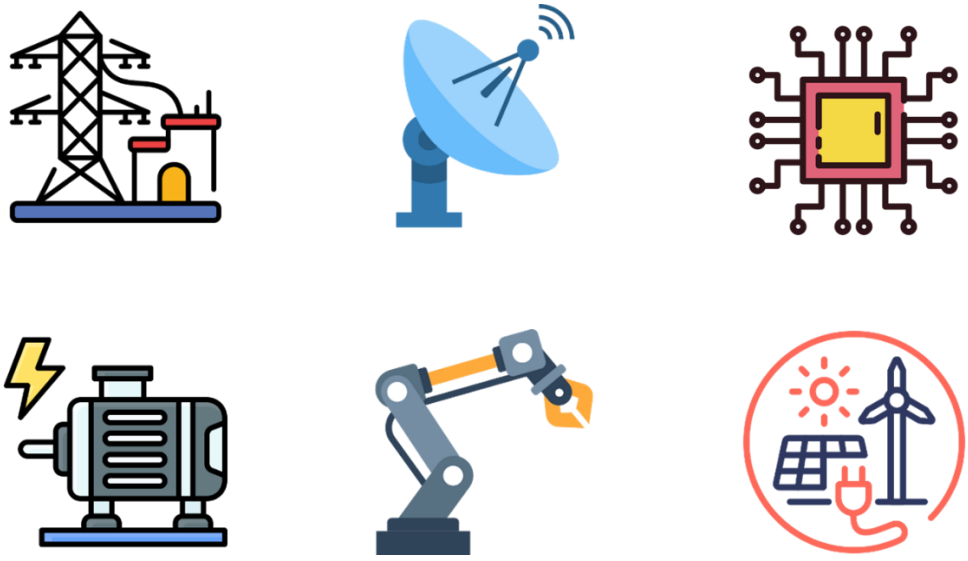
Syllabus

for

Master of Science (M. Sc.) in Electrical and Electronic Engineering (EEE)

(Effective from Academic Session, 2025 and onwards)



Department of Electrical and Electronic Engineering (EEE)

Hajee Mohammad Danesh Science and Technology University (HSTU)

Dinajpur-5200

Master of Science (M. Sc.) Degree Syllabus

Dept. of Electrical and Electronic Engineering (EEE)

Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur-5200

Board of Editors

Address of Correspondence

Chairman

Department of Electrical and Electronic Engineering (EEE)

Faculty of Computer Science and Engineering (CSE)

Hajee Mohammad Danesh Science and Technology University (HSTU)

Dinajpur-5200

Website: https://hstu.ac.bd/cse/eee

Email: chairman.eee@hstu.ac.bd, mdzamilsultan@hstu.ac.bd

Mobile: +88-01724216846

Basic Information

This Syllabus has been prepared according to the Ordinace for Awarding Master of Science (M. Sc.) Degree by Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur-5200, Bangladesh

1.1 Title of the Academic Degree

Master of Science (M. Sc.) in Electrical and Electronic Engineering (EEE)

1.2 Name of the University

Hajee Mohammad Danesh Science and Technology University (HSTU), Dinajpur, Bangladesh

1.3 Name of the Faculty offering the Degree

Faculty of Post Graduate Studies

1.4 Name of the Subject/Department offering the Degree

Department of Electrical and Electronic Engineering (EEE)

1.5 About the Department

The Department of Electrical and Electronic Engineering (EEE) is one of the most demanding and leading department at the Hajee Mohammad Danesh Science and Technology University (HSTU), Bangladesh. Initially it was established in 2004 in this University under the Faculty of Computer Science and Engineering. It commenced offering 4-years B.Sc. degree in Electrical and Electronic Engineering (EEE) in 2013. In addition to it's academic programs and research activities, the department organizes a range of extracurricular and outreach activities, such as EEE-based project design competitions, technical workshops, academic seminars, cultural programs as well as both indoor-outdoor sports events through the EEE CLUB of HSTU. We feel proud that our students participate regularly to various intra- and inter university different EEE-based project competitions, and receives awards successfully. Our graduates are making significant contributions to the national economy and development by serving in a broad spectrum of public and private sector roles. They are employed in core engineering fields such as power systems, electronics, telecommunications, and automation, as well as in non-engineering domains including banking, administration, and ICT services. Morever, our alumni continue to enhance the global reputation of the department through

their achievements in both research and professional careers across a wide range of countries, including USA, Australia, Germany, Japan and many others. Prospective students are warmly welcomed to be become a part of EEE family, HSTU and contribute to our enduring legacy of academic excellence, innovation, and societal impact.

2. Admission requirements to enroll Master of Science (M. Sc.) degree:

As per University rules

2.1 The candidate for admission to Master of Science (M. Sc.) in Electrical and Electronic Engineering (EEE) Course must possess a concerning Bachelor of Science (B. Sc.) degree from this University or an equivalent degree from other reputed University.

2.2 The candidate having passed a Bachelor degree in Annual-Course system must have secured a minimum mark of 50% of total marks studied in the concerned subject too.

2.3 The candidate having passed a Bachelor degree in Course-Credit system must have secured a minimum GPA of 2.5 out of 4.0 or 3.5 out of 5.0 and a C+ or equivalent grade in the concerned subject too.

2.4 Admission forms should be submitted to the Dean, Faculty of Post Graduate Studies.

2.5 There must be taken signatures of the Chairman of the Department and proposed Supervisor in the before submittion of the admission forms.

3. Admission requirements for Foreign Students:

3.1 A foreign student seeking admission to the M. Sc. course shall have a bachelor degree in the respective field. He/She should submit application through the respective government agencies to the Registrar, HSTU along with a certificate of proficiency in Engligh language (if necessary) and sources of fund. The admission shall be processed usual.

4. Duration of courses

4.1 An academic year shall consist of two semesters of six months each extending from January to June and from July to December. There shall be at least 14 working weeks in each semester covering instructions, assignments and examinations.

