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

B. Tech. (Electrical & Electronics Engineering) Syllabus

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

THIRD SEMESTER

EEE2101: 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.

EEE2102: ELECTRICAL MACHINES [3 1 0 4]

Transformers: Single phase & Three phase transformers - introduction, equivalent circuit, voltage regulation, parallel operation, DC Machines: - working principle, construction, types, armature reaction, commutation, characteristics, Starting & speed control methods of DC motor. BLDC motor: construction & working principle, Application in Electric Vehicle. Induction Machines: single-phase & three-phase Induction machine, construction, type and working principle, equivalent circuit, losses and efficiency, torque-slip characteristics, no load & blocked rotor tests, starting, speed control, Induction generator, Synchronous Machines: construction and working principle, Synchronization, Two reaction theory, Starting methods of Synchronous motor. Active and Reactive power control.

References:

1. Fitzarald & Kingslay, Electric Machinery, TMH, 2011.
2. P. S. Bhimbra, Electrical Machinery, Khanna Publication, 2011.
3. D. P. Kothari & I. J. Nagrath, Electric Machines (4e), TMH, 2013.
4. E. H. Langsdorf, Theory of Alternating Current Machinery (2e), TMH, 2004.

EEE2103: 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.

EEE2130: ELECTRICAL MACHINERY LAB [0 0 2 1]

Open circuit and short circuit tests on single phase transformer, Polarity tests and connection of single phase transformers as three phase bank, Parallel operation of two single phase transformers, No load & blocked rotor tests on single phase IM, Load test on single phase IM, No load & blocked rotor tests on three phase IM, Load test on three phase IM, Study of torque-slip characteristics by varying rotor resistance, Load test on induction generator, Magnetization characteristics of DC generator, Characteristics of Compound generator, speed control of DC shunt motor, load test of DC shunt motor, OCC and SCC of Synchronous generator, synchronization of Synchronous generator. Study of BLDC Motor.

References:

1. D. P. Kothari & I. J. Nagrath, Electric Machines (4e), TMH, 2013.
2. E. H. Langsdorf, Theory of Alternating Current Machinery (2e), TMH, 2004.

EEE2131: 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.

EEE2170: 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

EEE2201: SENSORS & SENSOR CIRCUITS [3 1 0 4]

Unit-1 Electrical instrumentation, characteristics, Errors in Measurements, instrumentation transformers, Moving Coil and Moving Iron Instruments. Unit-2 Electrical Sensor and their classification, Hall effect sensor, CT, PT. Thermal Sensors: Thermistors, Resistance Temperature Detector, Thermocouples. Mechanical Sensors: Displacement LVDT, Pressure sensors, Flow sensors. Unit-3 Design of temperature indicator using IC sensors, Errors due to resistance drift, effects of Op amp offset voltage drift, offset current drift. Error budgeting. Practical design of 4-20 mA current transmitter for resistance sensors and LVDT sensor. Practical designing of a capacitor measurement circuit. Ratio transformer technique, Differential capacitor measurement. Errors in the capacitance measurement. Unit-4 Instrumentation amplifier, Phase sensitive detection and use of the same for lock in amplifier design. Analog and Digital Signal Conditioning: Principles of analog signal conditioning, Signal-Level and Bias Changes, Linearization, Conversions, Filtering and Impedance Matching, Concept of Loading.

References:

1. P. Horowitz & W. Hill, The Art of Electonics (2e), Cambridge University Press, 1992.
2. C. D. Johnson, Process Control Instrumentation Technology (6e), Prentice Hall International Edition, 1999.
3. J. G. Webster., Measurement, Instrumentation, and Sensors Handbook, CRC Press, Taylor & Francis Group, 2014.
4. R. B. Northrop, Introduction to Instrumentation and Measurement (3e), CRC Press, Taylor & Francis Group, 2014.
5. M.K. Gunasekaran, Circuits for Analog System Design, NPTEL, IISc Bangalore.

EEE2202: GENERATION, TRANSMISSION & DISTRIBUTION [3 1 0 4]

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, receiving end power circle diagram, regulated system of transmission by reactive power control, 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

EEE2230: VIRTUAL INSTRUMENTATION LAB [0 0 2 1]

Introduction to MATLAB: Basics of MATLAB matrices and vectors, variables, arrays, conditional statements, loops, functions, and plots. Mathematical modelling & time domain analysis of first order and second order electrical system. Modeling and Simulation with SIMULINK: Analysis of electrical circuits-based system: Half wave, full wave rectifier and

armature voltage control of DC motors - Familiarization of graphical design tools. Review of Virtual Instrumentation, VI Programming Techniques- Concepts in graphical programming, VIs, Components of VI and sub-VIs, Data Acquisition Basics, Common Instrument Interfaces, Real time Control in VI.

