Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Syllabus for B. Tech Electrical and Computer Engineering
(Applicable from the academic session 2025-2026)

Name of the course	**Electric Machine**
Course Code: PC-ECS 401	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 2 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	To review the concept of magnetic fields and magnetic circuits
2.	To learn the basic principle of operation of DC machine
3.	To learn the principle of operation and characteristics of DC motor and generator
4.	To learn the principle of operation, connections and different tests on Transformers
5.	To acquire problem solving skills to solve problems of DC machines and Transformers

Pre-Requisite:

1.	Basic Electrical Engineering (ES-EE-101)
2.	Electric Circuit Theory (PC-ECS-301)

Unit	Content	Hrs	Marks
1	**Magnetic fields and magnetic circuits:** Review of magnetic circuits - MMF, flux, reluctance, inductance; review of Ampere Law and Biot Savart Law; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air; influence of highly permeable materials on the magnetic flux lines.	**3**	
2	**Electromagnetic force and torque:** B-H curve of magnetic materials; flux-linkage vs current characteristic of magnetic circuits; linear and nonlinear magnetic circuits; energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element. Examples - galvanometer coil, relay contact, lifting magnet, rotating element with eccentricity or saliency.	**5**	
3	**DC machines:** Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation – Elementary armature coil and commentator, lap and wave windings, construction of commentator, linear commutation	**8**	

	Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.		
4	**DC machine - motoring and generation:** Armature circuit equation for motoring and generation, Types of field excitations – separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to-back testing of DC machines	**7**	
5	**Transformers:** Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test, separation of hysteresis and eddy current losses Three-phase transformer - construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, effect of nonlinear B-H curve of magnetic core material, harmonics in magnetization current, Phase conversion - Scott connection, three-phase to six-phase conversion, Tap-changing transformers - No-load and on-load tap-changing of transformers, Three-winding transformers. Cooling of transformers.	**12**	

Text books:

1. Electrical Machines-I, P.S. Bimbhra, Khanna Publishing House (AICTE)
2. Electrical Machinery, P.S. Bimbhra, 7th Edition, Khanna Publishers
3. Electric machines, D.P. Kothari & I.J Nagrath, 3rd Edition, Tata Mc Graw-Hill Publishing Company Limited
4. Electrical Machines, P.K. Mukherjee & S. Chakrabarty, 2nd edition, Dhanpat Rai Publication.

Reference books:

1. Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
2. Electrical Machines, R.K. Srivastava, Cengage Learning
3. Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition.
4. The performance and Design of Alternating Current Machines, M.G.Say, CBS Publishers & Distributors.
5. Electric Machinery & transformer, Irving L Koskow, 2nd Edition, Prentice Hall India

Course Outcome:

After completion of this course, the learners will be able to

1. describe the function of different components of magnetic circuit, DC machines and transformers
2. explain the principle of operation of different types of DC machines and transformers
3. solve numerical problems of DC machines and transformers.
4. estimate the parameters and efficiency of transformer.
5. determine the characteristics of DC machines
6. recommend methods to control output of DC machines

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**CONTROL SYSTEMS**
Course Code: **PC-ECS 402**	Semester: 4^{th}
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: Nil	Assignment & Quiz: 10 Marks
Practical: 2 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	To find mathematical representation of LTI systems.
2.	To find time response of LTI systems of different orders
3.	To find the frequency response of LTI systems of different orders
4.	To understand stability of different LTI systems.
5.	To analyze LTI systems with state variables.
6.	To solve problems of mathematical modelling and stability of LTI systems

Pre-Requisite:

1.	Basic Electrical Engineering (ES-EE101)
2.	Electric Circuit Theory (PC-ECS 301)
3.	Electric Machines (PC-ECS 401)

Unit	Content	Hrs	Marks
1	**Introduction to control system:** Concept of feedback and Automatic control, Effects of feedback, Objectives of control system, Definition of linear and nonlinear systems, Elementary concepts of sensitivity and robustness. Types of control systems, Servomechanisms and regulators, examples of feedback control systems. Transfer function concept. Pole and Zeroes of a transfer function. Properties of Transfer function.	04	
2	**Mathematical modeling of dynamic systems:** Translational systems, Rotational systems, Mechanical coupling, Liquid level systems, Electrical analogy of Spring–Mass-Dashpot system. Block diagram representation of control systems. Block diagram algebra. Signal flow graph. Mason's gain formula. Control system components: Potentiometer, Synchros, Resolvers, Position encoders. DC and AC tacho-generators. Actuators. Block diagram level description of feedback control systems for position control, speed control of DC motors, temperature control, liquid level control, voltage control of an Alternator.	08	
3	**Time domain analysis:** Time domain analysis of a standard second order closed loop system. Concept of undamped natural frequency, damping, overshoot, rise time and settling time. Dependence of time domain performance parameters on natural frequency and damping ratio. Step and Impulse response of first	08	

