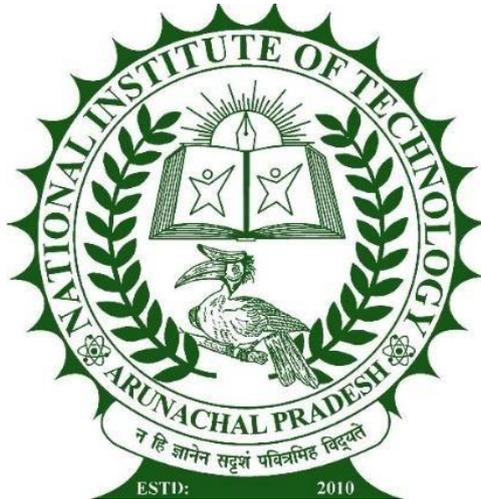Course Curriculum for M. Tech.

In

Power Electronics and Sustainable Energy (PESE)

(For students admitted in 2025-26 onwards)

National Institute of Technology Arunachal Pradesh

P.O.: Yupia, Dist.: Papumpare, Arunachal Pradesh, Pin–791112
Phone No: 0360-2284801/2001582
Fax No: 0360-2284972
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1.0 Semester wise Credit point distribution

Sl. No.	Year	Credit Point	
		ODD	EVEN
1	First	21	20
2	Second	12	12
Total Credit Point		33	32
		65	

2.0 Subject Category wise Credit point Distribution

Course Category	Sem-I	Sem-II	Sem-III	Sem-IV	Total Credit Point
Core (Basic Science)	3	--	--	--	3
Core (Engineering Science)	--	--	--	--	0
Core (Professional)	15	16	3		34
Core (Humanities)	--	3	--	--	3
Elective (Professional)	--	--	--	--	0
Open Elective	--	--	--	--	0
Elective (online course)	--	--	--	--	0
Lab (Basic Science)	--	--	--	--	0
Lab (Engineering Science)	--	--	--	--	0
Lab (Humanities)	--	--	--	--	0
Lab (Professional)	3	1	4	--	8
Internship	--	--	--	--	0
Academic Project	--	--	5	12	17
Audit (NSS/NCC)	--	--	--	--	0
Grand Viva	--	--	--	--	0
Total Credit Point	21	20	12	12	65

❖ INSTITUTE VISION

To transform into an acclaimed institution of higher learning with creation of an impact on the north eastern region in terms of innovation and entrepreneurship

❖ INSTITUTE MISSION

- ❖ *To generate new knowledge through state-of-the-art academic program and research in multidisciplinary field*
- ❖ *To identify regional, Indian and global need to serve the society better.*
- ❖ *To create an ambience to flourish new ideas, research and academic excellence to produce new leaders and innovators*
- ❖ *To collaborate with other academic, research institutes and industries for wholistic growth of the students*
- ❖ *Utilization of available big resources to encourage entrepreneurship through formation of startups.*

❖ Vision of the Department

Mould generations of Electrical Engineers on global standards with multidisciplinary perspective to meet evolving societal needs for the north eastern region.

❖ Mission of the Department

M1: *Empower students with knowledge in electrical and allied engineering facilitated in innovative class rooms and state-of-the art laboratories.*

M2: *Inculcate technical competence and promote research through industry interactions, field exposures and global collaborations.*

M3: *Promote professional ethics and selfless service.*

❖ Programme Outcome

PO1: Engineering Knowledge
PO2: Problem Analysis
PO3: Design/Development of Solutions

PO4: Conduct Investigations of complex problems
PO5: Modern tools usage
PO6: Engineer and Society
PO7: Environment and Sustainability
PO8: Ethics
PO9: Individual & Team work
PO10: Communication
PO11: Project management & Finance
PO12: Lifelong learning

❖ Programme Specific Outcome

PSO1: Future Technology.
PSO2: Research and Innovation.

