School of Electrical, Electronics & Communication Engineering
Department of Electrical Engineering

B. Tech. (Electrical & Computer Engineering) Syllabus

(Applicable for the students admitted in Academic Year 2023-24 & onwards)

THIRD SEMESTER

ELC2101: ANALOG & DIGITAL SYSTEM [3 1 0 4]

Differential Amplifiers, block diagram of Operational Amplifier, OPAMP characteristics, OPAMP configuration, OPAMP in linear Mode, OPAMP with positive and negative feedback, Linear applications of OPAMP: Summing amplifier, Integrator, Differentiator, Low pass filter, high pass filter, band pass filter, Notch filter, All pass filter, Nonlinear applications of OPAMP: Comparator, Schmitt Trigger. Astable and monostable multivibrator using IC 555. Algebraic simplification of Boolean expressions, realization using logic gates, minimization using Karnaugh map, Combinational logic circuits: adders, multiplexer, Demultiplexer, Realization using MUX, Decoder, Priority Encoder, Arithmetic logic circuit (ALU). Sequential logic circuits: Flip-flop types and conversions, asynchronous and synchronous counters, shift registers, finite state machines.

References:

1. Boylestad and Nashelsky, Electronic Devices and Circuit Theory (10e), Pearson Education, 2009,
2. R. A. Gayakwad, Op-Amps and Linear Integrated Circuits (4e), Pearson Education 2015.
3. Digital Design, 3rd Edition, Morris Mano, Pearson, 2002.
4. Digital Circuits And Design, 3rd Edition, S Salivahanan, Vikas Publishing House 2006
5. "Digital Circuits and Logic Design, by Sanjay Sharma, SKKS 2015.

ELC2102: DATA STRUCTURES & ALGORITHMS [3 1 0 4]

Psuedo-Code, algorithm analysis, asymptotic notations, iterative and recursive algorithms, Data Structures, data structure operations, review of arrays, structures, Stacks and Queues, stack and queue operations, array representation of stacks and queues, queues and stacks using linked list, applications of queues and stacks, Properties of binary search trees, array and linked list representation of binary search trees, binary search tree traversals, Graphs and their representations, application of graphs, Searching and sorting methods. Algorithm design techniques-Greedy, Divide and Conquer, Dynamic programming and backtracking. Addressing limitations of power-P, NP and NP complete problems.

References:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to algorithms", PHI, Third Edition, 2009.
2. Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, "Data Structures using C", Pearson Education, 2013.

ELC2103: COMPUTER ORGANIZATION & ARCHITECTURE [3 1 0 4]

Basic Structure of computers: Computer types, functional units, basic operational concepts, bus structures, software, performance; Machine Instructions and programs: Numbers, arithmetic operations and characters, Memory locations and addresses; Memory operations,

Addressing modes; Arithmetic: Addition and subtraction of signed numbers, Adders, ALU design, Bit slice processor, Multiplication of positive numbers Signed operand multiplication, Booth's Algorithm, Fast multiplication, Integer division, Floating point numbers and operations; Memory Systems: Introduction, Basic concepts, Design methods; RAM memories, Read only memories, Speed size and cost, Cache memories, Performance considerations, Virtual memories, Memory, Management Requirements, Secondary storage; Input / Output organization: Accessing I/O devices, Interrupts, Direct memory access, Buses, Interface circuits; Introduction to Parallel Processing: Flynn Classification, Multi-Core Architecture, Pipelining.

References:

1. W. Stallings, Computer Organization and Architecture –Designing for Performance, PHI, 2009.
2. C. Hamacher & Z. Vranesic, Computer Organization (5e), Tata McGraw Hill (TMH), 2011.
3. D. A. Patterson & J. L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Morgan Kaufmann, 2011.
4. J. P. Hayes, Computer Architecture and Organization (3e0, Tata McGraw Hill (TMH), 1998.

