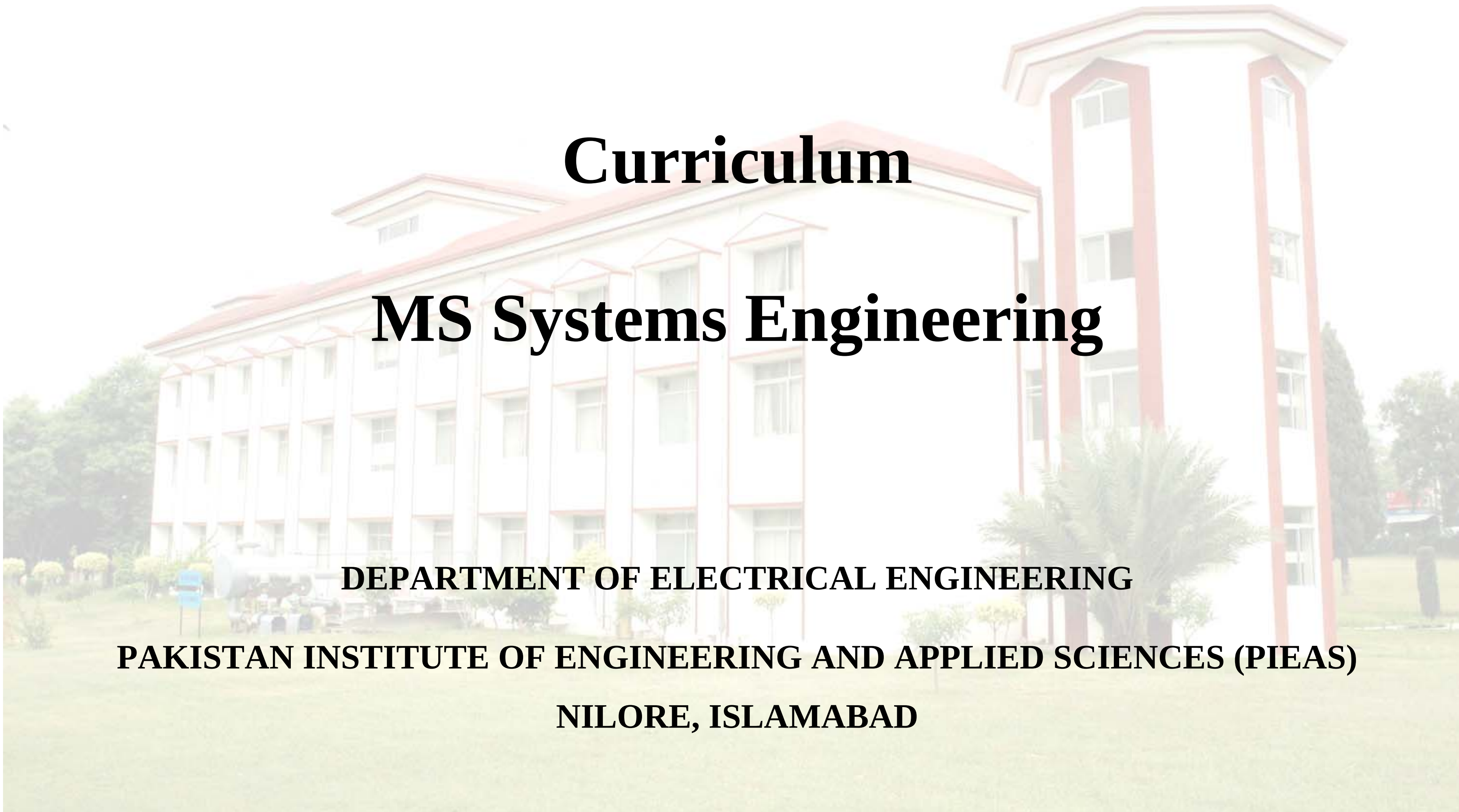

Curriculum

MS Systems Engineering

DEPARTMENT OF ELECTRICAL ENGINEERING

PAKISTAN INSTITUTE OF ENGINEERING AND APPLIED SCIENCES (PIEAS)

NILORE, ISLAMABAD

SEMESTER-WISE COURSE PLAN

SUMMARY

Spring Semester	EE-501: Control Systems Design-I	EE-502: Applied Electronics	NE-534: Introduction to Nuclear Engineering (Institutional Requirement)	Optional-1
Summer	EE-510: Process Instrumentation	Optional-2		
Fall semester	EE-511: Digital Control Systems Analysis & Design	EE-601: Control Systems design-II	EE-529: Power Converter Design	Optional-3
Spring Semester	EE-697: Thesis Research	Optional-4	Optional-5	Optional-6
Research Semester	EE-697: Thesis Research			

SEMESTER-WISE COURSE PLAN

	SR.NO	CODE	COURSE TITLE	CrHrs	STATUS	CrHrs
Spring Semester (Year 1)	**1**	**EE-501**	**Control Systems Design-I**	**3**	**C**	13
	2	**EE-502**	**Applied Electronics**	**3+1**	**C**	
	3	**NE-534**	**Introduction to Nuclear Engineering**	**3**	**IR**	
	4	XX-XXX	Optional 1	3	O	
Summer Session	**1**	**EE-510**	**Process Instrumentation**	**3+1**	**C**	7
	2	XX-XXX	Optional 2	3	O	
Fall Semester	**1**	**EE-511**	**Digital Control Systems Analysis & Design**	**3+1**	**C**	13
	2	**EE-529**	**Power Converter Design**	**3**	**C**	
	3	**EE-601**	**Control Systems design-II**	**3**	**C**	
	4	XX-XXX	Optional 3	3	O	
Spring Semester (Year 2)	**1**	**CMS-501**	**Communication Skills**	**1**	**IR**	13
	2	XX-XXX	Optional 4	**3**	O	
	3	XX-XXX	Optional 5	3	O	
	4	XX-XXX	Optional 6	3	O	
	5	**EE-697**	**Thesis Research**	3	**C**	
Research Semester	**1**	**EE-697**	**Thesis Research**	**12**	**C**	12
					Total CrHrs	**58**

