M.Sc. in Power Engineering & Sustainable Energy Curriculum

Thesis Track (34 Credit Hours):

A. Mandatory Courses (25 Credit Hours):

Course No.	Course Title	Credit Hours	Prerequisite
24700	Seminar & Research Methodology	1	-
24720	Power Systems & Renewable Energy Resources	3	-
24740	Smart Grids	3	-
24730	Energy Storage Systems	3	-
24711	Advanced Power Electronics and Applications	3	-
24741	Artificial intelligence for Energy Systems	3	-
24799	MS Thesis	9	Finish 12 Credits + (Co-requisite) 22700

B. Elective Courses (9 Credit Hours):

Course No.	Course Title	Credit Hours	Prerequisite
24780	Special Topics in Power & Energy Engineering (1)	3	-
24781	Special Topics in Power & Energy Engineering (2)	3	-
24712	Renewable Energy Grid-Integration	3	-
24731	Low Inertia Systems	3	-
24721	Power Quality & System Reliability	3	-
24702	Distributed Generation	3	-
24703	Protection of Power Systems	3	-

Course No.	Course Title	Credit Hours	Prerequisite
24706	Power System Control & Stability	3	-
24709	Flexible AC Transmission System (FACTS) devices and applications	3	-
24770	Optimal Control	3	-
20702	Mathematical Modeling and Optimization	3	-
25710	Wireless Networks Technologies	3	-
24713	Electric Machines and Drives	3	-
27750	Digital Signal Processing	3	-
24732	Energy Economics	3	-

Non-Thesis Track (34 Credit Hours):

A. Mandatory Courses (25 Credit Hours):

Course No.	Course Title	Credit Hours	Prerequisite
24700	Seminar & Research Methodology	1	-
24720	Power Systems & Renewable Energy Resources	3	-
24740	Smart Grids	3	-
24713	Electric Machines and Drives	3	-
24711	Advanced Power Electronics and Applications	3	-
24741	Artificial intelligence for Energy Systems	3	-
24730	Energy Storage Systems	3	-
24706	Power System Control & Stability	3	-
24790	Master Project	3	Finish 22 Credits (including 24700)
24791	Comprehensive Exam	0	Per Exam Regulations

B. Elective Courses (9 Credit Hours):

Course No.	Course Title	Credit Hours	Prerequisite
24780	Special Topics in Power & Energy Engineering (1)	3	-
24781	Special Topics in Power & Energy Engineering (2)	3	-
24731	Low Inertia Systems	3	-
24721	Power Quality & System Reliability	3	-
24702	Distributed Generation	3	-
24703	Protection of Power Systems	3	-
24709	Flexible AC Transmission System (FACTS) devices and applications	3	-
24770	Optimal Control	3	-

Course No.	Course Title	Credit Hours	Prerequisite
20702	Mathematical Modeling and Optimization	3	-
25710	Wireless Networks Technologies	3	-
24712	Renewable Energy Grid-Integration	3	-
27750	Digital Signal Processing	3	-
24732	Energy Economics	3	-

*** Course Description:**

24700	**Seminar & Research Methodology**
	Pre-requisite: None
	Credit Hours: 1
	This course aims to expose students to the most current developments and trends in the field of electrical engineering. It also aims to improve students' presentation, communication, and writing skills. In addition, the seminar covers basic research methodologies to prepare students for their master's thesis and provides them with a forum to represent their research work and offer critiques of others' work.

24720	**Power Systems & Renewable Energy Resources**
	Pre-requisite: None
	Credit Hours: 3
	Power Systems: Introduction to electric power systems, Structure of Electrical Energy Systems, Power System Components, Per Unit, Power flow calculations, symmetrical fault currents, Load modelling. Renewable Energy Resources: Overview about different Renewable Energy Resources, Solar PV systems, Solar thermal systems, Wind Energy

24740	**Smart Grids**
	Pre-requisite: None
	Credit Hours: 3
	Introduction to Smart Grids, Integration of low-carbon technologies, Decarbonization of heat and transport, Flexibility in low carbon electricity systems, Introduction to Electric Distribution Networks, Low-carbon technologies – technical aspects and their impacts (PV and EVs impacts and challenges), Smart metering, Demand site management technologies, Advanced Distribution Management System, Information and Communication Technology (ICT), wide area monitoring and protection, Smart homes and buildings.

24730	**Energy Storage Systems**
	Pre-requisite: None
	Credit Hours: 3
	Introduction to Energy Storage in power systems, Overview on Energy Storage Technologies. Mobile and Stationary Energy Storage Applications, Energy Storage with Renewable Energy Sources, Introduction to Electromobility, Integration of Electromobility with Energy Storage. Hydrogen Energy Systems.

24711	**Advanced Power Electronics and Applications**
	Pre-requisite: None
	Credit Hours: 3
	This course presents advanced topics on electrical energy conversion using power electronics. Power semiconductor devices and their physics of operation are covered. The course focuses on DC/DC converters and DC/AC inverters, exploring their topologies, key components, design approaches, and control schemes in various applications.