ELC2130: DATA STRUCTURES & ALGORITHMS LAB [0 0 2 1]

Implementation of array operations: insertion, deletion, linear search and binary search, matrix operation. Implementation of singly, doubly and circular linked lists: inserting, deleting, and inverting a linked list, Polynomial addition, subtraction and sparse matrix implementation by linked list, Stacks and Queues: adding, deleting elements. Circular Queue: Adding & deleting elements, conversion of infix to postfix and Evaluation of postfix expressions using stacks & queues, Implementation of stacks & queues using linked lists. Recursive and Non-recursive traversal of Trees: BST tree implementation. Implementation of sorting and searching algorithms: bubble sort, Insertion sort, selection sort, quick sort, heap sort, merge sort, radix sort, Hash table implementation.

References:

1. Augenstein, Tenenbaum Langsam, Data Structure Using C & C++ (2e), Prentice Hall India Ltd. 2015.
2. Mark Allen Weiss, Data structures and Algorithm Analysis in C, Pearson, Second edition, 2014.
3. S. Tannenbaum, J. Augenstein, Data Structures using C, Pearson India, 2018.
4. E. Horowitz, S. Sahni, Fundamentals of Data Structures in C (2e), Universities Press, 2008.
5. Forouzan, R. F. Gilberg, A Structured Programming Approach Using C (3e), Cengage Learning, 2007.

ELC2131: ANALOG & DIGITAL SYSTEM LAB [0 0 2 1]

Design, Simulation and Testing of operational amplifier-based circuits in linear and nonlinear mode. Timer based mono-stable and astable Multivibrators circuits. Design and Testing of combinational circuits using gates, multiplexers, decoders, arithmetic circuits. Design and Testing of sequential digital electronic circuits such as counters, shift registers & sequence generators, sequence detectors.

References:

1. Boylestad and Nashelsky, Electronic Devices and Circuit Theory (10e), Pearson Edu 2009.
2. R. A. Gayakwad, Op-Amps and Linear Integrated Circuits (4e), Pearson Education 2015.
3. Digital Design, 3rd Edition, Morris Mano, Pearson, 2002.

4. Digital Circuits And Design, 3rd Edition, S Salivahanan, Vikas Publishing House 2006
5. "Digital Circuits and Logic Design, by Sanjay Sharma, SKKS 2015.

ELC2170: PROJECT-BASED LEARNING 1 [0 0 2 1]

Project based learning aims to build students' creative capacity to work through difficult or complex problems. It encompasses student's involvement in designing, developing, and constructing hands-on solutions to a problem, commonly in small teams. Typically, Project based learning takes students through the following phases or steps: Identifying a problem, agreeing on or devising a solution and potential solution path to the problem (i.e., how to achieve the solution), Designing and developing a prototype of the solution, refining the solution based on feedback from experts, instructors, and/or peers. Depending on the goals of the instructor, the size and scope of the project can vary greatly.

FOURTH SEMESTER

ELC2201: NETWORKS & SYSTEMS [3 1 0 4]

Graph Theory: Graph of a network, Matrix representation of a graph, Cut- set and Tie set Matrix. Network Theorems: Superposition, Thevenin's, Norton's, Maximum power transfer, Reciprocity, Substitution. Signals and waveforms: Classification of Signals, elementary signals, characteristics, representation of waveforms. Time domain analysis: Initial and final conditions, transients analysis of RL, RC and RLC circuits. Frequency domain analysis: Laplace Transformed circuits, Network Function, poles and zeros. Two port networks: Z, Y, T and h parameters, Relation between parameters, Series, parallel and cascade connections.

References:

1. W. H. Hayt, J. E. Kemmerly & S. M. Durbin, Engineering Circuit Analysis (7e), TMH, 2010.
2. M. S. Sukhija and T. K. Nagsarkar, Circuits and Networks (2e), OXFORD University Press, 2016.
3. J. W. Nilsson & S. A. Reidel, Electric Circuits (9e), PHI, 2011.
4. R. R. Singh, Network Analysis and Synthesis, McGraw Hill Education 2013.
5. F. F. Kuo, Network Analysis and Synthesis (5e), Wiley, 2012.