DETAILED SEMESTER-WISE COURSE PLAN

	SR.NO	CODE	COURSE TITLE	CR	STATUS	PRE REQ
Spring Semester Year 1		**EE-501**	**Control Systems Design-I**	**3**	**C**	**A basic course on Control Systems**
		EE-502	**Applied Electronics**	**3+1**	**C**	**Basic circuit theory and electronics**
		NE-534	**Introduction to Nuclear Engineering**	**3**	**IR**	**NONE**
		EE-507	Stochastic Processes	3	O	Basic course in probability and Signals and Systems
		PAM-509	Numerical Optimization	3	O	NONE
		PAM-524	Linear Algebra	3	O	NONE
Summer Session		EE-425	Fundamentals of Robotics	3	O	NONE
		EE-426	PLCs and Industrial Automation	2+1	O	NONE
		EE-506	Embedded System Design	3	O	NONE
		EE-508	Computational Intelligence	3	O	NONE
		EE-510	**Process Instrumentation**	**3+1**	**C**	**EE-502**
		EE-526	Digital Design with Verilog HDL		O	NONE
		NE-555	Nuclear Reactor Analysis	3	O	NE-534
Fall Semester		NE-510	Nuclear Power Plant Systems	3	O	EE-534
		EE-511	**Digital Control Systems Analysis & Design**	**3+1**	**C**	**EE-501**
		EE-515	Advanced Digital Signal Processing	3	O	A basic course on Digital signal Processing and Stochastic processes
		EE-522	Pattern Recognition	3	O	NONE
		CMS-528	Project Management	3	O	NONE

		EE-529	**Power Converter Design**	3	C	**NONE**
		EE-530	Special Topics in Systems Engineering-I	3	O	To be defined by the instructor
		EE-554	Digital Image Processing	3	O	NONE
		EE-601	**Control Systems design-II**	**3**	**C**	**EE-501**
		EE-616	Industrial Drives	3	O	EE-529
		EE-618	Robot Structures, Sensing and Perception	3	O	EE-425
Spring Semester Year 2		CMS-501	Communication Skills		IR	NONE
		EE-544	Nuclear Reactor Instrumentation and Control	3	O	NE-510
		EE-602	Non-linear Control Systems	3	O	EE-601
		EE-603	Optimal Control Theory	3	O	EE-601
		EE-605	Robust Control	3	O	EE-601
		EE-606	Adaptive Control Systems	3	O	EE-601
		EE-607	System Identification	3	O	EE-511, EE-601
		EE-612	Fault Diagnosis and Tolerant Control	3	O	EE-511, EE-601
		EE-614	Computer Vision	3	O	EE-554 or Equivalent
		EE-615	Adaptive Signal Processing		O	Signals & Systems / Digital Signal Proc., A course in Probability
		EE-620	Mobile Robot Task Planning	3	O	EE-618
		EE-625	Special Topics in Systems Engineering-II	3	O	To be defined by the concerned instructor
		EE-697	**Thesis Research**	**3**	**C**	**NONE**
Research Semester		**EE-697**	**M.Sc. Thesis Research**	**12**	**C**	**NONE**

Detailed Course Contents

EE-425 FUNDAMENTALS OF ROBOTICS

Course Contents

Kinematics; Dynamics; State variable representation and linearization of nonlinear models; motion planning, motion control, trajectory planning; mechanisms and actuation; Sensors; Robotic system architecture and programming; mobile robotics, types and classification, localization and mapping; kinematically redundant manipulators, parallel mechanisms; robots with flexible joints; Programming in player/stage simulator; case studies: PUMA560, RHINO XR3, SCARA, STANDFORD ARM.

Recommended Texts

1. Craig, J., Introduction to Robotics: Mechanics and Control, 3rd Edition, Prentice Hall, 2004.
2. Siciliano, B., and Khatib, O., (Eds.), Handbook of Robotics, Springer, 2008.
3. Robert J. Schilling, Fundamentals of Robotics: Analysis and Control, Prentice Hall, 2007.

EE-426 PLCs AND INDUSTRIAL AUTOMATION

Course Contents

Introduction to Programmable Logic Controllers; Ladder Logic programming, PLC connections, Ladder Logic Inputs and Outputs, PLC Hardware; Input and Output Modules, Relays, Logical Sensors, Sensor wiring, Presence detection of Contact Switches, Reed Switches, Optical Sensors, Capacitive Sensors, Logical Actuators, Solenoids, Valves, Hydraulic and Pneumatic Actuators, Motors. Boolean Logic Design details; PLCs Operation, Latches Timers, Counters. Structured Logic Design. State Based Design; Handling numbers and data; Using PLC memory bits; Data handling using ladder logic functions; Structured Text Programming; Function Block Programming; Analog Inputs and Outputs, Continuous Control, PID Control, Serial Communication, Networking, Human Machine Interface (HMI), SCADA and its use.

Recommended Texts:

1. Bolton, W., Programmable Logic Controllers: Newnes, Elsvier, 2009.
2. Jack, H., Automating Manufacturing Systems: Springer, 2010.
3. Collins, K., PLC Programming for Industrial Automation, 2009
4. PLC manufacturers Material in PDF (e.g., Siemens), Latest available.

EE-501 CONTROL SYSTEMS DESIGN-I

Course Contents

Review of modeling and analysis technique for control systems; Bode diagram, Nyquist plot, polar plot, Nichols chart, Nyquist stability criterion, relative stability, Modeling of different benchmark systems and related transfer functions, Design of control systems using root locus techniques, control system design by frequency response; lag compensation, lead compensation, lag-lead compensation, PID controllers; tuning rules for PID controllers, Two degree of freedom PID control, Fundamental limitations in SISO control; sensors, actuators, model, error and structural limitations, industrial applications, remedies, Dealing with constraints; wind-up, anti wind-up schemes, state saturation,

Recommended Texts:

1.Ogata, K., Modern Control Engineering, 5th edition, Prentice Hall, 2009.

2.Kuo B. C., Automatic control systems, 9th edition, Wiley, 2009.

