Name of the course	**POWERELECTRONICS AND DRIVES**
Course Code: PC-ECS 601	Semester: 6th
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 understand the principal and operation of semiconductor devices.
2.	To apprehend the working principle of Phase controlled converters and DC- DC converters.
3.	To understand basics of Induction, DC and Synchronous motor drives.
4.	To solve problems based on Industrial application.

Pre-Requisite:

1.	Electric Circuit Theory (PC-ECS 301)
2.	Analog and digital Electronics (ES-ECS 301)
3.	Electric Machines (PC-ECS 401)

Unit	Content	Hrs	Marks
1	**Introduction:** Application of power electronics, advantages and disadvantages of power electronics converters, power electronics systems, power diodes, Power transistors, power MOSFETS, IGBT and GTO.	**02**	
2	**PNPN devices:** V-I characteristics and applications. Two transistor model of SCR, SCR turn on methods, switching characteristics, gate characteristics	**02**	
3	**Phase controlled converters:** Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters.	**04**	
4	**DC-DC converters:** Principle of operation, control strategies, step up choppers, types of choppers circuits based on quadrant of operation, performance parameters, **Inverters:** Principle of operation of single phase and three phase bridge inverter with R and R-L loads, performance parameters of inverters, methods of voltage control and harmonic reduction of inverters.	**08**	
5	**Electric Drive:** Concept, classification, parts and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Determination of moment of inertia, Steady state stability, Transient stability. Multi quadrant operation of drives. Load equalization.	**06**	

6	**Stating of Electric Drives:** Effect of starting on Power supply, motor and load. Methods of starting electric motors. Acceleration time, Energy relation during stating. Methods to reduce the Energy loss during starting. Breaking of Electric Drives: Types of braking, Breaking of DC motor, Induction motor and Synchronous motor, Energy loss during braking.	**06**	
7	**Induction motor drives:** Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed and current source inverter fed induction motor drive. Volts/Hertz Control, Vector or Field oriented control. **DC motor drives:** Single phase, three phases fully controlled and half controlled DC drives.	**08**	
8	**Synchronous motor drives:** Variable frequency control, Self Control, Voltage source inverter fed synchronous motor drive, Vector control.	**04**	
9	**Industrial application:** Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.	**02**	

Text books:

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.
2. Electric Drives, Vedam Subrahmanyam, TMH.
3. A first course on Electrical Drives, S.K. Pillai, New Age International Publication.
4. Power Electronics, M.H. Rashid,4thEdition, Pearson.
5. Power Electronics, P. S. Bimbhra, Khanna Publishing House.

Reference books:

1. Electric motor drives, R. Krishnan, PHI.
2. Modern Power Electronics & Ac drives, B.K. Bose, Pearson Education.
3. Electric Motor & Drives. Austin Hughes, Newnes.
4. Power Electronics, M. D. Singh and K. B. Khanchandani, Tata McGraw Hill.

Course Outcome:

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

1. understand the fundamentals of semiconductor devices.
2. describe working principle of Phase controlled converters and DC- DC converters.
3. understand basics of Induction, DC and Synchronous motor drives.
4. design suitable drive system for Industrial application.
5. solve problems based on different converters, and drive system.

Special Remarks:

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

Name of the course	**DATABASE MANAGEMENT SYSTEMS**

Course Code: PC-ECS 602	Semester: 6th
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 understand the different issues involved in the design and implementation of a database system.
2.	To study the physical and logical database designs, database modelling, relational, hierarchical, and network models.
3.	To understand and use data manipulation language to query, update, and manage a database.
4.	To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), Data Warehousing.
5.	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, designing, and implementing a DBMS.
6.	To understand the different issues involved in the design and implementation of a database system.
Pre-Requisite:	
1.	Electric Circuit Theory (PC-ECS 301)
2.	Analog and Digital Electronics (ES-ECS 301)

Unit	Content	Hrs	Marks
1	**Database system architecture:** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity-relationship model, network model, relational and object-oriented data models, integrity constraints, data manipulation operations.	**02**	
2	**Relational query languages:** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	**12**	
3	**Storage strategies:** Indices, B-trees, hashing.	**04**	
4	**Transaction processing:** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, Mult	**06**	

	version and optimistic Concurrency Control schemes, Database recovery.		
5	**Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.	**06**	
6	**Advanced topics:** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	**06**	

Text books:

1."Database System Concepts", 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan, McGraw-Hill.

2."Principles of Database and Knowledge – Base Systems", Vol 1 by J. D. Ullman, Computer Science Press.