Syllabus for M. Tech in Renewable Energy and Energy Management

COURSE STRUCTURE

M. Tech. 1st Year, Semester I

Sl. No	Course Code	Course Title	L	T	P	C
1.	EE-5101	Advance Power Electronics and Drives	3	0	0	3
2.	EE-5102	FACTs and HVAC Transmission System	3	0	0	3
3.	EE-5103	Micro Hydro Power Plants	3	0	0	3
4.	EE-5104	Power Electronics Interface for Photovoltaic System	3	0	0	3
5.	EE-5105	Sustainable Energy Economics and Planning	3	0	0	3
6.	EE-5106	Advance Power Electronics and Drives Laboratory	0	0	2	1
7.	EE-5107	Micro Hydro Power Plants Laboratory	0	0	2	1
8.	EE-5108	Photovoltaic System Laboratory	0	0	2	1
9.	BS-5111	Advanced Numerical Methods	3	0	0	3
		Total Credits	18	0	6	21

M. Tech. 1st Year, Semester II

Sl. No	Course Code	Course Title	L	T	P	C
1.	EE-5201	Advanced Control Systems	3	0	0	3
2.	EE-5202	Generalized Theory of Electrical Machines	3	0	0	3
3.	EE-5203	Renewable Energy Resources	3	0	0	3
4.	EE-5204	Power Quality Issues and Remedials	3	0	0	3
5.	EE-5205	Soft Computing Techniques in Power Electronics and Renewable Energy	3	1	0	4
6.	EE-5206	Advanced Control Systems Laboratory	0	0	2	1
7.	MH - 523	Technical Writing	3	0	0	3
		Total Credits	18	1	2	20

Syllabus for M. Tech in Renewable Energy and Energy Management

M. Tech. 2nd Year, Semester III

Sl. No	Course Code	Course Title	L	T	P	C
1.	EE-610A	ELECTIVE-I	3	0	0	3
2.	EE-6102	UG Teaching Assistance (Audit Course)	0	0	0	0
3.	EE-6103	Seminar	0	0	6	3
4.	EE-6191	Dissertation I	0	0	9	3
		Total Credits	3	0	15	9

M. Tech. 2nd Year, Semester IV

Sl. No	Course Code	Course Title	L	T	P	C
1.	EE-6292	Dissertation II	0	0	30	15
		Total Credits	0	0	30	15

Elective-I

EE 610A	Fundamentals of Thermal and Electrical Engineering
EE 610B	Bio-fuels and Decentralized Energy Systems
EE 610C	Building Energy and Green Building
EE 610D	Waste to Energy

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CURRICULUM

Programme	Masters in Power Electronics and Sustainable Energy		Academic Year of Regulation	2025-26
Department	Electrical Engineering		Semester	I

Course Code	Course Name	Credit Structure				Marks Distribution				
		L	T	P	C	INT	MID	END	Total	Bloom's taxonomy
EE – 5101	Advance Power Electronics and Drives	3	0	0	3	20	30	50	100	

Course Objectives	1. To provide a comprehensive understanding of advanced converter and electric drive systems. 2. To model, analyze, and control power electronic converters and motor drives using modern control theories. 3. To design and implement high-speed, high-voltage **gate driver circuits** for power semiconductor devices (MOSFET, IGBT, SiC, GaN). 4. To apply digital, intelligent, and real-time control for precision drive performance. 5. To prepare students for research and development in advanced converter–drive systems for EVs, renewable energy, and high-power industrial applications.	Course Outcomes	CO1	Demonstrate advanced understanding of modern power converters, modulation, and control strategies.	Understanding / Comprehension
			CO2	Model converter–machine systems and analyse dynamic behaviour using advanced simulation tools.	Apply / Analyze
			CO3	Design **gate driver circuits** and protection interfaces for modern power devices.	Apply / Evaluate
			CO4	Develop intelligent digital controllers using DSP, FPGA, and embedded platforms.	Analyze / Evaluate
			CO5	Evaluate system performance, EMI/EMC, thermal reliability, and optimize for industrial and EV applications.	Understand / Evaluate / Create