4.2 The duration of the course for the degree of M. Sc. shall be three consecutive semesters. However, two additional consecutive semesters may be allowed to a student if the Supervisor or Supervisory Committee (consisting of a supervisor and a .co-supervisor) and the Chairman of the relevant Department recommend and the recommendation is approved by the Dean, Faculty of Postgraduate Studies.

4.3 lf a student fails to obtain an M.Sc. degree in five consecutive semesters, his/her admission will stand cancelled.

5. Course requirements

5.1 Sixteen lectures/contact hours in a semester shall be considered as one credit hour. For practical classes three class hours shall be considered as one lecture/contact hour. Each credit hour shall carry 50 marks.

5.2 The number of credits for course work required for each candidate shall be specificd by the relevant Academic Committee. Minimum total credit requirement shall be 40. Out of this, at least 24 credits shall be ecourse work and 16 for the research work.

5.3.1 A student shall be required to complete two types of theory courses, which are as follows:

Compulsory	: 16 credits
Elective	: 8 credits
Total Credits	**: 24 Credits**

5.3.2 Credits for research work shall ordinarily have following distribution:

First semester	: 3 credits
Second semester	: 3 credits
Third or last semester	: 2 credits
Thesis evaluation in last semester	: 5 credits
Thesis defense in last semester	: 3 credits
Total Credits	**: 16 credits**

5.6 A student shall have to enroll for a minimum of 12 credits (Excluding thesis credits) in a Semester.

5.8 The thesis will be evaluated as follows:

a) Quality of thesis (5 Credits) : 250 marks

b) Thesis defense (3 Credits) : 150 marks

6 Examination procedure:

As per University rules

7 Evaluation system

7.1 All courses will be evaluated in percentageof the total marks in the following manner:

a) Classroom examination : 40% of the total marks

b) Report writing, homework or any other assessment : 20% of the total marks

c) Final examination : 40% of the total marks

Total : 100% of the total marks

7.2 Grading System and Grading Scales

Marks	Letter Grade	Grade Point
80% or above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	D	2.00
less than 40%	F	0.00

7.3 Cumulative Grade Point Average (CGPA) Calculation System

As per University rules

Syllabus Structure

Master of Science (M. Sc.) in Electrical and Electronic Engineering (EEE)

Duration of the Program: 1.5 years

Total Number of Semesters: 3 (2 Semesters per year)

Summary of number of credits/semester	
Semester	**Credit**
First Semester	15.00
Second Semester	15.00
Third Semester	10.00
Total Credits	**40.00**

Course Layout

First Semester		
Course Code	**Course Title**	**Credit**
EEE 501	Advanced Semiconductor Devices and Technology	3.00
EEE 503	Advanced Power System Stability and Control	3.00
EEE 505	Research Methodology in Engineering	2.00
EEE 5**	Two Courses From Elective Courses- I	2.00
EEE 5**		2.00
EEE 500 A	Research (Satisfactory/Unsatisfactory)	3.00
	Total Credits	**15.00**

Second Semester		
Course Code	**Course Title**	**Credit**
EEE 551	Renewable Energy Technology and Smart Grid	3.00
EEE 553	Artificial Intelligence and Machine Learning	3.00
EEE 555	Microwave Engineering and Antenna Array	2.00
EEE 5**	Two Courses From Elective Courses- II	2.00
EEE 5**		2.00
EEE 500 B	Research (Satisfactory/Unsatisfactory)	3.00
	Total Credits	**15.00**

Third Semester (Thesis and Research)		
Course Code	**Course Title**	**Credit**
EEE 500	C. Thesis Work	2.00
	D. Thesis Evaluation	5.00
	E. Thesis Defense	3.00
	Total Credits	**10.00**

List of Elective Courses -I

Two Courses will be selected for First Semester		
Course Code	**Course Title**	**Credit**
EEE 507	Robotics and Embedded Systems	2.00
EEE 509	Advanced Optical Fiber Communication	2.00
EEE 511	High Voltage Engineering	2.00
EEE 513	Advanced Power Electronics	2.00
EEE 515	Industrial Process Instrumentations and PLC	2.00
EEE 517	Material Science and Engineering	2.00
EEE 519	Advanced Digital Signal and Image Processing	2.00
EEE 521	Economics and Planning for Energy System	2.00
EEE 523	IoT and Smart Systems	2.00
EEE 525	Advanced Electrical Machine Technology	2.00
EEE 527	Power Plant Design and Maintenance	2.00
EEE 529	Telecommunication Installation and Maintenance	2.00

List of Elective Courses -II

Two Courses will be selected for Second Semester		
Course Code	**Course Title**	**Credit**
EEE 557	Advanced VLSI and Nanotechnology	2.00
EEE 559	Biomedical Instrumentation and Engineering	2.00
EEE 561	Advanced Control System Engineering	2.00
EEE 563	Advanced Power System Protection	2.00
EEE 565	Biosensor and Bioelectronics	2.00
EEE 567	Advanced Digital Electronics	2.00
EEE 569	Advanced Solar Energy System	2.00
EEE 571	Nuclear Engineering	2.00
EEE 573	Advanced Radar and Satellite Engineering	2.00
EEE 575	Cybersecurity and AI in Power System	2.00
EEE 577	Electric Vehicle and Maintenance	2.00

Detailed syllabus

Master of Science (M. Sc.) in Electrical and Electronic Engineering (EEE)

First Semester	Total credit: 15 Credit Hours

EEE 501 - Advanced Semiconductor Devices and Technology (3.00 Credits)

Fundamentals of semiconductor physics, Energy band structures and carrier statistics, Charge carrier transport mechanism, Doping techniques and junctions, Wide bandgap compound semiconductors and devices, Organic-perovskites semiconductors and devices, Nano-electronics, Optoelectronics, Spintronics, Molecular electronics, 0-dimensional (0D) devices or quantum dots, 1-dimensional (1D) devices or quantum nanowires, 2-dimensional (2D) devices or quantum wells (QW), High electron mobility transistors (HEMTs), FinFETs, and TFETs, Semiconductor fabrication technologies, Thin film technology, MOSFETs and CMOS Technology, Emerging trends in semiconductor technology. Simulation-based performance analysis of wide bandgap semiconductor devices. Modeling and characterization of low-dimensional quantum semiconductor structures.