3. Database Management Systems, R.P. Mahapatra, Khanna Publishing House, New Delhi (AICTE Recommended Textbook – 2018).

Reference books:

1. "Fundamentals of Database Systems", 5th Edition by R. Elmasri and S. Navathe,

2. Pearson Education "Foundations of Databases", Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley.

Course Outcome:

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

1. understand the basic concepts of database management systems.
2. apply SQL to find solutions to a broad range of queries.
3. apply normalization techniques to improve database design.
4. analyse a given database application scenario to use ER model for conceptual design of the database.
5. familiar with basic database storage structures and access techniques.
6. Implement the isolation property including locking, time stamping based on concurrency control and Serializability of scheduling.

Special Remarks:

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

Name of the course	**Machine Learning & Deep Learning**
Course Code: **PC-ECS 601A**	Semester: 6th

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: Nil	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To learn the concept of how to learn patterns and concepts from data without being explicitly programmed
2.	To design and analyze various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3.	Explore supervised and unsupervised learning paradigms of machine learning.
4.	To explore Deep learning technique and various feature extraction strategies.
Pre-Requisite:	

Unit	Content	Hrs	Marks
1.	**Supervised Learning (Regression/Classification)** Basic methods: Distance-based methods, Nearest-Neighbors, Decision Trees, Naive Bayes, Linear models: Linear Regression, Logistic Regression, Generalized Linear Models, Support Vector Machines, Nonlinearity and Kernel Methods, Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	**10**	
2.	**Unsupervised Learning** Clustering: K-means/Kernel K-means, Dimensionality Reduction: PCA and kernel PCA, Matrix Factorization and Matrix Completion, Generative Models (mixture models and latent factor models)	**7**	
3.	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	**6**	
4.	Artificial Neural Network, activation function, multi-layer neural network. Training Neural Network: Risk minimization, loss function, back propagation, regularization, model selection, and optimization	**6**	
5.	**Deep Learning:** Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network	**6**	
6.	**Deep Learning research:** Object recognition, sparse coding, computer vision, natural language processing	**5**	

Text books:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007
4. Dr. Rajiv Chopra, Machine Learning, Khanna Publishing House, 2018
5. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.

Course Outcome:

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

1. Apply supervised learning techniques
2. Implement unsupervised learning algorithms
3. Evaluate and select machine learning models
4. Design and train neural networks
5. Develop deep learning models for real-world applications

Special Remarks:

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

Name of the course	**SOFT COMPUTING TECHNIQUES**
Course Code: PE-ECS 601B	**Semester: 6th**
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	
Credit Points: 3		Attendance: 05 Marks	
		End Semester Exam: 70 Marks	
Objective:			
1.	To understand the theory of Neural network, Fuzzy logic and Genetic Algorithm.		
2.	To Introduce neural networks, Genetic Algorithm and Fuzzy logic from an engineering perspective.		
Pre-Requisite			
1.	Programming for problem solving		
Unit	**Content**	**Hrs**	**Marks**
1	**Introduction:** Introduction to soft computing; introduction to fuzzy sets and fuzzy logic systems; introduction to biological and artificial neural network; introduction to Genetic Algorithm.	5	
2	**Fuzzy sets and Fuzzy logic systems:** Classical Sets and Fuzzy Sets and Fuzzy relations: Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy relations. Membership functions: Features of membership functions, standard forms and boundaries, different fuzzification methods. Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods. Classical Logic and Fuzzy Logic: Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication Fuzzy Rule based Systems: Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System-Mamdani Fuzzy Models – Sugeno Fuzzy Models. Applications of Fuzzy Logic: How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting Fuzzy Control, Convention control systems, Fuzzy logic control vs. PID control.	12	
3	**Neural Network**: Introduction to Neural Networks: Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron. Learning Methods : Hebbian, competitive, Boltzman etc., Neural Network models: Perceptron, Adaline and Madaline networks; single layer network; Back propagation and multi layer networks. Competitive learning networks: Kohonen self organizing networks, Hebbian learning; Hopfield Networks. Neuo-Fuzzy modelling:Applications of Neural Networks: Pattern Recognition and classification**:**	10	

4.	**Genetic Algorithms:** Simple GA, crossover and mutation, Multi- objective Genetic Algorithm (MOGA). Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition	8	
5.	**Other Soft Computing techniques:** Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).	5	

Text book:

1. Fuzzy logic with engineering applications, Timothy J. Ross, Wiley ,2011
2. Neural Networks Fuxxy Logic and Genetic Algorithm: Synthesis and Application, S.Rajashekharan and G.A. Vijaylakshmi Pai, PHI,2013
3. Principles of Soft Computing, S N Sivanandam, S.N. Deepa, Wiley , 2011.

Reference books:

1. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg,Addison Wesley, 1989.
2. Neuro-Fuzzy and Soft computing, Jang, Sun, Mizutani, Pearson, 1996.
3. Neural Networks: A Classroom Approach, Satish Kumar, McGraw Hill, 2017.
4. Genetic Algorithms in search, Optimization & Machine Learning by David E. Goldberg,Pearson/PHI
5. Introduction to Soft Computing-Neuro Fuzzy and Genetic Algorithm, Samir Roy & UditChakraborty, Pearson, 2013.