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

SYLLABUS

No.	Content	Hours	COs
I	**Advanced Power Converter Topologies:** Review of controlled rectifiers, multi-pulse converters, interleaved DC–DC converters; multilevel inverters (diode-clamped, flying capacitor, cascaded H-bridge); modular multilevel converters (MMC); matrix converters; high-frequency link converters.	10	CO1 / CO2
II	**Modelling and Control of Power Converters:** State-space modelling, small-signal analysis, averaged models, and discrete-time representation; PWM and space vector modulation; sliding mode, model predictive, and hysteresis control. **Gate Driver Design and Device Interface:** Design of isolated and non-isolated gate drivers for IGBT, MOSFET, SiC, and GaN devices; opto-coupler and transformer isolation; desaturation protection, Miller clamp, active gate control, and dv/dt mitigation; PCB layout design for high-speed switching and EMI immunity.	15	CO2 / CO3
III	**Advanced Electric Drives:** Vector control (FOC), direct torque control (DTC), field-oriented PMSM and BLDC drives, sensor less control methods; high-speed drive systems and torque control loops.	10	CO3 / CO4
IV	**Digital and Intelligent Control Implementation:** DSP, FPGA, and microcontroller-based PWM generation; real-time current/voltage loops; adaptive, fuzzy, neural, and predictive control; communication protocols (CAN, SPI, UART). **Reliability, EMI/EMC, and Research Applications:** Thermal design and derating, fault diagnostics and condition monitoring; EMI suppression, filtering, and grounding; applications in EV propulsion, renewable grid interfaces, and aerospace drives; design case studies and laboratory validation.	10	CO3 / CO4 / CO5
	Total Hours	45	

Text Books:

1. N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications and Design*, Wiley.
2. B. K. Bose, *Modern Power Electronics and AC Drives*, Pearson Education.
3. R. W. Erickson and D. Maksimovic, *Fundamentals of Power Electronics*, Springer.
4. Fang Lin Luo and Hong Ye, *Advanced DC–DC Converters*, CRC Press.

Reference Books:

1. Ned Mohan, *Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB/Simulink*, Wiley.
2. Bimal K. Bose, *Power Electronics and Motor Drives – Advances and Trends*, Elsevier.
3. Marian K. Kazimierczuk, *Pulse-Width Modulated DC–DC Power Converters*, Wiley.
4. Fang Lin Luo, *Soft Switching PWM Inverters: Technology, Performance and Application*, Springer.
5. Rashid M. H., *Power Electronics: Devices, Circuits, and Applications*, Pearson.

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CURRICULUM

Programme	Master of Technology in Power Electronics and Sustainable Energy				Academic Year of Regulation			2025-26	
Department	Electrical Engineering				Semester			I	

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 5102	FACTs and HVAC Transmission Systems	3	0	0	3	20	30	50	100	

Course Objectives	• Understand the fundamental principles of high voltage AC transmission. • Analyze the design, operation, and performance of high voltage transmission lines. • Explore insulation coordination, corona discharge, and power system protection in high voltage transmission. • Evaluate emerging technologies in high voltage AC transmission.	Course Outcomes	CO1	Understand the fundamental principles and need for high voltage AC transmission.	Remembering
			CO2	Analyze high voltage transmission line performance parameters and effects.	Understanding
			CO3	Apply insulation coordination and overvoltage protection techniques.	Applying
			CO4	Evaluate modern trends and advancements in high voltage AC transmission.	Evaluating

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

	SYLLABUS		
No.	Content	Hours	COs
I	**Introduction to High Voltage AC Transmission**: Advantages, need for high voltage transmission, comparison with DC transmission, transmission line parameters, skin and proximity effects.	10	CO1, CO2
II	**Transmission Line Performance**: Voltage regulation, power flow, reactive power control, Ferranti effect, transient and steady-state stability.	12	CO2, CO3
III	**Corona and Insulation Coordination**: Corona discharge, power loss, radio interference, critical disruptive voltage, insulation coordination, overvoltage protection, surge arresters.	10	CO3, CO4
IV	**Modern Trends in High Voltage AC Transmission**: Use of FACTS devices, HV shunt and series compensation, EHV underground cables, smart grid technologies in high voltage transmission.	13	CO4
	Total Hours	45	

Text Books:

1. *N.G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems," IEEE Press/Wiley, 1999.*
2. *C.L. Wadhwa, "High Voltage Engineering," New Age International, 2018.*
3. *M. S. Naidu and V. Kamaraju, "High Voltage Engineering," McGraw Hill, 2013.*
4. *E. Kuffel, W.S. Zaengl, and J. Kuffel, "High Voltage Engineering Fundamentals," Elsevier, 2000.*