	and second order systems. Effects of Pole and Zeros on transient response. Stability by pole location. Routh-Hurwitz criteria and applications. **Error Analysis:** Steady state errors in control systems due to step, ramp and parabolic inputs. Concepts of system types and error constants.		
4	**Stability Analysis:** Root locus techniques, construction of Root Loci for simple systems. Effects of gain on the movement of Pole and Zeros. **Frequency domain analysis of linear system:** Bode plots, Polar plots, Nichols chart, Concept of resonance frequency of peak magnification. Nyquist criteria, measure of relative stability, phase and gain margin. Determination of margins in Bode plot. Nichols chart. M-circle and M-Contours in Nichols chart.	10	
5	**Control System performance measure:** Improvement of system performance through compensation. Lead, Lag and Lead- lag compensation, PI, PD and PID control.	05	
6	**State variable Analysis:** Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.	10	

Text books:

1. Modern Control Engineering, K. Ogata, 4th Edition, Pearson Education
2. Control System Engineering, I. J. Nagrath & M. Gopal. New AgeInternational Publication.
3. Control System Engineering, D. Roy Choudhury, PHI
4. Control System, A. Ambikapathy, Khanna Publishing House
5. Automatic Control Systems, B.C. Kuo & F. Golnaraghi, 8th Edition, PHI

Reference books:

1. Control Engineering Theory & Practice, Bandyopadhyaya, PHI
2. Control systems, K.R. Varmah, Mc Graw hill
3. Control System Engineering, Norman Nise, 5th Edition, John Wiley & Sons
4. Modern Control System, R.C. Dorf & R.H. Bishop, 11th Edition, PearsonEducation.
5. Control System Design, C. Goodwin Graham, F. Graebe F. Stefan, Salgado.E. Mario, PHI
6. Modeling & Control of dynamic system, Macia&Thaler, Thompson
7. Modern Control Technology Components & Systems, 3rd edition, C.T Kilian,Cengage Learning
8. Modern Control Engineering, Y. Singh & S. Janardhanan, Cengage Learning
9. Control System Engineering, R. Anandanatarajan& R. Ramesh Babu, ,SCITECH
10. Automatic Control system, A. William, Wolovich, Oxford

Course Outcome:

After completion of this course, the learners will be able to

1. develop mathematical model of mechanical, electrical, thermal, fluid system and different control system components like servomotors, synchros, potentiometer, tacho-generators etc.
2. analyse stability of LTI system using routh-hurtwitz (RH) criteria, root locus techniques in time domain and bode plot and nyquist technique in frequency domain.
3. design different control law or algorithms like proportional control, proportional plus derivative(PD) control, proportional plus integration(PI) control, and proportional plus integration plus derivative (PID) control and compensators like lag, lead, lag-lead for LTI systems.
4. apply state variable techniques for analysis of linear systems.
5. analyze the stability of linear discrete system.
6. solve numerical problems on LTI system modelling, responses, error dynamics and stability .

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Electricals & Electronics Instrumentations**
Course Code: PC-ECS 403	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 0 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	Understand the fundamentals and performance characteristics of measuring systems.
2.	Learn the working of analog and digital measuring instruments.
3.	Study signal analyzers and waveform generators and their applications.
4.	Explore different types of oscilloscopes and their uses in signal measurement.
5.	Gain knowledge of transducers, bridges, and techniques for measuring physical parameters.