ELC2202: DATA BASE MANAGEMENT SYSTEM [3 1 0 4]

Data-base system applications, Data models, schemas, and instances. Three-schema architecture and data independence. Entity-Relationship Model: Entity, Attribute, Constraints. Relational model Concepts, Relational algebra: SELECT, PROJECT and DIVISION. Relational database design using ER-to-Relational Mapping. Structured Query Language (SQL), Queries in SQL. Query processing and optimization, Database design: Functional dependencies, normalization. Transaction management: ACID properties, concurrency control, transactions, and scheduling, locking. Data warehousing, datamining, and data analytics. Applications and case studies.

References:

1. Silberschatz, H. F. Korth, S. Sudarshan, Database System Concepts, TMH, 2016.
2. R. Elmasri, S. B. Navathe, Fundamentals of Database Systems, Pearson, 2017.
3. R. Ramakrishnan, Database Management Systems, McGraw Hill, 2014.
4. Bayross, Introduction to SQL, Tata McGraw, 2014.

ELC2230: DATA BASE MANAGEMENT SYSTEM LAB [0 0 2 1]

DDL Commands: Create, Alter, Drop Table, **DML Commands:** Insert, Update, Delete, **SQL Functions:** Number, Aggregate, Character, Conversion, Date, **SQL Operators:** Arithmetic, Logical, Comparison, Special, Set, **Joins:** Inner, Outer, Natural, Advanced SQL: GROUP BY, HAVING, ORDER BY, Indexing, **Subqueries and Views, Constraints:** Types and Implementation, **Database Backup and Recovery Commands, Transaction Management:** Rollback, Commit, Savepoint, **Database and Table Space Management, User and Role Management:** Create, Delete, Grant, Revoke **PL/SQL:** Study and Implementation **SQL Triggers:** Study and Implementation.

References:

1. Winand, M., 2011. SQL performance explained. *Development, 2011*, pp.03-08.
2. Silberschatz, A., Korth, H.F. and Sudarshan, S., 2011. *Database system concepts*. McGraw-Hill.
3. Gulutzan, P. and Pelzer, T., 2003. *SQL Performance Tuning*. Addison-Wesley Professional.
4. Beaulieu, A., 2009. *Learning SQL: master SQL fundamentals*. " O'Reilly Media, Inc.".

ELC2231: MICROCONTROLLER LAB [0 0 2 1]

Introduction to ESAMCB – 51 kit and Keil software, Programs of Data transfer & Addressing modes, Programs of Data block transfer, Programs of Searching of data in array & sorting of data Array, Programs of Arithmetic & Logical operations, Programs of various Code Conversion techniques, Programs of Delay Generation using timer and counter, Simulation of LCD interface, Simulation of Interrupts Programming on ESA MCB51 Kit, Simulation of Logic Controller Interface, Speed control simulation of Stepper Motor Interface, Simulation of Traffic Light Interface and Elevator Interface, Arduino based motor and LED array interface.

References:

1. M. A. Mazidi, J. G. Mazidi, R. D. McKinlay, The 8051 microcontroller and embedded systems: using Assembly and C (2e), Pearson, 2006.
2. Ramesh S. Gaonkar, Microprocessor architecture, programming, and applications with the 8085 (5e), Prentice Hall, 2002.

ELC2270: PROJECT-BASED LEARNING 2 [0 0 2 1]

The problem-based project-oriented model for learning is a highly recommended approach that places the identification of a problem at its core. This model typically initiates with the recognition of a problem, often stemming from a question or a state of curiosity. This formulated problem then serves as the cornerstone for the learning process. The design and analysis of the problem within a defined interdisciplinary or subject framework. Problems can span various domains, including theoretical, practical, social, technical, symbolic, cultural, and scientific, emerging from students' inquiries across different disciplines and professional contexts. Interdisciplinary collaboration may be necessary during both the analysis and solution phases of the problem-solving process. However, there is no universally accepted set of criteria for what constitutes an acceptable project. Projects can vary significantly in terms of the depth of questions explored, the clarity of learning objectives, and the content and structure of activities involved.