Reference Books:

1. *Solid State Electronic Devices, B. G. Streetman, S. K. Banerjee, 7th Edition, Pearson, 2015*
2. *Physics of Semiconductor Devices, S. M. Sze, K. K. Ng, 3rd Edition, Wiley, 2006*
3. *Semiconductor Devices: Basic Principles, Jasprit Singh, 1st Edition, Wiley, 2001*

EEE 503 - Advanced Power System Stability and Control (3.00 Credits)

Power System Stability, Types of Stability (Transient, Dynamic, Voltage), Stability Analysis Methods, Power System Modeling (Generators, Turbines, Governors, Transmission Lines), Small-Signal Stability, Lyapunov's Direct Method, Transient Stability Analysis, Equal Area Criterion, Energy Function Method, Rotor Angle Stability, Voltage Stability and Control, Power System Voltage Control Mechanisms, Reactive Power Compensation, Power Flow Control, FACTS Devices (SVC, TCSC, STATCOM, UPFC), Power System Stabilizers (PSS), Control of Inter-Area Oscillations, Multi-Machine System Stability, Control of Frequency and Active Power, Stability of Power Systems with Renewable Energy Integration, Simulation Tools for Power System Stability Analysis, Control Strategies for Modern Power Systems, Dynamic Response of Power Systems,

Applications in Smart Grid and Microgrid Stability. Simulation and stability assessment of multi-machine power systems under disturbances. Modeling and control of power system stability with facts and renewable energy integration.

Reference Books:

1. *Power System Stability and Control, Prabha Kundur, 2nd Edition, McGraw-Hill, 2022*
2. *Power System Control and Stability, P. M. Anderson, A. A. Fouad, 2nd Edition, Wiley-IEEE Press, 2003*
3. *Power System Dynamics and Stability, P. W. Sauer, M. A. Pai, 1st Edition, Prentice Hall, 1998*
4. *Power System Analysis, Hadi Saadat, 4th Edition, McGraw-Hill, 2020*

EEE 505 - Research Methodology in Engineering (2.00 Credits)

Introduction to Research Methodology, Types of Research, Research Design and Planning, Literature Review, Formulation of Hypothesis, Research Data Collection Methods, Sampling Techniques, Data Analysis and Interpretation, Statistical Tools in Research, Experimental Design, Research Ethics, Technical Report Writing, Scientific Publications, Presentation of Research Findings, Use of Research Software, Case Studies in Engineering Research. Conduct a comprehensive literature review on a relevant research topic and prepare a well-structured review paper with proper formatting, citations, and academic practices.

Reference Books:

1. *Research Methodology: Methods and Techniques, C. R. Kothari, G. Garg, 4th Edition, New Age International, 2019*
2. *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, John W. Creswell, 5th Edition, Sage Publications, 2018*
3. *Practical Research: Planning and Design, Paul D. Leedy, Jeanne Ellis Ormrod, 12th Edition, Pearson, 2021*

EEE 500 A - Research (3.00 Credits)

Research methodology, paper writing, literature review techniques, advanced data analysis, research ethics, statistical modeling, experimental design, simulation tools (MATLAB, COMSOL, ANSYS, SCAPS-1D etc.), research collaboration strategies, intellectual property rights, scientific publication process, open-access publishing, reproducibility in research.

Elective Courses - I for the First Semester

Two Courses will be selected

EEE 507 - Robotics and Embedded Systems (2.00 Credits)

Introduction to robotics, kinematics and dynamics of robotic systems, robotic actuators and sensors, control of robotic systems, robot motion planning, path planning algorithms, robotic vision, and perception, industrial robots and automation. Design and implementation of a real-time embedded system for autonomous robotic navigation.

Embedded systems fundamentals, microcontrollers and microprocessors, embedded system design, real-time operating systems (RTOS), embedded programming languages, interfacing sensors and actuators, communication protocols in embedded systems, hardware/software co-design, applications of robotics in automation, and robotics in industrial and service applications. Simulation and control of robotic arm systems with embedded sensor integration.

Reference Books:

1. *Introduction to Autonomous Robots, Nikolaus Correll, Bradley Hayes, 3rd Edition, MIT Press, 2022*
2. *Robotics: Control, Sensing, Vision, and Intelligence, K. S. Fu, R. C. Gonzalez, C. S. G. Lee, 1st Edition, McGraw-Hill, 1987*
3. *Embedded System Design, Peter Marwedel, 2nd Edition, Springer, 2011*

EEE 509 - Advanced Optical Fiber Communication (2.00 Credits)

Principles of optical communication, optical fiber types and structures, light propagation in optical fibers, fiber attenuation and dispersion, optical sources and detectors, modulation techniques in optical communication, multiplexing techniques (WDM, TDM), optical amplifiers (EDFA, Raman amplifiers), fiber-optic link design, signal degradation and mitigation techniques, optical fiber network architectures, coherent optical communication systems, optical switching and routing, error correction in optical communication, fiber optic communication standards, applications in high-speed data transmission, and future trends in optical fiber communication. Modeling and simulation of high-speed optical fiber communication links. Design and performance analysis of wdm-based optical networks using simulation tools.

Reference Books:

1. *Fiber-Optic Communication Systems, Govind P. Agrawal, 5th Edition, Wiley, 2021*
2. *Optical Fiber Communications: Principles and Practice, John M. Senior, 3rd Edition, Pearson, 2009*
3. *Optical Fiber Communications, Gerd Keiser, 5th Edition, McGraw-Hill, 2022*

EEE 511 - High Voltage Engineering (2.00 Credits)

Introduction to high voltage engineering, types of high voltage stress, breakdown mechanisms in gases, liquids, and solids, dielectric properties of materials, electrical insulation, high voltage testing techniques, generation of high voltages, measurement of high voltages, lightning and switching surges, overvoltage protection and insulation coordination, design of high voltage equipment, partial discharge measurement, high voltage cables and accessories, testing of high voltage equipment, high voltage standards and regulations, and applications in power transmission and distribution systems. Field study report on high voltage substation operations and equipments.