Pre-Requisite:

1.	Basic Electrical Engineering (ES-EE-101)
2.	Electric Circuit Theory (PC-ECS-301)

Unit	Content	Hrs	Marks
1	**Block Schematics of Measuring Systems:** Performance characteristics, Static characteristics, Accuracy, Precision, resolution, Types of Errors, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag. **Measuring Instruments:** DC Voltmeters, D' Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.	**10**	
2	**Signal Analyzers:** AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Capacitance-Voltage Meters, Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary waveform Generator.	**12**	
3	**Oscilloscopes:** CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency.	**5**	

	Special Purpose Oscilloscopes: Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.		
4	**Transducers:** Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Piezoelectric Transducers, Magnetostrictive Transducers.	**4**	
5	Bridges: Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge. Measurement of Physical Parameters: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Pressure-High Pressure, Vacuum level, Temperature Measurements Data Acquisition Systems.	**6**	

Text Books:

1. Electronic instrumentation: H.S.Kalsi, TMH, 2nd Edition 2004.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI, 5th Edition, 2003

Reference Books:

1. Electronic Instrumentation and Measurements, David A. Bell, Oxford Uiv. Press, 1997.
2. Electronic Measurements and Instrumentation: B. M. Oliver, J. M. Cage TMH Reprint.
3. Measurement Systems, Emest O. Doebelin and Dhanesh N Manik, 6th Ed., TMH.
4. Electronic Measurements and Instrumentations by K. Lal Kishore, Pearson Education, 2010.
5. Industrial Instrumentation: T. R. Padmanabham Spiriger 2009.

Course Outcome:

Upon a successful completion of this course, the student will be able to:
1. Describe the fundamental concepts and principles of instrumentation
2. Explain the operation of various instruments required in measurements
3. Apply the measurement techniques for different types of tests
4. To select specific instruments for specific measurement function.
5. Understand principle of operation and working of different electronic instruments

Students will understand functioning, specification and application of signal analyzing instruments

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Artificial Intelligence**
Course Code: PC-ECS 404	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 2 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	Understand and design intelligent agents
2.	Apply problem-solving and search strategies
3.	Represent and reason with knowledge
4.	Analyze and implement AI techniques in specialized domains
5.	Evaluate AI models based on effectiveness and reasoning ability

Pre-Requisite:

1.	Programming for Problem Solving Paper Code: ES-CS-201
2.	Mathematics –IA*, Paper Code: BS-M-201
3	Data Structure & Algorithm, Paper Code: PC-ECS 302

Unit	Content	Hrs	Marks
1	**Introduction [2]** Overview of Artificial intelligence- Problems of AI, AI technique, Tic - Tac - Toe problem. **Intelligent Agents [2]** Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents. **Problem Solving [2]** Problems, Problem Space & search: Defining the problem as state space search, production system, problem characteristics, issues in the design of search programs.	**6**	
2	**Search techniques [5]** Solving problems by searching :problem solving agents, searching for solutions; uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. **Heuristic search strategies [5]**	**13**	

	Greedy best-first search, A* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, simulated annealing search, local beam search, genetic algorithms; constraint satisfaction problems, local search for constraint satisfaction problems. **Adversarial search [3]** Games, optimal decisions & strategies in games, the minimax search procedure, alpha-beta pruning, additional refinements, iterative deepening.		
3	**Knowledge & reasoning [3]** Knowledge representation issues, representation & mapping, approaches to knowledge representation, issues in knowledge representation.	**3**	
4	**Using predicate logic [2]** Representing simple fact in logic, representing instant & ISA relationship, computable functions & predicates, resolution, natural deduction. **Probabilistic reasoning [4]** Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics.	**6**	
5	**Natural Language processing [2]** Introduction, Syntactic processing, semantic analysis, discourse &pragmatic processing. **Learning [2]** Forms of learning, inductive learning, learning decision trees, explanation based learning, learning using relevance information, neural net learning & genetic learning. **Expert Systems [2]** Representing and using domain knowledge, expert system shells, knowledge acquisition	**6**	

Text Books:

1. Artificial Intelligence, Ritch & Knight, TMH
2. Artificial Intelligence A Modern Approach, Stuart Russel Peter Norvig Pearson
3. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI
4. Poole, Computational Intelligence, OUP
5. Logic & Prolog Programming, Saroj Kaushik, New Age International
6. Expert Systems, Giarranto, VIKAS 7. M.C. Trivedi, Artificial Intellig

Reference Books:

1. M.C. Trivedi, Artificial Intelligence, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018)

2. Friedman Jerome, Trevor Hastie, and Robert Tibshirani. The Elements of Statistical Learning. Springer-Verlag, 2nd Edition, 2013. Reference Books