FLEXI CORE

FLEXI CORE – I

ELC2120: ELECTRIC VEHICLE TECHNOLOGY [3 0 0 3]

Introduction to Electric Vehicles - History, social and environmental importance, Impact of modern drive-trains; Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, Electric Drive-trains - Basic concepts, power flow control, topologies; Electric Propulsion unit: Introduction, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives, Energy Storage - Introduction, Charging technologies, Battery based energy storage, Fuel Cell based energy storage, Super Capacitor based energy storage and Flywheel based energy storage and analysis, Sizing the drive system - Sizing the propulsion motor, power electronics, energy storage technology, Communications, Supporting subsystems - Energy Management Strategies, Battery management systems, Fleet management systems, EV standards, Case Studies - Design of a Battery Electric Vehicle (BEV).

References:

1. M. Ehsani, Y. Gao, S. E. Gay, and A. Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press, 2004.
2. C. Mi, M. A. Masrur and D. W. Gao, Hybrid Electric Vehicles, Wiley 2011
3. S. Rajkaruna, F. Shahnia, Plug in Electric Vehicles in Smart Grids, Springer, 2015
4. S. Dhameja, Electric Vehicle Battery Systems, Newnes, 2001.
5. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press, 2009
6. R. N. Jazar, Vehicle dynamics: theory and application, Springer, 2017.

ELC2121: COMPUTER NETWORKS [3 0 0 3]

Concept of layering: OSI and TCP/IP Protocol Stacks; Basics of packet, circuit and virtual circuit-switching; Data link layer: framing, error detection, Medium Access Control, Ethernet bridging; Routing protocols: shortest path, flooding, distance vector and link state routing; Fragmentation and IP addressing, IPv4, CIDR notation, Basics of IP support protocols (ARP, DHCP, ICMP), Network Address Translation (NAT); Transport layer: flow control and congestion control, UDP, TCP, sockets; Application layer protocols: DNS, SMTP, HTTP, FTP, Email.

References:

1. Tanenbaum, A.S., 2003. Computer networks. Pearson Education India.
2. Forouzan, B.A., 2007. Data communications and networking. Huga Media.
3. Peterson, L.L. and Davie, B.S., 2007. Computer networks: a systems approach. Elsevier.

FLEXI CORE – II

ELC2220: OBJECT ORIENTED PROGRAMMING [3 0 0 3]

Introduction to fundamental concepts of programming language, Object Oriented Programming paradigm, Characteristics of object-oriented languages. Classes and Objects: Class specification, Class objects, Accessing Class Members, Static members, Constructors and Destructors, Parameterized constructors, Multiple Constructors, Friend function. Operator

Overloading & Type conversion: Defining operator overloading, Overloading Unary and Binary operators, Overloading using friend function, Type conversion: Basics to class type, class to basic type and class to another class type. Inheritance: Derived class and base class, Types of inheritance, Levels of Inheritance, Single inheritance, Multiple Inheritance, Hierarchical inheritance and Hybrid inheritance. Polymorphism: Virtual Functions: Pure function, Friend classes. Files and Exception Handling: Classes for file stream operation, Opening and closing a file, file modes, file pointers and manipulators. Exception handling mechanism: throwing, catching all the exceptions.