Reference Books:

1. *High Voltage Engineering, M. S. Naidu, V. Kamaraju, 5th Edition, McGraw-Hill India, 2013*
2. *High Voltage Engineering Fundamentals, E. Kuffel, W. S. Zaengl, J. Kuffel, 2nd Edition, Elsevier, 2000*
3. *High Voltage Engineering, C. L. Wadhwa, 3rd Edition, New Age International, 2012*

EEE 513 - Advanced Power Electronics (2.00 Credits)

Advanced power semiconductor devices (IGBT, MOSFET, GaN, SiC), DC-DC converters (buck, boost, buck-boost), AC-DC and DC-AC converters, advanced modulation techniques (PWM, space vector modulation), resonant converters, multilevel inverters, power factor correction techniques, control strategies for power electronic systems, thermal management in power electronics, protection and fault diagnosis, applications in renewable energy systems, electric vehicles, and motor drives, modeling and simulation of power electronic circuits, and integration of power electronics in smart grids and energy storage systems. Modeling and simulation of multilevel inverter topologies for renewable energy applications. Design and control of dc-dc converters using advanced modulation techniques for electric vehicle systems.

Reference Books:

1. *Power Electronics: Converters, Applications, and Design, Ned Mohan, Tore M. Undeland, William P. Robbins, 3rd Edition, Wiley, 2003*
2. *Fundamentals of Power Electronics, Robert W. Erickson, Dragan Maksimovic, 2nd Edition, Springer, 2001*
3. *Advanced Power Electronics Converters: PWM Converters Processing AC Voltages, E. P. Wiechmann, Bimal K. Bose, 1st Edition, Wiley-IEEE Press, 2020*
4. *Power Electronics: Circuits, Devices and Applications, Muhammad H. Rashid, 4th Edition, Pearson, 2013*

EEE 515 - Industrial Process Instrumentations and PLC (2.00 Credits)

Introduction to industrial process instrumentation, types of process variables (temperature, pressure, flow, level), measurement techniques and sensors, signal conditioning, control valves, pneumatic and hydraulic systems, process control loops, fundamentals of programmable logic controllers (PLC), PLC architecture and programming languages, PLC interfacing with sensors and actuators, PID control in industrial systems, industrial communication protocols, PLC applications in automation and control systems, integration of PLC with SCADA systems, and troubleshooting and maintenance of industrial control systems. Design and implementation of a plc-based process control system for industrial automation. Simulation and analysis of pid control in a multi-variable industrial process.

Reference Books:

1. *Process Control: Modeling, Design, and Simulation, B. Wayne Bequette, 1st Edition, Prentice Hall, 2003*
2. *Programmable Logic Controllers: Principles and Applications, John W. Webb, Ronald A. Reis, 5th Edition, Pearson, 2003*
3. *Industrial Instrumentation and Control, S. K. Singh, 3rd Edition, McGraw-Hill India, 2016*

EEE 517 - Material Science and Engineering (2.00 Credits)

Introduction to material science, atomic structure and bonding in materials, crystal structures and defects, mechanical properties of materials (stress-strain behavior, hardness, toughness), thermal properties, electrical and magnetic properties of materials, semiconductors and their applications, materials for energy storage and conversion, dielectric materials, optical properties of materials, material characterization techniques (XRD, SEM, TEM, spectroscopy), polymers, composites, and ceramics, material selection for electrical and electronic applications, material degradation and corrosion, nanomaterials and their applications, and advanced materials for future technologies.

Characterization and analysis of electrical and optical properties of advanced functional materials. Thermal and structural analysis of solar energy materials using ansys for photovoltaic applications.

Reference Books:

1. *Materials Science and Engineering: An Introduction, William D. Callister, David G. Rethwisch, 10th Edition, Wiley, 2020*
2. *Foundations of Materials Science and Engineering, William F. Smith, Javad Hashemi, 6th Edition, McGraw-Hill, 2010*
3. *Introduction to Materials Science for Engineers, James F. Shackelford, 8th Edition, Pearson, 2015*

EEE 519 - Advanced Digital Signal and Image Processing (2.00 Credits)

Digital signal processing fundamentals, Various discrete-time sequences, Various discrete-time systems, Convolution, Z-transform, Correlation, Discrete Fourier series, Discrete Fourier transform (DFT), Fast Fourier transform (FFT), FIR and IIR filter design, Adaptive filtering, multi-rate signal processing, Wavelet transform, Noise reduction techniques, Signal compression algorithms, Biomedical signal processing.

Image processing fundamentals, Image enhancement techniques, Image compression, Feature extraction, Edge detection, Image restoration, and applications in medical imaging and computer vision. Design and implementation of digital filters for noise reduction and signal enhancement in biomedical applications. Simulation and analysis of image processing techniques for medical imaging using Matlab or Python.

Reference Books:

1. *Digital Signal Processing: Principles, Algorithms, and Applications, John G. Proakis, Dimitris G. Manolakis, 4th Edition, Pearson, 2007*
2. *Discrete-Time Signal Processing, Alan V. Oppenheim, Ronald W. Schafer, 3rd Edition, Pearson, 2009*
3. *Digital Image Processing, Rafael C. Gonzalez, Richard E. Woods, 4th Edition, Pearson, 2018*

EEE 521 - Economics and Planning for Energy System (2.00 Credits)

Introduction to energy economics, energy market structures and pricing, cost-benefit analysis of energy projects, economic optimization in energy systems, energy demand forecasting, energy

supply and demand balance, electricity pricing models, capacity planning for energy systems, investment analysis in energy infrastructure, environmental and social considerations in energy planning, renewable energy integration and economics, economic impact of energy policies, risk assessment and uncertainty in energy planning, energy efficiency and conservation strategies, energy system reliability and resilience, and case studies on energy system planning and policy. Optimization and economic analysis of microgrid systems using HOMER/PVSyst/similar software. Modeling and forecasting electricity demand and pricing in competitive energy markets.