3.Dorf R. C., Modern Control Systems, 11th edition, Prentice Hall, 2010

4.Goodwin, G. C., Control System Design, Prentice Hall, 2000.

EE-502 APPLIED ELECTRONICS

Course Contents

Operational amplifier basics; Basic circuits with operational amplifiers: stability issues and dynamic limitations; Comparators; Precision Rectifiers; Instrumentation amplifiers; Voltage regulators and regulated power supplies: voltage references, 3- and 4-terminal regulators, switching regulators, dc-dc converters; Digital and analog electronics interfacing: interfacing between different logic families, interfacing between digital and analog components; Optoelectronics: LED's, displays; Digital/Analog conversion: analog switches, sample and hold, multiplexers, analog to digital converters, digital to analog converters; Analog filter design and active filters: Butterworth, Chebychev, Bessel, elliptic filters, gyrator; Interference, shielding and grounding: signal grounds, grounding between instruments, ground loops, shielding; Data transmission; PCB design techniques;.

Recommended Texts:

1. Horowitz P., and Hill W., The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
2. Doebelin E. O., Measurement Systems application and Design, 5th edition, McGraw-Hill, 2003.
3. Franco S. "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd edition, McGraw-Hill, 2002.

EE EE-506 EMBEDDED SYSTEMS

Course Contents

Introduction to Embedded Systems; C8051FXXX/ARM series advanced Processors Architecture, Memory Organization and Real World Interfacing; Devices and Communication Buses for Devices Network; Device Drivers and Interrupt Service Mechanisms; Program modeling concepts, Inter process communications and synchronization of processes, threads and tasks, Real time operating systems, case studies: programming with RTOS in Micro C OS-I/RT-Linux/Windows CE

Recommended Texts:

1. Kamal, R., Embedded Systems Architecture, Programming and Design, McGrawHill, 2008.
2. Tammy N., Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers, Elsevier, 2005.
3. Labrosse, J. J., Micro C /OS-II, The Real Time Kernel, CMP Books, 2002.
4. Raghavan, P., Amol, L., Embedded Linux System Design and Development, Auerbach Publications, 2006.

EE-507 STOCHASTIC PROCESSES

Course Contents

Review of basic probability; Conditional probability; Random variables and transformations; Random vectors their transformations; Jointly Gaussian random variables; Sequences of random variables: Laws of large numbers, central limit theorem; Basic concepts of random processes; Special processes: Gaussian, Markov, Wiener, Poisson processes, random walk; Random processes in linear systems and Wiener filtering; Principles of Estimation Theory; sample mean and sample variance; maximum-likelihood estimator; Orthogonality principle, minimum mean squared error estimation and Kalman filtering; Introduction to Bayesian estimation.

Recommended Texts

1. Papoulis, A., and Pillai, S.U., Probability, Random Variables and Stochastic Processes, McGraw-Hill, 2002
2. Kay, S. M., Intuitive Probability and Random Processes using MATLAB®, Springer, 2005.
3. Stark, H., and Woods, J. W., Probability and Random Processes with Applications to Signal Processing, Prentice Hall, 2001.
4. Gallager, R.G., Discrete Stochastic Processes, Kluwer, 1996.

EE-508 COMPUTATIONAL INTELLIGENCE

Course Contents

Basic concepts of computational intelligence; single-layer and multi-layer feedforward neural networks; feedback and recurrent neural networks; learning vector quantizer (lvq); self-organizing feature maps; radial basis function neural networks; support vector machines; genetic algorithms, genetic programming; fuzzy sets and fuzzy logic, fuzzy neural networks; swarm intelligence and ant colony optimization, hidden markov models.

Recommended Texts

1. Engelbrecht, A. P., Computational Intelligence: An Introduction, 2nd Edition, Wiley, NY, 2007.
2. Hastie, T., Tibshirani, R., and Friedman, J., The Elements of Statistical Learning, 3rd Edition, Springer, 2009.
3. Zurada, J., Introduction to Artificial Neural Systems. West Publishing Company, St. Paul, 1992.

EE-509 NUMERICAL OPTIMIZATION

Course Contents

Optimization theory; problems; unconstrained nonlinear problems, linear equality constrained problems, linear inequality constrained problems, nonlinear equality constrained problems, nonlinear inequality constrained problems, methods; linesearch methods, trust-region methods, Newton's methods, linear and nonlinear conjugate gradient methods, simplex method, penalty function methods, barrier function methods, augmented Lagrangian methods, sequential linearly constrained methods, Convex optimization, sequential quadratic programming methods

Recommended Texts

1. Nocedal, J., Wright, S. J., Numerical Optimization, Springer Verlag, 1999.

2. Fletcher, R., Practical Methods for Optimization, Wiley, 2000.
3. Bertsekas, D., Nonlinear Programming, Athena Scientific, 1995.
4. Daniels, R. W., Introduction to Numerical Methods and Optimization Techniques, Elsevier Science Ltd., 1978.

EE-510 PROCESS INSTRUMENTATION

Course Contents

Measurement techniques and sensors for various process variables: length, motion, angle, force, weight, torque, pressure, flow, temperature, humidity, liquid level, time, frequency, etc; Properties of sensors: static and dynamic response, calibration, sensitivity, resolution, repeatability, reproducibility, size, weight, dimensions, fatigue life, reliability, errors, aging, pricing and availability, system reliability, etc; Manipulating, computing, and compensating devices: bridge circuits (ac/dc), amplifiers, integrators, instrumentation amplifiers, modulation and demodulation, voltage-to-frequency and frequency-to-voltage converters, grounding and shielding, filtering; Dynamic compensation: pole placement; Interfacing with microprocessors, Analog/digital inter-conversion; Data Transmission: analog voltage and current, digital data, radio transmission, pneumatic transmission, slip rings; Display: analog voltmeters and potentiometers, digital voltmeters, XY plotters, oscilloscopes;.