References:

1. E. Balagurusamy, "Object Oriented Programming with C++", (6e), Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 2013.
2. R. Lafore, "Object Oriented Programming in Turbo C++", (3e), Galgotia Publications Pvt. Ltd., New Delhi, 2006
3. S. B. Lippman, Josee Lajoie, Barbara E Moo, "C++ Primer",(5e), Addison-Wesley Professional, 2012
4. H. Schildt, "The Complete Reference C++", (4e), TMH, New Delhi, 2004.
5. J. Rumbaugh et. al, "Object Oriented Modeling and Design", PHI, 2004

ELC2221: MICROCONTROLLER BASED SYSTEM DESIGN [3 0 0 3]

Introduction to microprocessors and microcontrollers, general purpose and embedded systems, CISC and RISC architectures, AT89C51 (8051) microcontroller: Architecture, pin diagram, addressing modes, instruction set, programming, stack, subroutines, GPIO, timers, serial port, interrupts. Interfacing keyboard, LCD, ADC and DAC to 8051. Embedded software development in 'C'. Programming 8051 in 'C'. ARM7 based NXPLPC21XX microcontroller: architecture, programming and interfacing.

References:

1. M. A. Mazidi and G. Mazidi, The 8051 Microcontroller and embedded systems, using assembly and 'C', Pearson education, 2013.
2. K. Ayala, The 8051 Microcontroller and embedded systems, using assembly and 'C', Cengage Learning, 2009.
3. S. Furber, ARM System - on – Chip Architecture (2e), Pearson, 2015.
4. W. Hohl and H. Christopher, ARM Assembly Language, CRC Press, 2016.

PROGRAMME ELECTIVES

PROGRAM ELECTIVE – I

ELC2240: SOLAR PHOTOVOLTAIC SYSTEMS [3 0 0 3]

Solar Radiation: Spectrum, Terminologies, Measurement, Estimation; Sun-Earth Movement & Angles, Sun Tracking, PN Junction Diode & Characteristics, Solar Cell, Photovoltage, Light Generated Current, I-V equation & Characteristics: Short Circuit Current, Open Circuit Voltage, Maximum Power Point, Fill Factor, Efficiency, Losses, Equivalent Circuit, Effect of Series & Shunt Resistance, Solar Radiation, Temperature on Efficiency, Solar PV Modules: Series & Parallel connection, Hotspots, Bypass & Blocking Diodes, Power Output, Ratings, I-V & Power Curve, Effect of Solar Irradiation & Temperature, Balance of System (BOS): Batteries: Classification, Capacity, Voltage, Depth of Discharge, Life Cycle, Factors affecting

Battery Performance; Charge Controllers, DC to DC Converters, DC to AC converters, Maximum Power Point Tracking (MPPT).

References:

1. C. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Application, PHI New Delhi, 2009.
2. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa Publications New Delhi, 2013.

ELC2241: GENERATION, TRANSMISSION & DISTRIBUTION [3 0 0 3]

Generation of Electric Power: Hydro Electric Power Plants, Thermal and Nuclear Power Plants, Diesel Power Plant, Typical AC transmission and distribution scheme: Effect of system voltage and regulation, Distribution network elements, distribution schemes, Transmission Line Parameter Calculations, Transmission Line Performance, Ferranti effect, Power Factor Improvement, Mechanical characteristics of Overhead lines, Line Insulators, Corona , Underground cables.

References:

1. B. R. Gupta, Power System Analysis and Design (7e), S. Chand Publications, 2014.
2. C. L. Wadhwa, Electrical Power System (3e), New Age Intl., 2013.
3. D. P. Kothari & I. J. Nagrath, Power System Engineering (2e), TMH, 2010.
4. S. N. Singh, Electric Power Generation, Transmission and Distribution (6e), PHI, 2014

ELC2242: GRAPH THEORY & APPLICATIONS [3 0 0 3]

Introduction: Graphs, Regular graph, Finite and Infinite graphs, Incidence and degree, vertex, and null graph. Paths and Circuits: Isomorphism, Walk, Cycle, Paths and circuits, Simple and proper circuit, Connected and disconnected graph, Euler graphs, Operations on graphs. Trees and Fundamental Circuits: Trees, Properties of tree, Pendant vertices in a tree, Distance, and centers in a tree, Spanning tree. Cut sets and cut vertices: Cut sets, Properties of cut-set, all cut sets in a graph. Planer graph and dual graphs: Planar graphs, Homeomorphic graph, Different representation of a planar graph. Coloring, covering, and partitioning. Directed Graphs: Directed graph, Diagraph and binary relations, Directed Paths. Applications of Graph.