Course Outcome:

Upon a successful completion of this course, the student will be able to:

1. Describe the structure and function of intelligent agents and explain how they operate within various environments.
2. Apply search techniques and heuristic strategies to effectively solve complex problem-solving tasks and adversarial games.
3. Construct knowledge-based systems using predicate logic and probabilistic reasoning for intelligent decision-making.
4. Develop basic Natural Language Processing (NLP) and Expert Systems applications to simulate human reasoning and language understanding.
5. Evaluate AI models in terms of accuracy, efficiency, and ethical considerations across different application domains.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Object Oriented Programming**
Course Code: PC-ECS 404	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks
Practical: 2 hrs/week	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:

1.	Understand abstract data types (ADTs) and their implementation
2.	Explore and apply fundamental object-oriented programming concepts
3.	Analyze and design object-oriented systems using inheritance and design patterns
4.	Understand and implement core object-oriented features at the system level
5.	Develop GUI applications and manage software projects

Pre-Requisite:

1.	Programming for Problem Solving Paper Code: ES-CS-201
2.	Mathematics –IA*, Paper Code: BS-M-201
3	Data Structure & Algorithm, Paper Code: PC-ECS 302

Unit	Content	Hrs	Marks
1	Abstract data types and their specification. How to implement an ADT. Concrete state space, concrete invariant, abstraction function. Implementing operations, illustrated by the Text example.	**8**	
2	Features of object-oriented programming. Encapsulation, object identity, polymorphism – but not inheritance.	**6**	
3	Inheritance in OO design. Design patterns. Introduction and classification. The iterator pattern.	**10**	
4	Model-view-controller pattern. Commands as methods and as objects. Implementing OO language features. Memory management.	**8**	
5	Generic types and collections GUIs. Graphical programming with Scale and Swing . The software development process	**8**	

Text Books:

1. Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice Hall,India
2. Ali Bahrami – "Object Oriented System Development" – Mc Graw Hill
3. Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
4. R.K Das – "Core Java For Beginners" – VIKAS PUBLISHING

Reference Books:

1. Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
2. Ivor Horton's Beginning Java 2 SDK – Wrox
3. E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Outcome:

1. On completion of the course students will be able to
2. Specify simple abstract data types and design implementations, using abstraction functions to document them.
3. Recognise features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.
4. Name and apply some common object-oriented design patterns and give examples of their use.
5. Design applications with an event-driven graphical user interface.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Computer Organization & Architecture**		
Course Code: PC-ECS 406	Semester: 4th		
Duration: 6 months	Maximum Marks: 100		
Teaching Scheme	**Examination Scheme**		
Theory: 3 hrs/week	Mid Semester Exam: 15 Marks		
Tutorial: 0 hr/week	Assignment & Quiz: 10 Marks		
Practical: 0 hrs/week	Attendance: 05 Marks		
Credit Points: 3	End Semester Exam: 70 Marks		
Objective:			
1.	Understand the basic structure and operation of stored program computers.		
2.	Learn data representation, instruction sets, and arithmetic operations in digital systems.		
3.	Study memory hierarchy, organization, and CPU-memory interfacing techniques.		
4.	Explore pipelining concepts, hazards, and performance optimization in processors.		
5.	Understand instruction-level parallelism and control unit design methodologies.		
Pre-Requisite:			
Unit	**Content**	**Hrs**	**Marks**
1	Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage, Instruction format. Instruction sets and addressing modes. Commonly used number systems. Fixed and floating point representation of numbers.	**8**	
2	Design of adders - ripple carry and carry look ahead principles. Design of ALU. Fixed point multiplication -Booth's algorithm. Fixed point division - Restoring and non-restoring algorithms. Floating point - IEEE 754 standard.	**6**	
3	Memory organization, static and dynamic memory, memory hierarchy, associative memory. Memory unit design with special emphasis on implementation of CPU-memory interfacing Hierarchical memory technology: Inclusion, Coherence and locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, mapping and management techniques, memory replacement	**10**	

	policies.		
4	Pipelining: Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques;	**7**	
5	Instruction-level parallelism: basic concepts, techniques for increasing ILP, superscalar, super pipelined and VLIW processor architectures. Array and vector processors.	**6**	
6	Design of control unit - hardwired and micro programmed control.	**3**	

Text Books:

1. V. Carl, G. Zvonko and S. G. Zaky, "Computer organization", McGraw Hill, 1978.
2. B. Brey and C. R. Sarma, "The Intel microprocessors", Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, "Computer Architecture A Quantitative Approach", Morgan Kauffman, 2011.
4. W. Stallings, "Computer organization", PHI, 1987.
5. P. Barry and P. Crowley, "Modern Embedded Computing", Morgan Kaufmann, 2012.
6. N. Mathivanan, "Microprocessors, PC Hardware and Interfacing", Prentice Hall, 2004.