Course Outcome:

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

1. explain soft computing techniques and their roles in building intelligent machines
2. anlyse the feasibility of application of soft computing techniques for a particular problem
3. effectively use existing software tools to solve real problems using a soft computing approach
4. evaluate solutions by various soft computing approaches for a given problem.
5. apply different soft computing techniques to solve Engineering problems.

Special Remarks:

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

Name of the course	**POWER SYSTEM ANALYSIS**
Course Code: PE-ECS 601C	Semester: 6th
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: Nil	Attendance: 05 Marks
Credit Points: 3	End Semester Exam: 70 Marks

Objective:	
1.	To understand the modeling and analysis of electrical power systems.
2.	To acquire knowledge of power flow studies and solution techniques.
3.	To study symmetrical and unsymmetrical fault analysis methods.
4.	To analyze power system stability under dynamic conditions.

Pre-Requisite:	
1.	Electric Circuit Theory (PC-ECS 301)
2.	Electric Machines (PC-ECS 401)
3.	Power System (PC-ECS 402)

Unit	**Content**	**Hrs**	**Marks**
1.	POWER SYSTEM Need for system planning and operational studies – Power scenario in India – Power system components, Representation – Single line diagram – per unit quantities – p.u. impedance diagram – p.u. reactance diagram, Network graph Theory – Bus incidence matrices, Primitive parameters, Formation of bus admittance matrix – Direct inspection method – Singular Transformation method.	**8**	
2.	**POWER FLOW ANALYSIS** Bus classification – Formulation of Power Flow problem in polar coordinates – Power flow solution using Gauss Seidel method – Handling of Voltage controlled buses – Power Flow Solution by Newton Raphson method – Flow charts – Comparison of methods.	**9**	
3.	**SYMMETRICAL FAULT ANALYSIS** Assumptions in short circuit analysis – Symmetrical short circuit analysis using Thevenin's theorem – Bus Impedance matrix building algorithm (without mutual coupling) – Symmetrical fault analysis through bus impedance matrix – Post fault bus voltages – Fault level – Current limiting reactors.	**7**	
4.	**UNSYMMETRICAL FAULT ANALYSIS** Symmetrical components – Sequence impedances – Sequence networks – Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG – unsymmetrical fault occurring at any point in a power system.	**8**	
5.	**STABILITY ANALYSIS** Classification of power system stability – Rotor angle stability – Power-	**8**	

	Angle equation – Steady state stability – Swing equation – Solution of swing equation by step by step method – Swing curve, Equal area criterion – Critical clearing angle and time, Multi-machine stability analysis – modified Euler method.		

Text books:

1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2017.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, 3rd edition 2019.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

Reference books:

1. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
2. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
3. P. Venkatesh, B. V. Manikandan, A. Srinivasan, S. Charles Raja, "Electrical Power Systems: Analysis, Security and Deregulation" Prentice Hall India (PHI), second edition – 2017
4. Gupta B.R., 'Power System – Analysis and Design', S. Chand Publishing, Reissue edition 2005.
5. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013

Course Outcome:

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

1. Interpret and model the components of a power system using single line and per-unit representations.
2. Solve power flow problems using iterative numerical methods such as Gauss-Seidel and Newton-Raphson.
3. Analyze the behavior of a power system under symmetrical and unsymmetrical fault conditions.
4. Apply stability analysis techniques to determine the response of a power system under transient conditions.
5. Use matrix methods and network theory to form admittance and impedance models for large-scale power systems.

Special Remarks:

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

Name of the course	**DESIGN AND ANALYSIS OF ALGORITHM**
Course Code: PC-ECS 602A	Semester: 6th
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.	To design efficient algorithms for a variety of computational problems.
2.	To analyze their performance in terms of time and space complexity, and prove their correctness.
3.	To analyze the asymptotic performance of algorithms.
4.	To apply important algorithmic design paradigms and methods of analysis.
5.	To synthesize efficient algorithms in common engineering design situations.

Pre-Requisite:	
1.	Programming for Problem Solving (ES-CS201)
2.	Data Structure & Algorithm (PC-ECS 302)
3.	Object Oriented Programming (PC-ECS 405)

Unit	**Content**	**Hrs**	**Marks**
1	**Introduction:** Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behaviour; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters' theorem.	**06**	
2	**Fundamental Algorithmic Strategies:** Brute-Force, Greedy, Dynamic Programming, Branch and Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving, Bin Packing, Knap Sack TSP. Heuristics –characteristics and their application domains.	**10**	
3	**Graph and Tree Algorithms:** Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.	**10**	
4	**Tractable and Intractable Problems:** Computability of Algorithms, Computability classes – P, NP, NP complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.	**08**	
5	**Advanced Topics:** Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	**06**	

Text books:

1. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.