References:

1. D. Hanselman, Mastering MATLAB 7, Pearson Education, 2012.
2. S. J. Chapman, Essentials of MATLAB Programming, BAE Systems (3e), Cengage Learning, 2017.
3. S. L. Eshkavilov, MATLAB & Simulink Essentials: MATLAB & Simulink for Engineering Problem Solving and Numerical Analysis, Lulu Publishing, 2017.
4. E. Nesimi, LabVIEW for electric circuits, machines, drives, and laboratories., Prentice Hall Professional, 2002.

EEE2231: 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.

EEE2270: 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

EEE2120: 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.

EEE2121: ELECTROMAGNETIC FIELD THEORY [3 0 0 3]

Vector analysis: Vector algebra, Rectangular, Cylindrical and Spherical Coordinates. **Electrostatics:** Field intensity, Flux density, Electric scalar potential, Potential gradient, Energy density in an electric field, Boundary conditions, Capacitances, Laplace's and Poisson's equations. **Magnetostatics:** Field intensity, Flux density, Boundary conditions, Magnetic forces, Inductance. **Time-varying fields:** Maxwell's equations. **Uniform Plane wave:** Wave equation and its solution, Wave propagation in different media, Poynting's theorem, reflection of a plain wave in a normal incidence. Introduction to Transmission Lines and waveguides.

References:

1. W. Hayt, Engineering Electromagnetics, TMH, 2012.
2. M. Sadiku, Elements of Electromagnetics, Oxford University Press, 2014.
3. N. Rao, Elements of Engineering Electromagnetics, Pearson Education, 2006.
4. D.K. Cheng, Fields, Waves and Electromagnetics, (2e), Addison Wesley, 2014

FLEXI CORE – II

EEE2220: 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

EEE2221: 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

EEE2240: 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.

EEE2241: ENGINEERING SYSTEMS MODELLING [3 0 0 3]

Basic Introduction to Systems: Definitions and Classification of Systems, Analysis and Synthesis, Linear and Nonlinear Systems, Time-Varying and Time-Invariant Systems, Continuous-Time and Discrete-Time Systems, Deterministic and Stochastic Systems. Systems Modelling: Classification of Models, Characteristics of Models, Fundamental Hypothesis and Component Postulate, Model Evaluation, Model Reduction, Generic Description of Two-Terminal Components. Mathematical Modelling of Physical Systems: Review of Transfer Function Approach and State Space Approach, Modelling Examples of Mechanical Systems - Translational and Rotational Motion Systems, Electrical Systems, Electromechanical Systems, Hydraulic Systems, Thermal Systems. Modelling & Simulation using MATLAB.

References:

1. K. Ogata, System Dynamics, Pearson Education India, 2014.
2. C. A. Kluever, Dynamic Systems: Modeling, Simulation, and Control, (2e), Wiley, 2019.
3. V. P. Singh, System Modeling and Simulation, New Age International, 2009.
4. D. K. Chaturvedi, Modeling and Simulation of Systems using MATLAB and Simulink, CRC Press, 2010.

EEE2242: INTERNET OF THINGS [3 0 0 3]

Introduction to IoT: Definition and characteristics of IoT, Design of IOT: Physical design of IOT, Logical Design of IOT- Functional Blocks, communication models, communication APIs, Basics of Networking, Wireless Sensor Networks, Cloud computing. IoT Hardware and Software: Sensor and actuator, Humidity sensors, Ultrasonic sensor, Temperature Sensor, Arduino, Raspberry Pi, Communication Protocols, Sensor Networks, Integration of Sensors, and Actuators with Arduino, IOT and M2M: M2M, Difference and similarities between IOT and M2M, Introduction to SDN, SDN for IoT, Data Handling and Analytics. Challenges in IoT. IOT Applications. i) Lighting as a service (case study) ii) Intelligent Traffic systems (case study) iii) Smart Parking (case study) iv) Smart water management (case study).

References:

1. M. Miller, The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World(1e), Que, 2015.
2. R. Kamal, Internet of Things: Architecture and Design Principles, MacGra Hills, 2017.
3. H. David, IoT Fundamentals | Networking Technologies, Protocols, and Use Cases for the Internet of Things, Cisco Press,2017.

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.