Recommended Texts:

1. Doebelin E. O., Measurement Systems application and Design, 5th edition, 2003.
2. Bentley J., Principles of Measurement Systems, 4th edition, Prentice Hall, 2004.
3. Webster J. G. (Editor), The Measurement, Instrumentation and Sensors Handbook, 1st edition, CRC Press, 1998.
4. Horowitz P., and Hill W., The Art of Electronics, 2nd edition, Cambridge University Press, 1989.

NE-510 NUCLEAR POWER PLANT SYSTEMS

Course Contents

Layout of nuclear power plants; Containment buildings; Prirnary containment vessels; Structure of reactor core; and mechanical stress in various structures. Description and analysis of power plant systems and components including steam generator, steam dryer and separator, pressurizer, reheater, heat exchanger, condenser, demineralizer, pumps, turbine, generator, cooling tower; Auxiliary cooling systems. Fuel handling mechanisms; Control and mechanisms; Radwaste systems; Electrical Systems; Reactor grid interface and load following. Basic considerations in nuclear plant design; Components of nuclear power cost; Economic comparison of nuclear and fossil fueled plants; Dual and multipurpose nuclear plants; Future trends in nuclear power cost.

Recommended Texts

1. Saito, T., (editor), Advances in Light Water Reactor Technologies, Springer Science Publication, USA, 2011.

2. Lamarsh, J.R., Baratta, A. J., Introduction to Nuclear Engineering, 3rd Edition, Prentice Hall, USA, 2001.
3. Lish, K. C., Nuclear Power Plant Systems & Equipment, Industrial Press Inc., 1972.
4. Rust, J. H., Nuclear Power Plant Engineering, Haralson, 1979.
5. El-Wakil, M. M., Nuclear Energy Conversion, International Text Book, USA, 1982.
6. Pedersen, E. S., Nuclear Power, Volume 1 & 2, Ann Arbor Science, USA, 1978.
7. El-Wakil, M.M., Power Plant Technology, McGraw-Hill, 1984.

EE-511 DIGITAL CONTROL SYSTEMS ANALYSIS AND DESIGN

Course Contents

Z-transform review and applications; Sampling, Quantization, and discretization; Delta Modulation; Stability Tests; Digital control systems analysis and design using root locus and frequency domain; Dead beat design; Direct design method of Ragazzini; State-Space analysis; Different canonical forms; Cayley-Hamilton Theorem; Stability in the Sense of Lyapunov; Concepts of Controllability and Observability; Pole Assignment Techniques; Design of Static State Feedback Gain matrix; Design of Full Order Prediction and Current Observer; Design of Reduced Order Prediction Observer, Minimum Order Estimator Design; Pulse Width Modulation (PWM) control technique; Bang-Bang Control; Design of Servo-System with and without observer.

Recommended Texts:

1. Ogata K., Discrete-Time Control Systems, Pearson Education, 2nd Ed., 2007.
2. Franklin, Powell, Digital Control of Dynamical Systems, 3rd Ed., 2005
3. Franklin, Powell, Feedback Control of dynamical Systems, Pearson Education, 4th Ed. 2005

EE-515 ADVANCED DIGITAL SIGNAL PROCESSING

Course Contents

Review of discrete time systems, digital filters, and filter structures; Multi-rate digital signal processing fundamental: Basic sample rate alteration devices, multi-rate structures for sampling rate conversion, multi-state design for decimator and interpolator, poly-phase decomposition, arbitrary-rate sampling rate converter; Multi-rate filter banks: Digital filter banks, Two-channel quadrature-mirror filter bank, Perfect reconstruction two channel FIR filter banks, L-Channel QMF banks; Parametric signal modeling and linear prediction theory: Stochastic time-series models; Wold decomposition theorem; Discrete Wiener filters: principle of orthogonality, normal equations; linear prediction theory: forward and backward linear predictors and their properties, Levinson-Durbin algorithm, lattice prediction filter; Spectral Estimation: Parametric, nonparametric methods; Analysis of finite word length effects; (Optional)signal-to-noise ratio in low-order IIR filters, (Optional)low-sensitivity digital filters, round off errors in FFT algorithms.

Recommended Texts

1. Mitra, S. K., Digital Signal Processing, 3rd Edition, Mcgraw-Hill, 2006.
2. Hayes, M., Statistical Digital Signal Processing and Modeling, Wiley, 1996.
3. Vaidyanathan, P. P., Multi-rate Systems and Filter Banks, 1st Edition, Prentice Hall, 1992.
4. Manolakis, D. G., Ingle, V. K., and Kogon, S.M., Statistical and Adaptive Signal Processing, Mcgraw-Hill, 2000.
5. Haykin, S., Adaptive Filter Theory, 4th Edition, Prentice-Hall, 2002.

EE-522 PATTERN RECOGNITION

Contents

Supervised and unsupervised classification and recognition, Feature generation and selection: feature vectors, dimensionality reduction, principle component analysis, independent component analysis, Fourier feature, wavelet features, signal and noise subspace; Distance functions, measures, metrics; Baye's decision theory; Parametric/nonparametric estimation of probability density functions: maximum likelihood estimation, expectation maximization, histograms, *kNN* classifiers, least square methods; Linear/nonlinear classifiers; LMS, perceptron, support vector machines (SVM); Kernel methods; Neural networks: multilayer perceptron, back propagation, radial basis functions, competitive learning, vector quantization; Template matching. Context dependent classification; Clustering; sequential, hierarchical, fuzzy, probabilistic, possibilistic clustering, mixture decomposition and expectation maximization, clustering using graph theory, decision trees; Morphological clustering; System evaluation and cluster validity;

Recommended Texts:

1. Theodoridis S., and Koutroumbas K., Pattern Recognition, 2nd ed, Elsevier Science, 2003.
2. Shawe-Taylor J., and Cristianini N., Kernel Methods for Pattern Recognition, Cambridge University Press, 2004.
3. Hagan M. T., Demuth H. B., and Beale M., Neural Network Design, PWS Publishing Company, 1996.
4. Leonard T., and Hsu Jojn S. J., Bayesian Methods, Cambridge University Press, 1999.
5. Bezdek J. C., Pattern Recognition with Fuzzy Objective Function Algorithms, Plenum Press, New York, 1981.