2. Fundamentals of Algorithms – E. Horowitz et al.
3. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.

Reference books:

1. Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA
2. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House (AICTE Recommended Textbook – 2018)
3. Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

Course Outcomes

On completion of the course students will be able to

1. analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
2. describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
3. describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
4. describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and
5. develop the dynamic programming algorithms, and analyze it to determine its computational complexity.
6. explain the ways to analyze randomized algorithms (expected running time, probability of error).

Special Remarks:

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

Name of the course	**COMPUTER NETWORK**
Course Code: PC-ECS 602B	Semester: 6th
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.	To develop an understanding of modern network architectures from a design and performance perspective.
2.	To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3.	To provide an opportunity to do network programming.
4.	To provide a WLAN measurement ideas.

Pre-Requisite:

1.	Computer Organisation & Architecture (PC-ECS 406)
2.	Operating Systems (PC-ECS 501)

Unit	Content	Hrs	Marks
1	**Data communication Components:** Representation of data and its flow Networks, Various Connection Topology, Protocols and Standards, OSI model, Transmission Media, LAN: Wired LAN, Wireless LANs, Connecting LAN and Virtual LAN, Techniques for Bandwidth utilization: Multiplexing - Frequency division, Time division and Wave division, Concepts on spread spectrum	**08**	
2	**Data Link Layer and Medium Access Sub Layer:** Error Detection and Error Correction - Fundamentals, Block coding, Hamming Distance, CRC; Flow Control and Error control protocols - Stop and Wait, Go back – N ARQ, Selective Repeat ARQ, Sliding Window, Piggybacking, Random Access, Multiple access protocols -Pure ALOHA, Slotted ALOHA,CSMA/CD,CDMA/CA	**08**	
3	**Network Layer:** Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols	**10**	
4	**Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.	**08**	
5	**Application Layer:** Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.	**06**	

Text books:

1. Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.

2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.

Reference books:

1. "Algorithm Design" by Kleinberg and Tardos.

2. Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House, New Delhi

Course Outcomes

On completion of the course students will be able to

1. understand research problem formulation.
2. analyze research related information
3. follow research ethics
4. understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5. understand that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6. understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

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

Name of the course	**SOFTWARE ENGINEERING**
Course Code: PC-ECS 602C	Semester: 6th
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 software development life cycle (SDLC) and its various models.
2.	Apply systematic engineering approaches to software design, development, testing, and maintenance.
3.	Analyze user requirements and design software solutions that are scalable, efficient, and reliable.
4.	Employ best practices in software project management, including cost estimation, scheduling, and risk management
5.	Utilize modern development tools and techniques for version control, debugging, and documentation.
6.	Understand the importance of software quality assurance and testing strategies.
7.	Collaborate effectively in teams and communicate technical concepts clearly.
8.	Address ethical, legal, and social issues related to software development and usage.
Pre-Requisite:	
1.	Programming for Problem Solving (ES-CS291)
2.	Data Structure & Algorithm (PC-ECS 302)
3.	Object Oriented Programming (PC-ECS 405)

Unit	**Content**	**Hrs**	**Marks**
1	**Introduction:** Overview of System Analysis & Design, Business System Concept, System Development Life Cycle, Waterfall Model, Spiral Model, Feasibility Analysis, Technical Feasibility, Cost- Benefit Analysis, COCOMO model.	**10**	
2	**System Design:** Context diagram and DFD, Problem Partitioning, Top-Down and Bottom-Up design; Decision tree, decision table and structured English; Functional vs. Object- Oriented approach.	**05**	
3	**Coding & Documentation:** Structured Programming, OO Programming, Information Hiding, Reuse, System Documentation. Testing – Levels of Testing, Integration Testing, Test case Specification, Reliability Assessment, Validation & Verification Metrics, Monitoring & Control.	**08**	
4	**Software Project Management:** Project Scheduling, Staffing, Software Configuration Management, Quality Assurance, Project Monitoring.	**07**	
5	**Static and dynamic models:** why modelling, UML diagrams: Class diagram, interaction diagram: collaboration diagram, sequence diagram, state chart diagram, activity diagram, implementation diagram.	**10**	

Text books:

1. Pressman, Software Engineering : A practitioner’s approach– (TMH)

2. Pankaj Jalote, Software Engineering- (Wiley-India)

3. N.S. Gill, Software Engineering – (Khanna Publishing House)

Reference books:

1. Rajib Mall, Software Engineering- (PHI)

2. Agarwal and Agarwal, Software Engineering – (PHI)

3. Sommerville, Software Engineering – Pearson

4. Martin L. Shooman, Software Engineering – TMH

Course Outcomes

On completion of the course students will be able to

1. understand and explain fundamental software engineering concepts, including software process models, development methodologies, and lifecycle activities.
2. analyze, and document functional and non-functional requirements for software systems.
3. design software systems using appropriate design principles and notations such as UML.
4. apply coding standards, software construction practices, and modern development tools to implement software solutions.
5. develop and execute various software testing strategies to ensure software quality and reliability.
6. manage software development projects by estimating cost, scheduling tasks, and tracking progress using project management techniques.