Reference Books:

1. *Energy Economics: Concepts, Issues, Markets and Governance, Subhes C. Bhattacharyya, 2nd Edition, Springer, 2019*
2. *Fundamentals of Energy Economics, Andrea Baranzini, 1st Edition, Springer, 2017*
3. *Planning and Operation of Energy Systems with Renewable Energy, Taha Selim Ustun, 1st Edition, Springer, 2020*

EEE 523 - IoT and Smart Systems (2.00 Credits)

Introduction to Internet of Things (IoT) architecture and components, IoT sensors and actuators, communication protocols for IoT, IoT data acquisition and processing, cloud computing and IoT integration, edge and fog computing in IoT systems, IoT security and privacy concerns, smart homes and buildings, smart grids and smart meters, industrial IoT (IIoT), IoT in healthcare and agriculture, IoT platforms and development tools, real-time systems in IoT, data analytics and machine learning for IoT, energy-efficient IoT systems, IoT protocols for automation, and case studies on IoT applications and smart systems design. Basic implementation and simulation of IoT sensor networks for smart home applications. Introduction to IoT data collection and visualization using cloud platforms.

Reference Books:

1. *Internet of Things: A Hands-On-Approach, Arshdeep Bahga, Vijay Madisetti, 1st Edition, Universities Press, 2014*
2. *Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Florian Michahelles, 1st Edition, Springer, 2011*
3. *Internet of Things (IoT): Principles, Paradigms and Applications of IoT, Bharat Bhushan, 1st Edition, Springer, 2022*

EEE 525 - Advanced Electrical Machine Technology (2.00 Credits)

Introduction to advanced electrical machines, design principles of synchronous and induction machines, permanent magnet synchronous machines (PMSM), brushless DC motors, switched reluctance machines, high-efficiency motors and generators, special electrical machines (linear motors, stepper motors, hysteresis motors, and reluctance machines), machine control techniques, variable frequency drives (VFD) for electrical machines, machine modeling and simulation, fault detection and diagnosis in electrical machines, thermal management in electrical machines, materials for advanced electrical machines, electrical machines for renewable energy systems, high-speed and high-torque machine design, electric vehicle traction motors, and emerging technologies in electrical machine design and applications. Modeling and simulation of permanent magnet synchronous machines (PMSM) for electric vehicle. Applications. Design and analysis of variable frequency drive (VFD) control strategies for induction motors.

Reference Books:

1. *Electrical Machines, Drives and Power Systems, Theodore Wildi, 6th Edition, Pearson, 2006*
2. *Electrical Machinery, P. S. Bimbhra, 7th Edition, Khanna Publishers India, 2011*
3. *A Textbook of Electrical Technology (Vol. 2: AC & DC Machines), B. L. Theraja, A. K. Theraja, 23rd Edition, S. Chand, 2013*
4. *Permanent Magnet Synchronous and Brushless DC Motor Drives, R. Krishnan, 1st Edition, CRC Press, 2009*

EEE 527 - Power Plant Design and Maintenance (2.00 Credits)

Introduction to power plant types and classifications, fundamental principles of thermal, hydro, nuclear, and renewable power plants, layout and design considerations, selection of equipment and materials, boiler and turbine design fundamentals, fuel handling systems, instrumentation and control systems, cooling systems design, maintenance strategies and scheduling, predictive and preventive maintenance techniques, failure analysis and troubleshooting, safety regulations and environmental considerations, case studies on modern power plants.

Design a schematic layout of a small-scale thermal or hydro power plant using basic design principles, including component selection, flow diagram, and maintenance plan with a fault diagnosis strategy.

Reference Books:

1. *Power Plant Engineering, P. K. Nag, 4th Edition, McGraw-Hill India, 2017*
2. *Power Plant Technology, M. M. El-Wakil, 1st Edition, McGraw-Hill, 1984*
3. *Thermal Engineering, R. K. Rajput, 10th Edition, Laxmi Publications India, 2016*

EEE 529 - Telecommunication Installation and Maintenance (2.00 Credits)

Introduction to telecommunication systems and networks, overview of analog and digital communication systems, transmission media including coaxial cable, fiber optics, and wireless systems, installation of network infrastructure and hardware components, tower and antenna installation procedures, grounding and lightning protection systems, configuration of switches, routers, and modems, structured cabling standards and techniques, signal testing and fault detection tools, preventive and corrective maintenance practices, safety procedures and regulatory compliance, documentation and reporting techniques, case studies on field installations and upgrades.

Prepare a technical report and schematic diagram for the installation of a small-scale telecommunication system (e.g., a local office network or cellular repeater setup), including component selection, cable layout, safety compliance checklist, and a maintenance plan with common fault scenarios and resolution strategies.

Reference Books:

1. *Telecommunication Switching, Traffic and Networks, J. E. Flood, 1st Edition, Pearson, 1998*
2. *Optical Fiber Communications, Gerd Keiser, 5th Edition, McGraw-Hill, 2022*
3. *Telecommunications: Principles and Practice, J. C. Bellamy, 5th Edition, Wiley, 2000*

Second Semester	Total credit: 15 Credit Hours

EEE 551 - Renewable Energy Technology and Smart Grid (3.00 Credits)

Introduction to Conventional and Renewable energy sources, Advanced knowledge about various renewable energy sources- like Solar Energy, Wind Energy, Hydropower, Biomass, Geothermal Energy, Ocean Energy and their availability, potentiality and suitability as a substitute for conventional energy resources in future energy demand.

Integration of Renewable Energy (Solar, Wind, Biomass, Hydropower) to Power grid system, Distributed Generation and Microgrids, Power Electronics for Renewable Energy Systems, Energy Storage Technologies (Batteries, Supercapacitors).

Smart Grid Fundamentals and Architecture, Key Components of Smart Grids-Smart Meters, AMI, Communication Networks. Smart Grid Communication Protocols, Demand Response and Load Management, Smart Grid Protection, Fault Detection, and Self-Healing, Power Quality and Reliability in Smart Grids, Optimization and Control of Smart Grids, Modeling and optimization of energy storage and demand response in smart grids for enhanced reliability. Field visit report on operational aspects and technological integration of a solar power plant.