Reference Books:

1. Y. C. Lieu and G. A. Gibson, "Microcomputer Systems: The 8086/8088 Family", Prentice Hall India, 1986.
2. J. Uffenbeck, "The 8086/8088 Design, Programming, Interfacing", Prentice Hall, 1987.
3. B. Govindarajalu, "IBM PC and Clones", Tata McGraw Hill, 1991.
4. P. Able, "8086 Assembly Language Programming", Prentice Hall India6. Winfried Karl Grassmann and Jean-Paul Tremblay, Logic and Discrete Mathematics, PEARSON.
5. Rajaraman – "Computer Organization & Architecture", PHI
6. B.Ram – "Computer Organization & Architecture", Newage Publications

Course Outcome:

On completion of the course students will be able to

1. Learn pipelining concepts with a prior knowledge of stored program methods
2. Learn about memory hierarchy and mapping techniques.
3. Study of parallel architecture and interconnection network

Special Remarks:
The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Electric Machine Laboratory**
Course Code: PC-ECS 491	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: Nil	Continuous Internal Assessment:40
Tutorial: Nil	External Assessment: 60
Practical: 2 hrs/week	
Credit Points: 1	

	Laboratory Experiments:
1	Determination of the characteristics of a separately excited DC generator.
2	Determination of the characteristics of a DC motor
3	Study of methods of speed control of DC motor
4	Determination of the characteristics of a compound DC generator (short shunt)
5	Determination of speed of DC series motor as a function of load torque.
6	Polarity test on a single phase transformer
7	Determination of equivalent circuit of a single phase transformer and efficiency.
8	Study of different connections of three phase transformer.
9	Study of Parallel operation of a single phase transformers.
10	Determination of temperature rise and efficiency of the transformer.(Back to back test)

Course Outcome:

After completion of this course, the learners will be able to

- Analyze the characteristics and performance of DC generators and motors.
- Demonstrate various speed control methods for DC motors.
- Perform and interpret transformer tests including polarity, efficiency, and equivalent circuit.
- Understand different transformer connections and their parallel operation.
- Evaluate transformer performance under load and conduct back-to-back testing for efficiency and temperature rise.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**CONTROL SYSTEMS LABORATORY**
Course Code: **PC-ECS 492**	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: Nil	Continuous Internal Assessment:40
Tutorial: Nil	External Assessment: 60
Practical: 2 hrs/week	
Credit Points: 1	

	Laboratory Experiments:
1.	Familiarization with MAT-Lab control system tool box, MAT-Lab- Simulink tool box & PSPICE
2.	Determination of Step response for first order & Second order system with unity feedback with the help of CRO &calculation of control system specification , Time constant, % peak overshoot, settling time etc. from the response.
3.	Simulation of Step response & Impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB & PSPICE.
4.	Determination of Root locus, Bode plot, Nyquist plot using MATLAB control system tool box for a given system &stability by determining control system specification from the plot.
5.	Determination of PI, PD and PID controller action of first order simulated process.
6.	Determination of approximate transfer functions experimentally from Bode plot.
7.	Evaluation of steady state error, setting time , percentage peak overshoot, gain margin, phase margin with addition of Lead, Lag, Lead-lag compensator.
8.	Study of a practical position control system obtaining closed step responses for gain setting corresponding to over-damped and under-damped responses. Determination of rise time and peak time using individualized components by simulation. Determination of un-damped natural frequency and damping ratio from experimental data.
9.	Analysis of performance of Lead, Lag and Lead-Lag compensation circuits for a given system using simulation.
10.	Determination of Transfer Function of a given system from State Variable model and vice versa.
11.	Analysis of performance of a physical system using State variable technique by simulation. Study of step response and initial condition response for a single input, two-output system in SV form by simulation.