Special Remarks:

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

Name of the course	**EMBEDDED SYSTEM**
Course Code: OE-ECS 601A	Semester: 6th
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 architecture and functioning of microcontrollers and embedded processors.

2.	Explore the principles of embedded system design, including both hardware and software components.
3.	Learn programming techniques specific to embedded systems, with emphasis on C/C++ and assembly language.
4.	Interface embedded systems with various peripherals and sensors using GPIO, timers, ADCs, communication protocols (UART, SPI, I2C, etc.).
5.	Analyze real-time operating system (RTOS) concepts and their role in embedded applications.
6.	Develop, test, and debug embedded applications using development boards and simulation tools.
7.	Apply embedded system concepts in solving real-world problems through mini or capstone projects.
Pre-Requisite:	
1.	Analog & Digital Electronics (ES-ECS 301)
2.	Microcontroller & it's Application (PC-ECS 503)
3.	Computer Organisation & Architecture (PC-ECS 406)

Unit	Content	Hrs	Marks
1	**Introduction to Embedded Systems:** Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems, Characteristics and Quality Attributes of Embedded Systems.	**05**	
2	**Typical Embedded System:** Core of the Embedded System: General Purpose and Domain Specific Processors, ASICs, PLDs, Commercial Off-The-Shelf Components (COTS), Memory: ROM, RAM, Memory according to the type of Interface, Memory Interfacing techniques, Memory Shadowing, Memory selection For Embedded Systems, Sensors and Actuators, Communication Interface: Onboard and External Communication Interfaces.	**07**	
3	**Advanced Embedded Microcontrollers: PIC Microcontrollers:** Overview and features; PIC 16C6X/7X - File Selection Register (FSR), PIC Reset Actions, PIC Oscillator connections, PIC Memory Organization, PIC 16C6X/7X instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, Timers. PIC 16F8XX Flash Microcontroller – Introduction, Pin diagram, Registers, Memory organization, Interrupts, I/O Ports, Timers. Introduction to AVR microcontroller: Introduction to AVR (ATmega 328p-pu) microcontroller, pin layout, architecture, program memory, Data Direction register, Port Registers (PORTx), PWM registers (8-bit), ADC registers. Introduction to ARM microcontroller: Architecture of ARM Embedded microcontroller, ARM instruction sets	**12**	
4	**Embedded Firmware:** Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.	**06**	
5	**RTOS Based Embedded System Design:** Operating System Basics,	**10**	

	Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Synchronization: Task Communication/Synchronization Issues, Task Synchronization Techniques, Device Drivers, How to Choose an RTOS.		

Text books:

1. Introduction to Embedded Systems, Shibu K.V, Mc Graw Hill. 2017.
2. Embedded Systems – Architecture, Programming and design, Raj Kamal, McGraw Hill Education, 2017

Reference books:

1. Embedded System Design: A unified Hardware/ Software introduction, Tony Givargis and Frank Vahid, Wiley 2006
2. Design with PIC Microcontrollers , J. B. Peatman, Pearson India,2008

Course Outcomes

On completion of the course students will be able to

1. explain the architecture and working of microcontrollers and embedded processors.
2. develop embedded C/assembly programs for microcontroller-based applications.
3. design and implement embedded systems interfacing with external devices like LEDs, sensors, motors, and displays.
4. utilize communication protocols (e.g., UART, SPI, I2C) to enable device-to-device interaction.
5. analyze the role and functionality of Real-Time Operating Systems (RTOS) in embedded applications.
6. develop and debug embedded system projects using development tools such as IDEs, simulators, and hardware kits.

Special Remarks:

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

Name of the course	**ROBOTICS**
Course Code: OE-ECS 601B	Semester: 6th
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 structure, types, and functions of robotic systems.