Reference Books:

1. *Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, 4th Edition, Oxford University Press, 2012*
2. *Integration of Renewable Energy Sources into the Power Grid Through PowerFactory, Alfredo Vaccaro, Luigi Martirano, Pierluigi Siano, IEEE-Wiley, 2021*
3. *Smart Grids: Fundamentals and Technologies in Electricity Networks, Bernd M. Buchholz, Zbigniew A. Styczynski, 2nd Edition, Springer, 2020*

EEE 553 - Artificial Intelligence and Machine Learning (3.00 Credits)

Introduction to AI and ML, supervised and unsupervised learning, deep learning architectures (CNN, RNN, Transformers), reinforcement learning, AI for control and automation, AI hardware acceleration, federated learning, explainable AI, embedded AI for real-time applications, generative adversarial networks (GANs), evolutionary algorithms, AI-driven decision support systems, natural language processing for engineering applications, machine learning for predictive maintenance, AI

in robotics and autonomous systems, AI for smart grid management, optimization techniques in AI, ethical considerations and bias in AI. Implementation of ai-based techniques for power demand forecasting using real-world data sets. Forecasting solar power generation using machine learning techniques on historical solar data. Development and evaluation of machine learning models for predictive maintenance in industrial systems.

Reference Books:

1. *Artificial Intelligence: A Modern Approach, Stuart Russell, Peter Norvig, 4th Edition, Pearson, 2021*
2. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, Aurélien Géron, 3rd Edition, O'Reilly, 2022*
3. *Deep Learning, Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016*

EEE 555 - Microwave Engineering and Antenna Array (2.00 Credits)

Introduction to Antennas and Antenna Parameters; Fundamentals of Electromagnetic Theory for Antennas; Basics of Antenna Arrays and Pattern Multiplication; Uniform Linear Array (ULA) and Array Factor; Phased Array Antennas and Beam Steering; Beam Scanning Techniques and Phase Shifting; Array Design Parameters including Element Spacing, Sidelobes, and Half Power Beamwidth (HPBW); Grating Lobes and Null Placement; Types of Antenna Arrays such as Uniform, Non-uniform, Circular, and Planar Arrays; Broadside and End-Fire Array Configurations; Introduction to Beamforming; Time-Delay and Phase-Shift Beamforming; Digital Beamforming Techniques; Adaptive Beamforming using LMS and RLS Algorithms; MVDR and Capon Beamforming; Robust Beamforming and Diagonal Loading Techniques, Near-Field Challenges and Optimization in Beamforming, Applications of AI and Machine Learning in Beamforming Design; Beamforming Applications in 5G and mm Wave Systems; Beamforming in Massive MIMO and IoT; Beamforming in Satellite and Wireless Communications; Radar and Sonar Systems with a focus on Direction-of-Arrival (DOA) Estimation; MUSIC and ESPRIT Algorithms for Source Localization.

Microwave Frequency Bands and Propagation Basics; Microwave Antennas and Measurement Techniques. Simulation and analysis of phased array antennas with beam steering techniques for 5G applications. Implementation of adaptive beamforming algorithms (LMS/RLS) for direction-of-arrival estimation in wireless communication systems.

Reference Books:

1. *Microwave Engineering, David M. Pozar, 4th Edition, Wiley, 2012*
2. *Antenna Theory: Analysis and Design, Constantine A. Balanis, 4th Edition, Wiley, 2016*
3. *Phased Array Antenna Handbook, Robert J. Mailloux, 3rd Edition, Artech House, 2017*

EEE 500 B - Research (3.00 Credits)

Experimental research, data analytics, industry collaboration, research proposal writing, scientific presentation skills, grant writing, open-access publishing, reproducibility in research, peer-review processes, project management in research, commercialization of research outcomes, interdisciplinary research strategies.

Elective Courses - II for the Second Semester

Two Courses will be selected

EEE 557 - Advanced VLSI and Nanotechnology (2.00 Credits)

Introduction to VLSI Design, CMOS Technology and Scaling, VLSI Fabrication Process, Advanced Logic Design, High-Speed VLSI Circuits, Low Power VLSI Design, Analog and Mixed-Signal VLSI, VLSI Testing and Verification, Introduction to Nanotechnology, Nanomaterials and Nanostructures, Nanoelectronics and Nanosensors, Quantum Devices and Applications, Nanofabrication Techniques, Carbon Nanotubes and Graphene in VLSI, Applications of Nanotechnology in Electronics, Future Trends in VLSI and Nanotechnology. Design and simulation of low-power CMOS logic circuits and exploration of emerging nanotechnology applications in VLSI. Analysis of CMOS scaling challenges and the role of nanotechnology in future VLSI design.

Reference Books:

1. *CMOS VLSI Design: A Circuits and Systems Perspective, Neil H. E. Weste, David Harris, 4th Edition, Pearson, 2011*
2. *Fundamentals of Nanoelectronics, George W. Hanson, 1st Edition, Pearson, 2008*
3. *Nanotechnology for Microelectronics and Optoelectronics, Anatoli Korkin, Federico Rosei, 1st Edition, Elsevier, 2006*

EEE 559 - Biomedical Instrumentation and Engineering (2.00 Credits)

Introduction to Biomedical Instrumentation, Biological Signals and Measurements, Electrocardiogram (ECG) and Electroencephalogram (EEG), Bioelectrical Impedance and Impedance Cardiography, Medical Imaging Systems, Biomedical Sensors and Transducers, Patient Monitoring Systems, Signal Conditioning and Amplification, Medical Instrumentation for Diagnostics, Medical Devices and Safety Standards, Biomedical Data Acquisition and Processing, Rehabilitation Engineering, Telemedicine and Remote Monitoring, Applications of Biomedical Engineering in Healthcare. Design and simulation of a multi-channel ECG acquisition and filtering system using Matlab or Labview. Simulation and analysis of a biomedical patient monitoring system integrating sensor data for remote telemedicine applications.