24741	**Artificial Intelligence for Energy Systems**
	Pre-requisite: Non
	Credit Hours: 3
	Introduction to Data Analytics (Big data, data collection and processing, exploratory analysis), Machine learning techniques (supervised learning, unsupervised learning), deep learning (ANN, CNN, RNN), Time series models, statistics models, optimization, Case studies of ML algorithms in Power Systems (Load Forecasting, Renewable energy forecasting and prediction, faults detection, classification and estimation, DGs and smart grid optimization, Predictive maintenance, power quality classification, management of energy harvesting), other Machine Learning Applications in energy.

24799	**24799 MS Thesis**
	Pre-requisite: Finish 12 Credits (including 24700)
	Credit Hours: 9
	After reviewing literature, the student defines a research problem under the supervision of a faculty member. Then he/she develops a suitable solution and writes the thesis, describing the targeted problem, his/her suggested solution and obtained results. Afterwards, the student defends his thesis against an appointed examining committee.

24780	**24780 Special Topics in Power & Energy Engineering (1)**
	Pre-requisite: None
	Credit Hours: 3
	The objective of this course is to introduce advanced and new topics in Power Engineering and Sustainably Energy. The topics may change from one semester to another according to latest technological advances and available faculty specializations.

24781	**Special Topics in Power & Energy Engineering (2)**
	Pre-requisite: None
	Credit Hours: 3
	The objective of this course is to introduce advanced and new topics in Power Engineering and Sustainably Energy. The topics may change from one semester to another according to latest technological advances and available faculty specializations.

24712	**24712 Renewable Energy Grid-Integration**
	Pre-requisite: None
	Credit Hours: 3
	This course introduces technologies connecting renewable energy systems, such as PV systems and wind turbines, to the power grid. It covers the main power electronic-based energy conversion systems used in renewable energy applications, detailing their structure, functionality, and control mechanisms, including grid-forming, and grid-following inverters.

24731	**Low Inertia Systems**
	Pre-requisite: None
	Credit Hours: 3
	Introduction to modern power system components and transformation, Conventional Powe grids and networks, Concept of low inertia systems (main aspects and characteristics), Conventional generators and Inverter-based resources, Issues and challenges in low inertia system (stability, protection), Operation and control of low inertia systems, fault level and system strength, stability and weak grids.

24721	**Power Quality & System Reliability**
	Pre-requisite: None
	Credit Hours: 3
	Probabilistic Methods for Reliability Evaluation, Generation System Reliability, Interconnected System Reliability, Distribution System Reliability Indices, Monte Carlo Simulation, Introduction to Power Quality, Sources and classification of Disturbances in power systems, Power quality and renewable energy sources, mitigation measures to improve QoS, harmonics study and filter design.

24702	**Distributed Generation**
	Pre-requisite: None
	Credit Hours: 3
	Introduction to modern power system components and transformation, Introduction to Distributed Generation, Types of DG, Power Electronics- Interfaced Distributed Generation, Micro-grids and control, Grid codes and integration requirements, short circuit contribution of DGs, challenges and mitigation, hosting capacity of DGs.

24703	**Protection of Power Systems**
	Pre-requisite: None
	Credit Hours: 3
	Fundamentals of power systems protection; non-directional and directional overcurrent protection; Distance protection of Transmission Lines, Differential protection of Generators, Transformers, and Busbars; Numerical (Digital) protection including wide-area protection systems; Protection schemes for the distribution network with Distributed Generation; Fault characteristics of renewables including PV and Wind; Fault level and system strength.

24706	**Power System Control & Stability**
	Pre-requisite: None
	Credit Hours: 3
	Power System Control: Automatic Generation Control, Speed governor and frequency control, State Space Modelling of Power Systems, Generation Control Methodologies, Reactive Power Control, Computer Simulation Methods for Power System Control. Power Systems Stability: Transient Stability Analysis Review, Small signal stability analysis, Models Based Stability Analysis, Lyapunov's stability methods in power systems, Excitation system, automatic voltage regulator, power system stabilizer, Voltage Stability, Effect of renewable energy penetration on small signal stability

24709	**Flexible AC Transmission System (FACTS) devices and applications**
	Pre-requisite: None
	Credit Hours: 3
	FACTS Concepts and General System Considerations, Voltage-Sourced Converters, Current Sourced Converters, Shunt Compensators: The Static Var Compensator (SVC), The Static Synchronous Compensator (STATCOM), Series Compensators: The Thyristor-Controlled Series Compensator (TCSC), The Static Synchronous Series Compensator (SSSC), Introduction to Combined Compensators and Other Compensators.

24770	**Optimal Control**
	Pre-requisite: None
	Credit Hours: 3
	This course gives the basic principles of optimal control. It presents background material on stability, observability, controllability, and minimality. Optimal control topics include static optimization, optimal control of discrete and continuous-time systems, and dynamic programming, including Solutions to linear quadratic regulation, fixed final state regulation, final-time free problems, constrained input problems, the tracking problem, and Billman's principle of optimality.