2.	Analyze and model robot kinematics and dynamics for motion and control.
3.	Explore various actuators, sensors, and control strategies used in robotics.
4.	Learn techniques for path planning, navigation, and robot programming.
5.	Use simulation tools and hardware platforms to design and implement robotic applications
Pre-Requisite:	
1.	Programming for Problem Solving (ES-CS291)
2.	Introduction to Artificial Intelligence & Machine Learning (PC-ECS 404)
3.	Microcontroller & it's Application (PC-ECS 503)
4.	Control Systems (PC-ECS 502)

Unit	Content	Hrs	Marks
1	**Introduction:** Introduction -- brief history, types, classification and usage, Science and Technology of robots, Some useful websites, textbooks and research journals.	**01**	
2	**Elements of robots – links, joints, actuators, and sensors:** Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.	**05**	
3	**Kinematics of serial robots:** Introduction, Direct and inverse kinematics problems, Examples of kinematics of common serial manipulators, workspace of a serial robot, Inverse kinematics of constrained and redundant robots, Tractrix based approach for fixed and free robots and multi-body systems, simulations and experiments, Solution procedures using theory of elimination, Inverse kinematics solution for the general 6R serial manipulator**.**	**04**	
4	**Kinematics of parallel robots:** Degrees-of-freedom of parallel mechanisms and manipulators, Active and passive joints, Constraint and loop-closure equations, Direct kinematics problem, Mobility of parallel manipulators, Closed-from and numerical solution, Inverse kinematics of parallel manipulators and mechanisms, Direct kinematics of Gough-Stewart platform.	**05**	
5	**Velocity and static analysis of robot manipulators:** Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a Gough-Stewart platform, Singularity analysis and statics.	**05**	
6	**Dynamics of serial and parallel manipulators:** Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics, commercially available	**04**	

	multi-body simulation software (ADAMS) and Computer algebra software Maple.		
7	**Motion planning and control:** Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non- linear control of manipulators.	**06**	
8	**Modelling and control of flexible robots:** Models of flexible links and joints, Kinematic modelling of multi- link flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results, Experiments with a planar two-link flexible manipulator.	**04**	
9	**Modelling and analysis of wheeled mobile robots:** 3Introduction and some well-known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modelling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR's on uneven terrain, Simulations using Matlab and ADAMS.	**03**	
10	**Selected advanced topics in robotics:** Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough- Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform-based sensors. Over- constrained mechanisms and deployable structures, Algorithm to obtain redundant links and joints, Kinematics and statics of deployable structures with pantographs or scissor-like elements (SLE's).	**03**	

Text books:

1. Robotics Process Automation, Khanna Publishing House
2. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.

Reference books:

1. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.2. Design with PIC Microcontrollers , J. B. Peatman, Pearson India,2008

Course Outcomes

On completion of the course students will be able to

1. understand and explain the fundamental concepts, components, and classifications of robotic systems.
2. analyze the kinematics and dynamics of robotic manipulators using mathematical models.
3. design robotic systems considering actuators, sensors, end-effectors, and control systems.
4. apply algorithms for robot motion planning, pathfinding, and trajectory generation.
5. integrate hardware and software components to develop simple robotic applications.
6. use simulation tools and development platforms (e.g., MATLAB, ROS, Arduino) for robotic system design and testing.

Special Remarks:

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

Name of the course	**SENSORS & ACTUATORS**
Course Code: OE-ECS 601C	Semester: 6th
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.	Understanding basic laws and phenomena on which operation of sensors and actuators transformation of energy.
2.	Create analytical design and development solutions for sensors and actuators.
3.	To know the basic laws of behaviour of sensors and actuators.

4.	To able to know about the Standards for Smart Sensor Interface
5.	Analyse the development and application of sensors and actuators.
Pre-Requisite:	
1.	Programming for Problem Solving (ES-CS201)
2.	Electric Circuit Theory Laboratory (PC-ECS 301)
3.	Introduction to Artificial Intelligence & Machine Learning (PC-ECS 404)
4.	Microcontroller & it's Application (PC-ECS 503)

Unit	Content	Hrs	Marks
1	**Introduction to different Sensors:** Measurement system architecture, Overview of Signal Conditioning, measurement characteristics, Sensors and Transducers, Selection of Sensors, Basic Interfacing circuits. Electrical Sensors: Hall effect sensor, CT, PT, Inductance and Eddy Current Sensors. Thermal Sensors: RTD, Thermistors, Thermocouples, Thermal IC Sensors. Mechanical Sensors: Displacement- LVDT, Velocity, accelerometer, gyro, Pressure, Flow, level, Proximity, humidity, Force, optical. Error budgeting: Errors due to resistance drift, offset voltage drift, offset current drift and temperature drift.	**12**	
2	**Analog Signal Conditioning:** Principles of analog signal conditioning, Instrumentation amplifier, Signal-Level and Bias Changes, Linearization, Conversions, Filtering, and Impedance Matching. Concept of Loading, Sensor-to-Frequency Conversion. Data-Acquisition Systems: Hardware and Software components of Data Acquisition System (DAS). Characteristics of digital data: Digitized Value, Sampled Data Systems.	**10**	
3	**Actuation systems:** Pneumatic and Hydraulic Systems: Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Mechanical Switches – Cams – Gear Trains – Ratchet and Pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Solid State Switches – Solenoids. Smart sensors – communication. Case Study: Applications of sensors and actuators	**08**	
4	**Smart Sensors:** Introduction, Primary Sensors, Excitation, Converters, Compensation, Information Coding/Processing, Data Communication, Standards for Smart Sensor Interface, the Automation. Sensors Applications: Introduction, On-board Automobile Sensors (Automotive Sensors), Home Appliance Sensors.	**10**	

Text books:

1. Robert B. Northrop, “Introduction to Instrumentation and Measurement”, 3rd Edition, CRC – Press – Taylor and Francis Group.
2. Patranabis, “Sensors and Transducers”, 2nd Edition, Prentice Hall of India, 2013.