PAM-524 LINEAR ALGEBRA

Course Contents

Basics of linear algebra: Gaussian elimination and matrices, two-point boundary value problems, ill-conditioned systems, homogeneous & non homogeneous systems, electrical circuits, matrix algebra, matrix inversion, factorization, elementary matrices & equivalence, determinants and its properties; Vector spaces: spaces and subspaces, four fundamental subspaces, linear independence, basis and dimension, classical least squares, change of basis and similarity, invariant subspaces, linear transformations, normed spaces, metric vector spaces, metric spaces, Hilbert spaces, complex vector spaces and its properties; Norms, inner products, and orthogonality: vector & matrix norms, inner-product spaces, complex inner product spaces, orthogonal vectors, Gram–Schmidt procedure, unitaryand orthogonal matrices, orthogonal reduction, discrete Fourier transform, complementary subspaces, range-nullspace decomposition, orthogonal decomposition, singular value decomposition, orthogonal projection, angles between subspaces; Eigenvalues and eigenvectors: elementary properties of eigen system, diagonalization bysimilarity transformations, functions of diagonalizable matrices, systems of differential equation, normal matrices, positive definite matrices, nilpotent matrices and Jordan structure, functions of nondiagonalizable matrices, difference equations, limits, and summability, minimum polynomials and Krylov methods; Perron–Frobenius theory: Introduction, positive matrice, nonnegative matrices, stochastic matrices and Markov chain.

Recommended Texts:

1. Meyer, C.D., Matrix Analysis and Applied Linear Algebra, 3rd Edition, siam, 2000
2. Lay D.C., Linear Algebra and Its Applications, 3rd Edition, Pearson Addison-Wesley, 2006
3. Anton H. and Rorres C., Elementary Linear Algebra with Applications, 9th Edition, John Wiley & Sons, 2005.
4. Strang G., Linear Algebra and Its Applications, 3rd Edition, Wellesley-Cambridge Press, 1988

EE-526 DIGITAL DESIGNS WITH Verilog HDL

Course Contents

Introduction, Basic Concepts; Hierarchy and Modeling Structures; Syntax, Lexical Conventions, Data Types, and Memories; Expressions and Simulation Mechanics; Gate Level Modeling; Behavioral and Register Transfer Level Modeling; State Machine Design; Xilinx Synthesizer (ISE); Design and Synthesis of Data path Controllers; Modeling Storage Devices; Architecture of Digital Processors; Using Spartan-3E FPGA Kit with Practical Examples; Debugging Verilog Models

Recommended Texts:

1. Micheal D Ciletti, Advance Digital Design with the Verilog HDL, Prentice Hall, 2009.
2. Pong P. Chu, FPGA Prototyping By Verilog Examples: Xilinx Spartan-3 Version, Wiley, 2008.
3. Vivek Sagdeo, THE COMPLETE VERILOG BOOK, Kluwer, 2002.

CMS-528 PROJECT MANAGEMENT

Course Contents

Introduction to management principles, Inter-disciplinary and multidisciplinary skill of a project manager; Project management vs. line management; Project life cycle, different phases of a project life cycle, dynamic and static project interfaces, integration and management of project interfaces; Team building for a project; selection of team members, concept of skills inventory and responsibility matrices; Project planning modeling, a five step-planning model, strategic planning techniques, project planning facilitation techniques;

Development of work breakdown structure (WBS) for the project; Project networking techniques; Critical path method (CPM), scheduling, cost and resource utilization techniques; Managing the project change, techniques to manage the scope changes and baseline changes; Project control techniques, formal and informal control, five-step model for project control, status reports an reviews; Earned value management techniques, achievement monitoring and accomplishment monitoring,; Supporting project management, software types, training and administration techniques.

Recommended Texts

1. PMI, A Guide to the Project Management Body of Knowledge (PMBOK Guide), 4th Edition, Project Management Institute, PA, USA, 2008.
2. Clifford F. G., Project Management: The Managerial Process, 3rd Edition, McGraw-Hill Book Co., USA, 2006.
3. Knutson, J., and Bitz, I., Project Management, AMACOM Publishers., USA, 1993.
4. Ruskin, M. A., and Estes W. E., What Every Engineer Should Know About Project Management, Marcel Dekker Inc., 1982. (available in PIEAS library)
5. David, I. C., and King, W. R., Project Management Handbook, Van Nostrand Reinhold Publishers, USA, 1990.
6. Lundy, J. L., TEAMS (Together Each Achieves More Success), Dartnel Publishers, Chicago, USA, 1994. (Reference Book).

EE-529 POWER CONVERTER DESIGN

Course Contents

Introduction; Steady State Converter Analysis & Modeling; Switch Realization; Converter Circuits: Circuit Manipulations; Transformer Isolation; Converter Evaluation & Design; AC Modeling: State-Space Averaging; Canonical Circuit Model; Converter Transfer Functions; Stability; Regulator Design; Case Study; Measurement Of Loop Gains; Discontinuous Mode Equivalent Circuit; Current Programmed Control; Magnetics Theory; Filter Inductor Design: Types& BH-Loops; Design Constraints & Design Procedure; Transformer Design: Design Procedure & Basic Constraints; AC Inductor Design; Case Studies; Modern Rectifiers & Power System Harmonics: Line-Commutated Rectifiers; Low Harmonic Rectifier Modeling And Control; Resonant Converters: Resonant Conversion; Quasi-Resonant Converters; Case Studies.

Recommended Texts:

1. Mohan.N, Undeland.T, and W. Robbins. Power Electronics, Converters, Applications, and Design, John Wiley, 3rd Edition, 2002.
2. Erickson.R.W, Maksimovic.D, Fundamentals of Power Electronics, Springer; 2nd edition,2001
3. Ramírez. H.S & Ortigoza.R.S, Control Design Techniques in Power Electronics Devices, Springer, 2002.
4. Mohan.N, First Course on Power Electronics and Drives, Mohan, MNPERE, 2003.