Course Outcome:

After completion of this course, the learners will be able to

1. identify appropriate equipment and instruments for the experiment.
2. test the instrument for application to the experiment.

3. construct circuits with appropriate instruments and safety precautions.
4. use MAT-Lab control system tool box, MAT-Lab- simulink tool box & PSPICE for simulation of systems.
5. Determine control system specifications of first and second order systems.
6. validate step response & impulse response for type-0, type-1 & Type-2 system with unity feedback using MATLAB & PSPICE.
7. work effectively in a team

Special Remarks:
The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Artificial Intelligence Lab**
Course Code: PC-ECS 494	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: Nil	Continuous Internal Assessment:40
Tutorial: Nil	External Assessment: 60
Practical: 2 hrs/week	
Credit Points: 1	

	Laboratory Experiments:
1	Create a family tree and solve queries using back tracking through Prolog programming
2	Write a Prolog program to compute fibonacci term using recursion
3	Write a Prolog Program to print Fibonacci series up to nth term
4	Write a Prolog program to print factorial of any number
5	Write a Prolog program to compute greatest common divisor (using Euclidean algorithm) using recursion
6	Write a Prolog program of generating numbers in a given range
7	Write a program in Prolog to insert an element at any position in the list
8	Write a program in Prolog to delete any element from the list
9	Write a program in Prolog to concatenate two lists
10	Write a program in Prolog print all sub lists of a given list or not
11	Write a program in Prolog to reverse a list
12	Write a program in Prolog to permute a given list
13	Write a program in Prolog to delete the Last element from the list
14	Write a program in Prolog to find the nth element of the List
15	Write a program in Prolog to check whether a list is palindrome or not
16	Write a Prolog Program to check whether an element is in a given list or not
17	Write a Prolog Program to determine the length of a list
18	Write a Prolog Program to multiply the elements in a given list
19	Write a Prolog Program to insert an element at the front of the list
20	Write a Prolog Program to delete an element from a list
21	Write a program in Prolog to print the nodes of binary tree through INORDER traversal
22	Write a program in Prolog to print the nodes of binary tree through POSTORDER traversal
23	Write a program in Prolog to print the nodes of binary tree through PREORDER traversal

24	Check whether a given element belongs to a binary tree
25	Write a program for searching an element in a binary search tree
26	Prolog Programming using Cut and Negation operator
27	Write a program to implementation of DFS
28	Write a program to implementation of BFS
29	Write a Program to find the solution for traveling salesman Problem
30	Write a program to implement Simulated Annealing Algorithm
31	Write a program to find the solution for wampus world problem
32	Write a program to implement 8 puzzle problem
33	Write a program to implement Tower of Hanoi problem
34	Write a program to implement A* Algorithm
35	Write a program to implement Hill Climbing Algorithm

Course Outcome:

After completion of this course, the learners will be able to

1. Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.
3. Demonstrate awareness and a fundamental understanding of various applications of AI Techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
4. Demonstrate proficiency developing applications in an 'AI language', expert system shell, or data mining tool.
5. Demonstrate proficiency in applying scientific method to models of machine learning.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.

Name of the course	**Object Oriented Programming Laboratory**
Course Code: PC-ECS 495	Semester: 4th
Duration: 6 months	Maximum Marks: 100
Teaching Scheme	**Examination Scheme**
Theory: Nil	Continuous Internal Assessment:40
Tutorial: Nil	External Assessment: 60
Practical: 2 hrs/week	
Credit Points: 1	

	Laboratory Experiments:
1	Assignments on class, constructor, overloading, inheritance, overriding Assignments on wrapper class, arrays Assignments on developing interfaces- multiple inheritance, extending interfaces Assignments on creating and accessing packages
2	Assignments on multithreaded programming Assignments on applet programming

**** using JAVA**

Course Outcome:

After completion of this course, the learners will be able to

- Implement object-oriented concepts such as classes, constructors, inheritance, and polymorphism in Java.
- Apply interfaces, packages, and wrapper classes for modular and reusable code development.
- Develop and manage multithreaded programs for concurrent task execution.
- Create simple Java applets and graphical interfaces for interactive applications.

Special Remarks:

The above mentioned outcomes are not limited. Institute may redefine outcomes based their program educational objective.