Reference books:

1. Paul Horowitz and Winfield Hill, "The Art of Electronics", 2nd Edition, Cambridge University Press, 1992.
2. Curtis D. Johnson, "Process Control Instrumentation Technology", 6th Edition, Prentice Hall International Edition.
3. Ida, Nathan., "Sensors, actuators, and their interfaces: a multidisciplinary introduction", No. 11040. SciTech Publishing Inc, 2013.
4. John G. Webster, "Measurement, Instrumentation, and Sensors Handbook", CRC – Press – Taylor and Francis Group, 1999.
5. Pallas-Areny, Ramon, and John G. Webster. Sensors and signal conditioning. John Wiley & Sons, 2012.
6. J. P. Bentley, "Principles of Measurement systems", 4th Edition, Pearson education ltd, UK, 2005.
7. G.C.M. Meijer, "Smart Sensor Systems", Vol 10, John Wiley and Sons, UK, 2008.

Course Outcomes

On completion of the course students will be able to

1. understand the characteristics and operating principles of different types of sensors.
2. select different actuators for various applications.
3. apply different analog and digital signal conditioning techniques for sensor circuits.
4. design and analyse sensor-based applications

Special Remarks:

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

Name of the course	**VALUES AND ETHICS IN PROFESSION**
Course Code: HU 601	Semester: 6th
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.	To inculcate Human values to grow as a responsible human beings with a proper personality.
2.	To instill Professional Ethics to maintain ethical conduct and discharge professional duties.

Pre-Requisite:			
	NOT APPLICABLE		
Unit	**Content**	**Hrs**	**Marks**
1	**Human values:** Morals, Values, and Ethics – Integrity –Trustworthiness – Work Ethics – Service-Learning – Civic Virtue – Respect for others – Living Peacefully – Caring – Sharing – Honesty –Courage – Value Time – Co-operation – Commitment – Empathy – Self-confidence –Spirituality- Character.	**03**	
2	**Principles for harmony:** Truthfulness customs, Traditions -Value Education – Human Dignity – Human Rights – Fundamental Duties – Aspirations and Harmony (I, We & Nature) – Gender Bias – Emotional Intelligence– Salovey – Mayer Model – Emotional Competencies –Conscientiousness.	**08**	
3	**Engineering Ethics and Social experimentation:** Senses of Engineering Ethics- Profession and Professionalism —Self Interest –Moral Autonomy – Utilitarianism – Virtue Theory – Uses of Ethical Theories – Deontology- Types of Inquiry – Kohlberg's Theory –Gilligan's Argument – Heinz's Dilemma – Comparison with Standard Experiments — Learning from the Past – Engineers as Managers – Consultants and Leaders – Balanced Outlook on Law – Role of Codes – Codes and Experimental Nature of Engineering	**08**	
4	**Engineers' responsibility towards safety and risk for sustainable development:** The concept of Safety – Safety and Risk – Types of Risks –Voluntary v/s Involuntary Risk – Consequences – Risk Assessment–Accountability – Liability – Reversible Effects – Threshold Levels of Risk – Delayed v/s Immediate Risk – Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.	**09**	
5.	**Engineers' duties and rights:** Concept of Duty – Professional Duties – Collegiality – Techniques for Achieving Collegiality – Senses of Loyalty – Consensus and Controversy – Professional and Individual Rights – Confidential and Collective Bargaining – Confidentiality – Gifts and Bribes –Problem Solving- Occupational Crimes- Industrial Espionage- Price Fixing-Whistle Blowing.	**05**	
6.	**Global issues:** Globalization and MNCs, Cross Culture Issues – Business Ethics – Media Ethics – Environmental Ethics – Endangering Lives – Bio Ethics – Computer Ethics – War Ethics – Research Ethics -Intellectual Property Rights.	**05**	

Text books:

1. Professional Ethics & Human Values, Premvir Kapoor, Khanna Publishing House, Delhi (AICTE Recommended Textbook).
2. A text book on professional Ethics & Human values, R.S. Naagarazan, New Age international Publishing.
3. Engineering Ethics, M. Govindarajan, S. Natarajan , V.S. Senthilkumar, Prentice Hall India.
4. Human value and professional Ethics, Jayshree Suresh, B.S. Raghvan, S. Chand Publishing

Reference books:

1. Deborah Johnson, Ethical Issues in Engineering, Prentice Hall, Englewood Cliffs, New Jersey 1991.
2. A N Tripathi, Human values in the Engineering Profession, Monograph published by IIM, Calcutta 1996.