Reference Books:

1. *Medical Instrumentation: Application and Design, John G. Webster, 4th Edition, Wiley, 2009*
2. *Introduction to Biomedical Engineering, John Enderle, Joseph Bronzino, 3rd Edition, Academic Press, 2012*
3. *Handbook of Biomedical Instrumentation, R. S. Khandpur, 3rd Edition, McGraw-Hill India, 2014*

EEE 561 - Advanced Control System Engineering (2.00 Credits)

Advanced control system concepts, state-space analysis and representation, controllability and observability, stability analysis using Lyapunov's method, root locus and frequency domain analysis, modern control theory (optimal control, LQR, LQG), robust control techniques (H∞ control, μ-synthesis), nonlinear control systems (describing functions, Lyapunov stability for nonlinear systems), adaptive control systems, sliding mode control, multivariable control systems, digital control systems, model predictive control (MPC), system identification, fault detection and diagnosis in control systems, and case studies in advanced control system design. Design and simulation of a model predictive controller for a multi-input multi-output (MIMO) process using Matlab/Simulink. Robust control design and performance analysis of an uncertain system using H∞ techniques in Matlab.

Reference Books:

1. *Modern Control Engineering, Katsuhiko Ogata, 5th Edition, Pearson, 2010*
2. *Robust and Optimal Control, Kemin Zhou, John C. Doyle, 2nd Edition, Prentice Hall, 1996*
3. *Nonlinear Systems, Hassan K. Khalil, 3rd Edition, Pearson, 2002*

EEE 563 - Advanced Power System Protection (2.00 Credits)

Introduction to power system protection, protection of transmission lines, transformers, generators, and buses, overcurrent and differential protection schemes, distance protection and impedance-based protection, numerical relays and digital protection systems, fault analysis and fault detection techniques, protection coordination and settings, relay communication and automation, protection of renewable energy systems, fault detection in distributed generation systems, high-voltage and high-current protection, protection against transient overvoltage and lightning, protection system reliability and security, protection schemes for smart grids, protection of power electronic devices and converters, and case studies in advanced power system protection. Simulation and coordination of overcurrent and differential protection for a power transformer using ETAP or Matlab/Simulink. Modeling and analysis of distance protection scheme for a transmission line under various fault scenarios using PSCAD or DIgSILENT powerfactory.

Reference Books:

1. *Power System Protection and Switchgear, B. Ravindranath, M. Chander, 2nd Edition, New Age International, 2012*
2. *Protective Relaying: Principles and Applications, J. Lewis Blackburn, Thomas J. Domin, 4th Edition, CRC Press, 2014*
3. *Power System Protection: Principles and Practice, The Electricity Training Association, 3rd Edition, IET, 1995*

EEE 565 - Biosensor and Bioelectronics (2.00 Credits)

Introduction to biosensors and bioelectronics, principles of biosensing, types of biosensors (enzymatic, immunosensors, and DNA sensors), transducers and their working principles (electrochemical, optical, piezoelectric, and thermal), signal processing in biosensor systems bioelectronic devices and their applications, biocompatibility and material selection for bioelectronics, bioelectronics in medical diagnostics, wearable bioelectronics and health monitoring, microelectromechanical systems (MEMS) in biosensors, lab-on-chip technologies, biosensors for disease detection (cancer, diabetes, etc.), bioelectronics for neural and muscle signal monitoring, biosensors in environmental monitoring, wireless biosensing and IoT integration, and future trends in biosensors and bioelectronics. Design and simulation of a glucose biosensor using electrochemical transducer model in COMSOL multiphysics or Matlab. Development of a wearable

health monitoring system integrating biosensor data with IoT-based wireless transmission using Proteus or Arduino.

Reference Books:

1. *Fundamentals of BioMEMS and Medical Microdevices, Stephen D. Senturia, 1st Edition, Springer, 2001*
2. *Biosensors and Bioelectronics, Bansi D. Malhotra, Anthony P. F. Turner, 1st Edition, Elsevier, 2018*
3. *Introduction to Bioelectronics: Materials, Devices and Applications, Jingquan Liu, 1st Edition, Springer, 2012*

EEE 567 - Advanced Digital Electronics (2.00 Credits)

Advanced digital circuit design, logic families (CMOS, TTL, and BiCMOS), high-speed digital circuits, combinational and sequential circuit design, finite state machines (FSM) and their design, digital circuit optimization techniques, synchronous and asynchronous design, digital filters and signal processing, error detection and correction codes (Hamming, CRC), FPGA and CPLD architectures, digital system design using hardware description languages (HDL), synthesis and simulation of digital circuits, digital timing analysis and synchronization, digital system integration, low-power design techniques in digital electronics, high-performance digital systems, and emerging trends in digital electronics such as quantum computing and neuromorphic computing. Design and FPGA-based implementation of a pipelined digital signal processing system using VHDL/Verilog. Low-power FSM design and simulation for real-time embedded applications using Xilinx Vivado or Quartus.

Reference Books:

1. *Digital Design and Computer Architecture, David Money Harris, Sarah L. Harris, 2nd Edition, Morgan Kaufmann, 2012*
2. *Fundamentals of Digital Logic with VHDL Design, Stephen Brown, Zvonko Vranesic, 3rd Edition, McGraw-Hill, 2009*
3. *Digital Electronics: Principles, Devices and Applications, Anil K. Maini, 1st Edition, Wiley, 2007*

EEE 569 - Advanced Solar Energy System (2.00 Credits)

Advanced principles of photovoltaic (PV) systems, solar cell technologies (monocrystalline, polycrystalline, thin-film), maximum power point tracking (MPPT) techniques, solar energy conversion efficiency, design and optimization of grid-connected and off-grid PV systems, solar inverters and power electronics, integration of solar power with energy storage systems, hybrid solar

energy systems, solar thermal systems and applications, concentrated solar power (CSP) technology, performance analysis and testing of solar energy systems, system reliability and maintenance, modeling and simulation of solar energy systems, solar energy economics and grid integration challenges, and emerging technologies in solar energy (perovskite solar cells, tandem solar cells, etc.). Modeling and simulation of a grid-connected pv system with mppt and battery storage using Matlab/Simulink. Performance analysis and optimization of a hybrid solar-diesel microgrid using HOMER or PVSyst.

