms and principles involved in machine learning. Linear regression, logistic regression. Discriminative learning. Fundamentals of representing uncertainty, learning from data, supervised learning. Support vector machines and kernel trick. Model selection and feature selection. Combining features, classifiers, and boosting. Ensemble methods. Clustering and unsupervised learning. Expectation maximization regularization. Hidden Markov models. Learning from Bayesian networks. Probabilistic inference. Collaborative filtering. Reinforcement learning. Neural networks representation and learning. Deep neural network and manifold learning. Design and analysis of machine perception systems. Design and implementation of a technical project applied to real-world problems of images, text, and robotics.   ***This course also belongs to the CSP group**