Course Outcomes

On completion of the course students will be able to

1. illustrate different aspects of human values, ethics, engineers' responsibility and duties
2. explain different principles, different theories and laws of engineering ethics and social experimentation
3. identify different factors in the light of Engineers' responsibility towards safety and risk
4. correlate ethics of different work environment.
5. explain the need for intellectual property rights.

Special Remarks:

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

Name of the course	**POWER ELECTRONICS AND DRIVES LABORATORY**
Course Code: PC-ECS 691	Semester: 6th
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.	Gate Pulse Generation using R, RC and UJT.
2.	Characteristics of SCR and Triac
3.	Characteristics of MOSFET and IGBT
4.	AC to DC half controlled converter with different load.

5.	AC to DC fully controlled Converter with different load.
6.	Step down and step up MOSFET based choppers
7.	. IGBT based single phase PWM inverter
8.	IGBT based three phase PWM inverter
9.	AC Voltage controller with different load.
10.	Switched mode power converter.
11.	Simulation of PE circuits (1Φ&3Φsemiconverter, 1Φ&3Φfullconverter, dc-dc Converters, ac voltage controllers).

Course Outcome:

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

1. analyze and verify the performance of power electronic devices such as SCR, TRIAC, MOSFET, and IGBT through experiments.
2. demonstrate the operation of various power converters, including rectifiers, inverters, choppers, and AC voltage controllers.
3. evaluate the characteristics and control methods of electric drives using power electronic converters.
4. design and implement triggering circuits for thyristor-based applications.
5. control the speed of DC and AC motors using appropriate power electronic drive circuits.
6. use simulation tools (e.g., MATLAB/Simulink or PSPICE) to model and analyze power electronic systems.

Special Remarks:

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

Name of the course	**DATABASE MANAGEMENT SYSTEM LABORATORY**
Course Code: PC-ECS 692	Semester: 6th
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.	Structured Query Language **Creating Database** • Creating a Database • Creating a Table

	• Specifying Relational Data Types • Specifying Constraints • Creating Indexes
2.	Table and Record Handling • INSERT statement • Using SELECT and INSERT together • DELETE, UPDATE, TRUNCATE statements • DROP, ALTER statements
3.	Retrieving Data from a Database i. The SELECT statement ii. Using the WHERE clause iii. Using Logical Operators in the WHERE clause iv. Using IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause v. Using Aggregate Functions vi. Combining Tables Using JOINS vii. Subqueries
4.	Database Management • Creating Views • Creating Column Aliases • Creating Database Users • Using GRANT and REVOKE
5.	Cursors in Oracle PL / SQL Writing Oracle PL / SQL Stored Procedures

Course Outcome:

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

1. design and implement relational database schemas using ER modelling and normalization techniques.
2. create, modify, and manage databases using Structured Query Language (SQL) effectively.
3. develop SQL queries to retrieve, update, and manipulate data from multiple tables using joins, subqueries, and set operations.
4. implement constraints, views, triggers, and stored procedures/functions to enforce data integrity and business rules.
5. perform database transaction management with concepts like commit, rollback, and concurrency control.
6. use database connectivity in applications by integrating a front-end programming language with a backend database.

Special Remarks:

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

Name of the course	**Computer-Aided Electrical [Machine] Design Laboratory**
Course Code: PC-ECS 693	Semester: 6th
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.	Introduction Matlab software
2.	Design of D.C. Machine By Using Matlab
3.	Design of 3-φ Transformer By Using Matlab
4.	Design of 1-φ Induction Motor By Using Matlab
5.	Design of Synchronous Machine By Using Matlab
6.	Design of Circuit Breaker Operation By using Matlab

7.	Testing of Different Types of Relays By Using Matlab
8.	Study of Protective Equipment & Layout of 220/11KV Substation
9.	Design of Surge Arresters in Transmission System By Using Matlab
10.	Design and Parameter Estimation of Alternator By Using Matlab

Course Outcome:

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

1. understand the principles and design procedures of electrical machines using computer-aided tools.
2. design DC machines, transformers, and AC machines (induction and synchronous) based on given specifications.
3. utilize simulation and design software (such as MATLAB, ANSYS Maxwell, or FEMM) for modelling and analysis of electrical machines.
4. analyze the performance characteristics of designed machines using computer-based tools and validate against theoretical calculations.
5. evaluate core dimensions, winding details, and thermal performance of electrical machines.
6. develop custom scripts or programs for parametric machine design and optimization.

Special Remarks:

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