Reference Books:

1. *Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, 4th Edition, Wiley, 2013*
2. *Fundamentals of Solar Cells: Photovoltaic Solar Energy Conversion, Alan L. Fahrenbruch, Richard H. Bube, 1st Edition, Academic Press, 1983*
3. *Photovoltaic Systems, James P. Dunlop, 3rd Edition, Pearson, 2012*

EEE 571 - Nuclear Engineering (2.00 Credits)

Introduction to nuclear engineering, principles of nuclear fission and fusion, nuclear reactions and cross-sections, neutron transport theory, nuclear reactors and their types (pressurized water reactor, boiling water reactor, fast breeder reactors), reactor control and safety systems, radiation detection and measurement, shielding and protection from radiation, nuclear fuel cycles, nuclear waste management, nuclear power plant operations and economics, nuclear instrumentation and control, applications of nuclear energy in medicine, industry, and power generation, environmental and regulatory aspects of nuclear energy, and future trends in nuclear energy technologies (including fusion energy and small modular reactors). Comparative survey of nuclear reactor types with simulation of core thermal behavior using open-source tools. Comprehensive study and analysis of the Bangladesh Rooppur nuclear power plant: design, operation, and strategic importance.

Reference Books:

1. *Introduction to Nuclear Engineering, John R. Lamarsh, Anthony J. Baratta, 4th Edition, Pearson, 2017*
2. *Fundamentals of Nuclear Reactor Physics, Elmer E. Lewis, 1st Edition, Academic Press, 2008*
3. *Nuclear Reactor Physics, Weston M. Stacey, 2nd Edition, Wiley-VCH, 2007*

EEE 573 - Advanced Radar and Satellite Engineering (2.00 Credits)

Principles of radar systems, radar signal propagation, Doppler effect in radar, radar waveforms and modulation techniques, radar antennas and beamforming, radar detection and tracking, radar system performance and optimization, advanced radar techniques (synthetic aperture radar, phased array radar, pulse compression), radar signal processing (clutter suppression, target detection, tracking algorithms), satellite communication systems, satellite orbits and constellations, satellite payloads and transponders, satellite link budget and performance analysis, ground station technologies, remote sensing and Earth observation satellites, GPS and GNSS systems, integration of radar and satellite technologies, and emerging trends in radar and satellite engineering. Design and simulation of a phased array radar beamforming system using Matlab/Simulink. Survey and operational analysis of the bangladesh satellite-1 (BS-1): capabilities, applications, and strategic impact.

Reference Books:

1. *Introduction to Radar Systems, Merrill I. Skolnik, 3rd Edition, McGraw-Hill, 2001*
2. *Radar Systems Analysis and Design Using MATLAB, Bassem R. Mahafza, 3rd Edition, CRC Press, 2013*
3. *Satellite Communications, Dennis Roddy, 4th Edition, McGraw-Hill, 2006*

EEE 575 - Cybersecurity and AI in Power System (2.00 Credits)

Introduction to cybersecurity in power systems, cyber threats and vulnerabilities in smart grids, risk assessment and management for power systems, encryption and authentication techniques in power system communication, intrusion detection and prevention systems (IDPS) for critical infrastructure, secure communication protocols for power system control, AI techniques for anomaly detection and intrusion detection in power systems, machine learning for predictive maintenance and fault detection, AI-driven optimization for power system operation, cyber-physical system modeling and simulation, integration of AI and cybersecurity in smart grid protection, blockchain for secure energy trading, and case studies on cybersecurity incidents in power systems. Global survey of cybersecurity threats to power systems and strategies for prevention and mitigation. Case study and risk assessment of cybersecurity threats in power system communication networks with AI-based anomaly detection.

Reference Books:

1. *Cybersecurity for Critical Infrastructures: A Risk-Based Approach, Nozari, Kott, Wang, 1st Edition, Springer, 2022*

2. *Smart Grid Security: Innovative Solutions for a Modernized Grid, Florian Skopik, Paul Smith, 1st Edition, Elsevier, 2015*
3. *Artificial Intelligence Applications in Power Systems, Kevin Warwick, Arthur Ekwue, Raj Aggarwal, 1st Edition, IET, 1997*

EEE 577 - Electric Vehicle and Maintenance (2.00 Credits)

Introduction to electric vehicle (EV) architecture and types, EV powertrain components, battery technologies and management systems, motor types and control strategies, regenerative raking systems, charging infrastructure and standards, thermal management in EVs, diagnostic tools and software, preventive and corrective maintenance of batteries and motors, troubleshooting EV subsystems, safety protocols in EV handling, sustainability and environmental impacts, overview of EV industry trends and future prospects.

Perform a case study analysis of a selected electric vehicle model, detailing its architecture, battery system, motor control mechanism, and propose a routine maintenance schedule including diagnostic methods and troubleshooting steps.

Reference Books:

1. *Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, 3rd Edition, CRC Press, 2021*
2. *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, 3rd Edition, CRC Press, 2018*
3. *Electric Vehicle Technology Explained, James Larminie, John Lowry, 2nd Edition, Wiley, 2012*

Third (Thesis and Research) Semester	Total credit: 10 Credit Hours

EEE 500 C - Thesis Work (2.00 Credits)

Independent research on selected topics in electrical engineering, experimental validation, simulation studies, interdisciplinary collaboration, progress report submission.

EEE 500 D - Thesis Evaluation (5.00 Credits)

Submission of research work, peer review, plagiarism check, technical writing quality assessment, research impact evaluation, revision and resubmission process.

EEE 500 E - Thesis Defense (3.00 Credits)

Oral defense, external examiner evaluation, viva voce, technical question handling, thesis presentation, publication requirements, research dissemination strategies.

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