5. Luo.F.L ,Hong and Rashid.M, Digital Power Electronics and Applications, Elsevier, 2005

EE-530 SPECIAL TOPICS IN SYSTEMS ENGINEERING - I

This is a course on advanced topics not already covered in the syllabus. The special paper may be conducted as a lecture course or as an independent study course. The topic and contents of the course must be approved by the faculty.

NE-534 INTRODUCTION TO NUCLEAR ENGINEERING

Course Contents

Role and importance of nuclear energy; Nuclear cross-sections. Reaction rates; Nuclear fission and chain reaction; Criticality conditions; Conversion and breeding, Reactor components and their characteristics; Classification and design features of research, production, and power reactors, Introduction to fast and fusion reactor systems; Different types of fuel cycles; Core and feed-material preparations; Uranium enrichment; Fabrication of fuel; Reprocessing of irradiated fuel; Process waste disposal. Reactor fuel requirements; Burn up studies of nuclear fuels; Radiation units; Standards of radiation protection; Calculation of exposure and dose, Health physics instruments for personal Dosimetry and environmental surveillance, Nuclear instrumentation module used with various radiation detectors.

References:

1. Lamarsh, J.R, and Baratta A.,J. Introduction to Nuclear Engineering, 3rd edition, Prentice Hall, 2001.
2. Glasstone, S. and A. Sesonske, Nuclear Reactor Engineering, D Van Nostrand. 1981.
3. Rahman, I.U. and P.S. Sheikh, Introduction to Nuclear Engineering, Krieger, 1981.
4. Graves, H.W., Jr., Nuclear Fuel Management, John Wiley, 1979

EE-544 INSTRUMENTATION AND CONTROL OF NUCLEAR REACTORS

Course Contents

Reactor kinetics; Transfer function; Overview of reactor systems; Safety; Outcore sensors; Incore sensors; Process instrumentation; Signal conditioning; Transfer function measurement systems; Control rod drives and indicating systems; Power supplies; Installation of instrumentation systems; Quality assurance and reliability; Protection systems; Instrumentation systems of nuclear power plants.

Recommended Texts:

1. Nuclear Power Reactor Instrumentation System, Vol I & II, US Atomic Energy Commission, 1985
2. Herrer, J. M., Rector Control Engineering, Van Nostrained Co., 1985
3. Scualtz, M. A., Control of Nuclear Rectors and Power Plants, McGraw Hill International, 1961
4. Digital Instrumentation and Control Systems in Nuclear Power Plants, National Academy Press, Washington DC, 1997.

EE-554 DIGITAL IMAGE PROCESSING

Course Contents

Image processing fundamentals; Digital image enhancement techniques; Digital image enhancement in the Frequency Domain; Digital image restoration; Color image processing, Wavelets and multi-resolution processing; Morphological image processing; Image segmentation; Feature extraction

Recommended Texts:

1. Gonzalez, R., and Woods, R. E., Digital Image Processing, Prentice Hall, 2008.
2. Gonzalez, R., and Woods, R. E., Digital Image Processing Using MATLAB, Prentice Hall, 2003.
3. Castleman, K. R., Digital Image Processing, Prentice-Hall Inc., 1996.

NE-555 NUCLEAR REACTOR ANALYSIS

Course Contents

Neutron slowing-down; Thermal neutron spectra; Neutron diffusion in non-multiplying media; The one speed diffusion model of a nuclear reactor, Criticality calculations for bare and reflected homogeneous systems; Effects of heterogeneity reactor parameters; The multigroup diffusion method; Numerical solution of multigroup diffusion model; Use of computational codes for criticality calculation; The point reactor kinetics model; Temperature and void coefficient of reactivity, Fuel depletion; Fission product poisoning, Control rods; Introduction to neutron transport equation.

Recommended Texts

1. Duderstadt, J.J. and L.J. Hamilton, Nuclear Reactor Analysis, John Wiley, 1976.
2. Lamarsh, J.R, Introduction to Nuclear Reactor Theory, Addison-Wesley, 1966.
3. Ott, K.O. and W.A. Bazella, Introductory Nuclear Reactor Statics, American Nuclear Society, 1983.
4. Lamarsh, J.R, Introduction to Nuclear Engineering, Addison-Wesley, 1983.

EE-601 CONTROL SYSTEMS DESIGN-II

Course Contents

Linear Continuous-Time State Space Models, Transformation of dynamical systems into state-space, Similarity Transformations, Transfer Function to State Space Representation, Controllability, reachability and Stabilizability, Observability, reconstructability and Detectability, Canonical Decomposition, Pole-Zero Cancellation and System Properties, Pole Assignment by State Feedback; Design of servo systems; State Observers, Design of regulator system with observers; design of control systems with observers; Quadratic optimal regulator systems; Phase plane plots of linear systems, investigating stability of linear system using Lyapunve techniques, Case studies

Recommended Texts:

1.Ogata, K., Modern Control Engineering, 5th ed., Prentice Hall, 2009.

2.Dorf R. C., Modern Control Systems, 11th ed., Prentice Hall, 2010

3.Goodwin, G. C., Control System Design, Prentice Hall, 2000.

4.Slotine, J. J. and Li, W., Applied nonlinear control, Prentice Hall, 1991

5.T. Kailath, Linear Systems, Printice Hall, 1980

EE-602 NONLINEAR CONTROL

Course Contents

Introduction to nonlinear control; nonlinear models and nonlinear phenomena, limit cycles, bifurcation, etc., Type of nonlinearities, describing functions, Phase-Plane Trajectories, Equilibrium points, Stability Definition, Lyapunov stability; Input-output stability; feedback linearization; stability of perturbed systems; feedback control; sliding mode control; Back-stepping; Pacification and Passivity based control; High gain observers.

Recommended Texts:

1. Khalil, H., Nonlinear systems, 3rd edition, Prentice Hall, 2000.
2. Slotine, J. J. and Li, W., Applied nonlinear control, Prentice Hall, 1991
3. Isidori, A. , Nonlinear Control Systems, 3rd edition, Springer, 1995.
4. Vidyasagar, M., Nonlinear Systems Analysis, 2nd edition, SIAM, 2002

EE-603 OPTIMAL CONTROL THEORY

Course Contents

State-space representation of physical systems; Selection of a performance measure; The optimal control law; The principle of optimality applied to the optimal control problem; The calculus of variations; Necessary conditions of optimal control; Linear regulator problems; Pontryagin's minimum principle and state inequality constraints; Minimum time and minimum control effort problems; Numerical determination of optimal control by the method of steepest decent and by the method of variation of extremals.