20702	**Mathematical Modeling and Optimization**
	Pre-requisite: None
	Credit Hours: 3
	This course explores a wide range of optimization techniques and their engineering applications. Topics covered include linear, integer, nonlinear, and stochastic optimization. The covered optimization techniques will be applied to problems involving data in different applications. Students will develop an understanding of mathematical formulations and use tools for computation. Metaheuristic optimization algorithms will also be introduced in this course.

25710	**Wireless Networks Technologies**
	Pre-requisite: None
	Credit Hours: 3
	Overview of wireless networking concepts. Key technologies and standards of Wireless Personal Area Networks, Wireless Local Area Networks, Wireless Body Area Networks, Wireless Vehicular Networks, and Cellular Networks. Performance analysis and evaluation of wireless networks.

24713	**Electric Machines and Drives**
	Pre-requisite: None
	Credit Hours: 3
	This course provides an in-depth study of electric machines and drive systems. The topics covered include the principles of electromechanical energy conversion, principles of electric machines, General structure and major components of electric machine; derivation of steady state model of electric machines and other electromechanical devices , Steady state performance analysis of electric machine and other electromechanical devices, Variable speed control and operation of electric machines, Matrix representation of magnetic coupling of windings, Dynamic modeling and simulation of AC machines , Interface of AC machines with voltage source converters, AC machine with power electronics control , Torque and speed capability of AC machine drives , Vector control of AC machines , Special topics on permanent magnetic machines and control.

27750	**Digital Signal Processing**
	Pre-requisite: None
	Credit Hours: 3
	Wiener filters. Linear prediction. Least Mean Square (LMS) adaptive filters. Normalized NLS adaptive filters. Recursive Least Square algorithms. Kalman filters. Implementing adaptive filters using MatLab.

24732	**Energy Economics**
	Pre-requisite: None
	Credit Hours: 3
	Review of Power Flow Concepts, Economic Dispatch, Optimal Power Flow, Unit Commitment, Electricity Markets, Cost of Generating Electrical Energy, Demand Side Management & Electricity Pricing, Ancillary Services.

24790	**MS Project**
	Pre-requisite: Finish 22 Credits Hours (including 24700)
	Credit Hours: 3
	This is a practical project to be conducted by students opting for the comprehensive exam track. The project allows students to integrate knowledge gained in multiple courses into a fully functional practical project. A written report and an oral presentation are due upon the completion of the project. Projects are to be evaluated by a committee formed by the department.

24791	**Comprehensive Exam**
	Pre-requisite: Per Exam Regulations
	Credit Hours: 0
	The comprehensive examination aims to measure the student's ability to understand and make correlations between the basic and advanced concepts that he/she has acquired through his/her studies, and to apply them in solving theoretical and applied problems in his/her field of specialization.

Guidance Plan (Thesis Track)

First Year – First Semester			First Year – Second Semester		
Course No.	**Course Name**	**Credit Hours**	**Course No.**	**Course Name**	**Credit Hours**
24700	Seminar & Research Methodology	1	24741	Artificial intelligence for Energy Systems	3
24720	Power Systems & Renewable Energy Resources	3	24740	Smart Grids	3
24711	Advanced Power Electronics and Applications	3	24730	Energy Storage Systems	3
Total Credits		**7**	**Total Credits**		**9**

Second Year – First Semester			Second Year – Second Semester		
Course No.	**Course Name**	**Credit Hours**	**Course No.**	**Course Name**	**Credit Hours**
-	Elective Course (1)	3	-	Elective Course (3)	3
-	Elective Course (2)	3	24799	MS Thesis	6
24799	MS Thesis	3			
Total Credits		**9**	**Total Credits**		**9**

Second Year – Summer Semester		
Course No.	**Course Name**	**Credit Hours**
24799	MS Thesis	0

Guidance Plan (Comprehensive Exam)

First Year – First Semester			First Year – Second Semester		
Course No.	**Course Name**	**Credit Hours**	**Course No.**	**Course Name**	**Credit Hours**
24700	Seminar & Research Methodology	1	24741	Artificial intelligence for Energy Systems	3
24720	Power Systems & Renewable Energy Resources	3	24740	Smart Grids	3
24711	Advanced Power Electronics and Applications	3	24730	Energy Storage Systems	3
Total Credits		**7**	**Total Credits**		**9**

Second Year – First Semester			Second Year – Second Semester		
Course No.	**Course Name**	**Credit Hours**	**Course No.**	**Course Name**	**Credit Hours**
24713	Electric Machines and Drives	3	_	Elective Course (2)	3
24706	Power Systems Control & Stability	3	_	Elective Course (3)	3
_	Elective Course (1)	3	24790	MS Project	3
Total Credits		**9**	**Total Credits**		**9**

Second Year – Summer Semester		
Course No.	**Course Name**	**Credit Hours**
24791	Comprehensive Exam	0