References:

1. Deo Narsingh, Graph Theory with applications to Engineering and Computer Science, Dover Publications Inc, (2016).
2. Parmenter Michael M., Goodaire Edgar G., Discrete Mathematics with Graph Theory, Pearson Education India (2015).
3. Rosen Kenneth H. Discrete Mathematics and its Applications, McGraw Hill Education (2017).
4. Bondy, J.A. Murty U.S.R., Graph theory and Applications, North Holland Publications (1995).

OPEN ELECTIVES

OPEN ELECTIVES – I

ELC0001: FUNDAMENTALS OF ELECTRIC VEHICLES [3 0 0 3]

History of electric vehicles (EV) and hybrid electric vehicles (HEV), need and importance of EV and HEV, comparison between IC engine and electric vehicle. Vehicle Fundamental: General description of vehicle movement rolling resistance, aerodynamic drag, grading resistance, acceleration resistance, dynamic equation. Electric Vehicle: Configuration of electric vehicle, electric propulsion unit - DC machines (BLDC & BDC), three phase induction machines, switched reluctance machines. Energy Source System: Types of batteries, parameters, BMS. types of charger, conductive charging, inductive charging, level 1, 2 & 3 charging scheme, charging technology for Electric vehicle charging station, converter topologies. Charging methods: constant current (CC), constant voltage (CV), constant power (CP), fast charging strategies of an EV battery.

References:

1. S. Rajkaruna, F. Shahnia, Plug in Electric Vehicles in Smart Grids, Springer, 2015.
2. S. Dhameja, Electric Vehicle Battery Systems, (1e), Newnes, 2001.
3. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC Press, 2009.
4. R. N. Jazar, Vehicle dynamics: theory and application, Springer, 2017.
5. J. Larminie, J. Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
6. P. Krause, O. Wasynczuk, S. D. Sudhoff and S. Pekarek, Analysis of Electric Machinery and Drive Systems (3e), Wiley-IEEE Press, 2013.

ELC0002: FUNDAMENTALS OF SOLAR PV SYSTEM [3 0 0 3]

Solar Radiation: Spectrum, Terminologies, Measurement, Estimation; Sun-Earth Movement & Angles, Sun Tracking, PN Junction Diode & Characteristics, Solar Cell, Photovoltage, Light Generated Current, I-V equation & Characteristics: Short Circuit Current, Open Circuit Voltage, Maximum Power Point, Fill Factor, Efficiency, Losses, Equivalent Circuit, Effect of Series & Shunt Resistance, Solar Radiation, Temperature on Efficiency, Solar PV Modules: Series & Parallel connection, Hotspots, Bypass & Blocking Diodes, Power Output, Ratings, I-V & Power Curve, Effect of Solar Irradiation & Temperature, Balance of System (BOS): Batteries: Classification, Capacity, Voltage, Depth of Discharge, Life Cycle, Factors affecting Battery Performance; Charge Controllers, DC to DC Converters, DC to AC converters, Maximum Power Point Tracking (MPPT).

References:

1. C. Solanki, Solar Photovoltaics: Fundamentals, Technologies and Application, PHI New Delhi, 2009.
2. G. N. Tiwari, Solar Energy: Fundamentals, Design, Modeling and Applications, Narosa Publications New Delhi, 2013.
3. S. Deambi, Photovoltaic System Design, CRC Press USA, 2016.
4. F. Kreith and D. Y. Goswami, Energy Management and Conservation Handbook (2e), CRC Press USA, Fairmont Press, USA, 2017.
5. J. Balfour, M. Shaw and N. B. Nash, Advanced Photovoltaic Installations, Jones & Barlett Learning USA, 2013.