Recommended Texts

1. Hull, D. G., Optimal Control Theory for Application, Springer, 2003
2. Naidu, D. S., Optimal Control Systems," CRC press, 2002
3. Kirk, D., Optimal Control Theory-An Introduction, Prentice- Hall, 1970
4. Lewis, F. L. and Syrmos, V. L., Optimal Control, John Wiley and Sons, 1995

EE-605 ROBUST CONTROL

Course Contents

Introduction of robust control problem; Limitation on performance; Analysis of MIMO control loops; closed loop stability, frequency domain analysis, Exploiting SISO techniques in MIMO control; completely decentralized control, pairing of inputs and outputs, converting MIMO problems to SISO problems. Poles and zeros of multivariable control systems; Internal stability; Nyquist stability and Gershgorin bands; Principal gains for assessment of performance and robustness; Limitation on performance MIMO systems; Signals and systems norms and their use to assess robustness and performance; Representation of uncertainty; Stability and performance robustness; Loop failure and gain variation; LQG method for control design; Youla parameterization; H-infinity Control; Mu analysis and synthesis; Model reduction techniques; LMI based design.

Recommended Texts:

1. Maciejowski, J. J., Multivariable feedback design, Addison-Wesley, 1991.

2. Zhou K., Essentials of Robust Control, Prentice Hall, 1997.
3. Skogestad, S., Multivariable Feedback Control, 2nd edition, Wiley-Interscience, 2005.

EE-606 ADAPTIVE CONTROL SYSTEMS

Course Contents

Introduction to adaptive control; real time parameter estimation, deterministic self tuning estimators, stochastic and predictive self tuning regulators, model reference and adaptive systems, properties of adaptive systems, stochastic adaptive control, auto tuning, gain scheduling, practical issues and implementation.

Recommended Texts:

1. Astrom, K. J. and Wittenmark, B., Adaptive Control, 2nd edition, Dover Publications, 2008
2. Ioannou P. and Fidan B., Adaptive Control Tutorial, SIAM, 2006.

EE-607 SYSTEM IDENTIFICATION

Course Contents

Introduction; Overview of identification methods, areas of application, mathematical models of linear dynamic systems and stochastic signals; Identification of non-parametric models in the frequency domain; spectral analysis methods for periodic and non-periodic signals, frequency response measurement with non-periodic signals, frequency response measurement for periodic test signal; Identification of non-parametric models with correlation analysis; correlation analysis with continuous time models, correlation analysis with discrete time models, Identification with parametric models; least squares parameter estimation for static processes, least squares parameter estimation for dynamic processes, modifications of the least squares parameter estimation, Bayes and maximum likelihood methods, parameter estimation for time-variant processes, parameter estimation in closed-loop, Identification with parametric models; parameter estimation for frequency responses, parameter estimation for differential equations and continuous time processes, subspace methods, Identification of multi-variable systems; parameter estimation for MIMO systems, Identification of non-linear systems; parameter estimation for non-linear systems, state and parameter estimation by Kalman filtering.

Recommended Texts:

1. Isermann, R. and Münchhof, M., Identification of Dynamic Systems: An Introduction with Applications, Springer, 2010.
2. Raol J. R., Girija G. and Singh, J., Modelling and Parameter Estimation of Dynamic Systems, Institution of Engineering and Technology, 2004.
3. Juang, J. N., Applied System Identification, Prentice Hall, 1993.

EE-612 FAULT DIAGNOSIS AND TOLERANT CONTROL

Course Contents

Importance of the subject; some basic concepts; fault, failure, fault detection, fault isolation, fault identification, modeling of faults in technical systems; Classification of fault detection techniques; hardware redundancy based, signal based, analytical model based, qualitative model based, Residual generation techniques; observer based approaches, parity space approach, parameter identification based approach, Residual evaluation and threshold computation; Norm based methods, statistical methods, integration of norm based and statistical methods, Integrated design of fault detection systems; Fault isolation schemes; Fault identification schemes; Fault tolerant control; architecture, control reconfiguration for sensor and actuator failures, fault tolerant H1 control, handling of fault recovery transients.

Recommended Texts:

1. Ding S. X., Model-based fault diagnosis Techniques, Design Schemes, Algorithms, and Tools. Springer, 2008.
2. Blanke M., Kinnaert M., Lunze J., and Staroswiecki M., Diagnosis and Fault Tolerant Control. 2nd ed, Springer, 2010.
3. Chen J. and R. Patton R. J., Robust Model-Based Fault Diagnosis for Dynamic Systems. Bosten, MA: Kluwer, 1999.
4. Isermann, R., Fault-Diagnosis Applications: Model-Based Condition Monitoring: Actuators, Drives, Machinery, Plants, Sensors, and Fault-tolerant Systems, Springer, 2011

EE-614 COMPUTER VISION

Course Contents

Basic Optics and Radiometry; Geometric Image Formation; Segmentation: K-means, EM Clustering, Mean shift, Image Watershed, Active Snakes, Level Sets, Graph Cuts; Bilateral Filtering; Anisotropic Diffusion; Texture Analysis; Representation and Description of regions; Shape Analysis; Feature tracking; Projective Geometry; Camera Calibration; Structure from stereo; Structure from Motion; Kalman Filtering and Tracking; Image Registration.

Recommended Texts:

1. Szeliski, R., Computer Vision: Algorithms and Applications, Springer, 2010.
2. Gonzalez, R., and Woods, R. E., Digital Image Processing, Prentice Hall, 2008
3. Goshtasby, A., 2-D and 3-D image registration for medical, remote sensing, and industrial applications, John Wiley and Sons, 2005
4. Trucco, E., and Verri, A., Introductory Techniques for 3-D Computer Vision, Prentice Hall, 1998.

EE-615 ADAPTIVE SIGNAL PROCESSING

Course Contents

Introduction to discrete-time signal processing and random processes; Optimum linear filters: Wiener filter; linear prediction; Kalman filter; Linear adaptive filters: Steepest-descent algorithm, LMS algorithm and its variants; Frequency domain adaptive filters; Method of least squares and RLS algorithm, tracking of time varying systems; Analysis of adaptive algorithms: learning curve, convergence, stability, excess mean square error, mis-adjustment; Applications of adaptive signal processing: Adaptive modeling and system identification, inverse adaptive modeling, deconvolution and equalization, adaptive interference cancelling; cancelling noise, cancelling periodic interference, cancelling interference in ECG signals, etc.

Recommended Texts

1. Haykin, S., Adaptive Filter Theory, 4th ed., Prentice-Hall, 2002.
2. Farhang-Boroujeny, B., Adaptive Filters: Theory and Applications, John Wiley, 1998.
3. Widrow, B., and Stearns, S. D., Adaptive Signal Processing, Prentice-Hall, 1985.

EE-616 INDUSTRIAL DRIVES

Course Contents

Introduction: Drives Introduction, Dynamics of Electrical Drives, Concept of Multi-Quadrant Operation, Selection of Motor Power Rating; Phase Controlled Dc Machines Drives: DC Motor Modeling, Equivalent Circuits Phase Control Dc Motor Drive Basics, Steady State Analysis Modeling, Controller Design, Harmonics Control; Chopper Controlled Dc Motor Drives: Basic Operation, Steady State Analysis, Closed Loop Operation; Induction Motor & Phase Controlled Drives: Dynamic Modeling, Stator-Voltage Control, Sip Control, Closed Loop Control, Harmonic Torques; Frequency Controlled Induction Motor Drives: Voltage Source Inverter, Speed Control Constant Volts/Hz Control, Constant Slip Speed Control, Constant Air Gap Flux Control, Torque Pulsations & Harmonics Control, Field Weakling Operation; Permanent Magnet Synchronous & Brushless Dc Motor Drives: Introduction to Permanent Magnet Synchronous Machines, Control Strategies, Flux Weakening Operation, Speed Controlled Design, PM Brushless Drive Basics, Half Wave PM Brushless Drive, Design of Current And Speed Controllers; Stepping Motors: Introduction, Principle of Motor Operation, Motor Characteristics, Steady State Characteristics, Drive Circuits & Pull Out Torque-Speed Curves, Transient Performance.

Recommended Texts:

1. Ion Boldea , Syed A. Nasar, Electric Drives, CRC, 2nd Edition,2005
2. R.KRISHNAN, Electric Motor Drives Modeling, Analysis and Control , Prentice Hall,2001
3. Hughes, Electric Motors & Drives , Newnes; 3rd Edition, 2005
4. Bimal K, Power Electronics And Motor Drives: Advances and Trends , Academic Press , 2006
5. JMD Murphy & FG Turnbull, Power Electronic Control of AC Motors, Pergamon Press, 1990.

EE-618 ROBOT STRUCTURES, SENSING and PERCEPTION

Course Contents

Structures: Introduction to power transmission methods in Robotics; Wheel Vehicles Suspensions and drive trains; tracked vehicles suspensions and drive trains; Walkers, Crawler; Grippers; Sensing and Perception: Tactile Sensors, Inertial Sensors, Ranging Sensors, Vision Sensing and Visual Servoing, Multisensor Data Fusion.

Recommended Texts:

1. Paul Sandin, Robot Mechanisms and Mechanical Devices Illustrated, 1st Edition, McGraw-Hill/TAB Electronics, 2003.

2. Thomas Braunl, Embedded Robotics: Mobile Robot Design and Applications with Embedded Systems, Springer, 2003.
3. Neil Sclater and Nicholas Chironis, Mechanisms and Mechanical Devices Sourcebook, 4th Edition, McGraw-Hill Professional, 2006.
4. B. Siciliano and O. Khatib (Eds.), Handbook of Robotics, Springer, 2008.

EE-620 Mobile Robot Task Planning

Course Contents

Trajectory and path planning; cell decomposition, roadmaps, potential fields and navigation functions; kinematic and dynamic constraints; holonomic/non-holonomic vehicles' constraints; behaviour based navigation, representations, architectures and models; evolutionary navigation, conditional planning for uncertain situations and task graphs, probabilistic planning methods; SLAM algorithms; Case Study: Programming in player/stage for different mobile robot mechanisms.

Recommended Texts

1. H. Choset, K. M. Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki and S. Thrun, Principles of Robot Motion: Theory, Algorithms, and Implementations, MIT Press, Boston, 2005.
2. Ronald C. Arkin, Behaviour based Robotics, The MIT Press, 1998.
3. S. Thrun, W. Burgard and D. Fox, Probabilistic Robotics, The MIT Press, 2005.
4. Jean-Paul Laumond (Editor), Robot Motion Planning and Control, Springer, 1998.

EE-625 SPECIAL TOPICS IN SYSTEMS ENGINEERING - II

This is a course on advanced topics not already covered in the syllabus. The special paper may be conducted as a lecture course or as an independent study course. The topic and contents of the course must be approved by the faculty.

EE-697 M.Sc. THESIS RESEARCH

In fourth semester as a subject and fifth semester in full, student will study some system engineering related problem. He may join some on-going research program or initiate a new program in close cooperation with a faculty member. The faculty member will instruct, supervise, and grade the conduct of this study with the student. He is charged with the primary responsibility of reporting the grade based on the evaluation of the performance of the fellows. He may be aided in the process of evaluation by a committee to be appointed by Rector, PIEAS. A report and seminar are to be given by the student before the end of the semester. The nature of the project may be research, development or design may involve experimental or computational work or combination of these. The student shall write a comprehensive report and shall deliver at least one seminar shall also be used in the overall evaluation of the student. Normally this project is to be completed in full time work for one semester. However, if supervisor(s) feel that more time is needed for the satisfactory completion of the project, the duration may be extended beyond the end of semester.