Reference Books:

1. *R. Arora and W. Mosch, "High Voltage Insulation Engineering," Wiley, 2011.*
2. *S. R. Mehta, "Principles of High Voltage Engineering," McGraw Hill, 2015.*
3. *P. Vas, "Electrical Machines and Drives: A Space Vector Theory Approach," Oxford University Press, 1992.*
4. *J. Arrillaga, "High Voltage Direct Current Transmission," IET Power and Energy Series, 2008.*

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CURRICULUM

Programme	M.Tech. (Power Electronics and Sustainable Energy)	Academic Year of Regulation	2025-26
Department	Electrical Engineering	Semester	I

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 5103	Micro-Hydro Power Plants	3	0	0	3	20	30	50	100	

Course Objectives	1. impart the knowledge of Renewable Energy through use of water. 2. enable the students to do analysis of different schemes of micro hydro plants and its applications 3. make students capable of analysis of Mini, micro and small hydro power installation.	Course Outcomes	CO1	Able to understand the basic structure of Micro-hydro power generation, its functionality.	Understanding/ Comprehension
			CO2	Able to illustrate and analyse the various concept and importance of small and MHP.	Understanding/ Analyzing
			CO3	Able to describe the structure of various components of MHP.	Identify/ Knowledge/ Remember
			CO4	Able to interpret and analyze the installation of micro, mini and small hydro power plants.	Understanding Analyzing

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS			
No.	Content	Hours	COs
I	**Introduction to Hydropower:** Definition of hydropower and renewable energy context, Classification by capacity: Large, Small, Mini, Micro, Disadvantages of Large Hydro power plants, Distinction between run-of-river and storage-type plants, Role of MHP in rural electrification and decentralized power. Hydrological cycle: rainfall, evaporation, infiltration, runoff. Stream flow measurement methods: current meter, float method, weirs, flumes. Head measurement: static head, gross head, net head. Flow duration curve, hydrographs, and power duration curves. Site selection parameters: head availability, flow reliability, accessibility, ecology. Estimation of theoretical and practical power potential.	10	CO1 CO2 CO3
II	**Electro-Mechanical Components of MHP**: Civil Structures: Intake types (Tyrolean, side intake, open intake), Settling basin and desilting chamber, Headrace canal/troughs and forebay tank design, Penstock design (diameter, thickness, pressure losses). Turbine and Generators: Classification by head and flow, Impulse vs. reaction turbines, Detailed study of Pelton, Francis, Kaplan, Crossflow, Propeller, Turgo, Pumps as Turbines (PAT) – working principle and applications. Generators: Synchronous generators Vs Induction generators, Permanent Magnet Generator for MHP, Self-Excited Induction Generators.	12	CO2 CO3
III	**Electrical System & Control Design:** Load estimation for rural households and small enterprises, Stand-alone vs. grid-connected operation, Principle, design and working of Electronic Load Controller (ELC). Voltage and frequency control in micro-hydro. Power electronics interface for hybrids microgrids. Design of intake, penstock, and turbine sizing, Calculation of turbine efficiency and selection criteria, Electrical sizing: generator capacity, cables, and switchgear, Design of ELC and dump load, Performance parameters: efficiency, power output, load factor, plant factor, Case study: Design of a 5–50 kW rural micro-hydro system, PAT-SEIG based MHP design considerations	13	CO3 CO4
IV	**Installation, Operation & Maintenance:** Installation procedures of civil works and electro-mechanical equipment, Alignment and balancing of turbine-generator shaft, Testing of turbine and generator at site, Routine operation: startup, shutdown, synchronization (if grid-connected), Preventive and predictive maintenance practices, Spare parts and local fabrication opportunities. Economics, Policies: Financing models: government subsidy, community-owned, PPP models, Indian policies for small and micro-hydro development (MNRE guidelines), Environmental aspects: fish migration, siltation, deforestation, Social acceptance and community participation models	10	CO2 CO3 CO4
Total Hours		45	

Text Books:

1. T. Jiandong, "Mini hydropower", John Wiley, 1997

2. H. Wagner and J. Mathur, "Introduction to Hydro energy Systems : Basics, Technology and Operation", Springer, 2011

Reference Books:

1. R. K. Bansal, "A textbook of fluid mechanics and hydraulic machines", Laxmi publications, 2005, New Delhi
2. Z. Hussian, M. Z. Abdullah, "Basic Fluid Mechanics and Hydraulic Machines", Wiley 2012
3. P. K. Nag, "Power Plant Engineering", 3rd Edition, Tata McGraw Hill, 2008
4. Micro-Hydro Design Manual – Adam Harvey et al

		CURRICULUM

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Programme	Master of Technology in Power Electronics and Sustainable Energy	Academic Year of Regulation	2025-26
Department	Electrical Engineering	Semester	I

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE - 5104	Power Electronics Interface for Photovoltaic Systems	3	0	0	3	20	30	50	100	

Course Objectives	• Provide fundamental knowledge of solar energy conversion principles. • Introduce photovoltaic (PV) technology and its applications. • Analyze the design, efficiency, and performance of solar energy systems. • Evaluate recent advancements in solar energy technologies for sustainable development.	Course Outcomes	CO1	Understand the fundamental concepts of solar energy conversion.	Remembering
			CO2	Analyze the working of photovoltaic cells and their efficiencies.	Understanding
			CO3	Apply design principles to solar PV systems.	Applying
			CO4	Evaluate the performance and advancements of solar technologies.	Evaluating

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS			
No.	Content	Hours	COs
I	**Introduction to Solar Energy:** Basics of solar radiation, solar spectrum, energy potential, solar thermal vs. photovoltaic conversion.	10	CO1, CO2
II	**Photovoltaic Technology:** Semiconductor physics, working principles of PV cells, types of PV materials, efficiency factors, and losses.	12	CO2, CO3
III	**Solar PV System Design:** Solar panel characteristics, MPPT techniques, inverters, system components, and grid integration.	10	CO3, CO4
IV	**Advanced Solar Energy Technologies:** Emerging PV technologies (PERC, Bifacial, Perovskite, Tandem Cells), hybrid solar systems, energy storage integration.	13	CO3, CO4
Total Hours		45	

Text Books:

1. M. Green, "Solar Cells: Operating Principles, Technology, and System Applications," Prentice Hall, 2008.
2. S. Messenger and J. Ventre, "Photovoltaic Systems Engineering," CRC Press, 2018.
3. C.S. Solanki, "Solar Photovoltaics: Fundamentals, Technologies, and Applications," PHI Learning, 2015.
4. J. Nelson, "The Physics of Solar Cells," Imperial College Press, 2003.

Reference Books:

1. J. Twidell and T. Weir, "Renewable Energy Resources," Taylor & Francis, 2021.
2. M. Wolf, "Solar Energy: The Physics and Engineering of Photovoltaic Conversion," Oxford University Press, 2016.
3. B. Parida, S. Iniyan, and R. Goic, "A Review of Solar Photovoltaic Technologies," Renewable and Sustainable Energy Reviews, 2011.
4. A. Luque and S. Hegedus, "Handbook of Photovoltaic Science and Engineering," Wiley, 2011.

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CURRICULUM

Programme	Masters in Power Electronics and Sustainable Energy			Academic Year of Regulation			2025-26
Department	Electrical Engineering			Semester			I

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE 5105	Sustainable Energy Economics and Planning	3	0	0	3	20	30	50	100	

Course Objectives	1. To understand energy scenario, energy sources and their utilization. 2. To explore society's present needs and future energy demands. 3. To Study the principles of renewable energy conversion systems. 4. To exposed to energy conservation methods	Course Outcomes	CO1	Describe the environmental aspects of renewable energy resources. In Comparison with various conventional energy systems, their prospects and limitations.	Understanding/ Comprehension
			CO2	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation.	Understanding/ Comprehension
			CO3	Understand the conversion principles of wind and tidal energy	Identify/ Knowledge/ Remember
			CO4	Understand the concept of biomass energy resources and green energy and Acquire the basic knowledge of ocean thermal energy conversion and hydrogen energy.	Understanding/ Comprehension

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS			
No.	Content	Hours	COs
I	**Introduction to Energy Economics**: Basics of energy supply and demand, energy balance, primary and secondary energy sources.	10	CO1
	Energy Markets and Pricing: Market structures, energy pricing mechanisms, demand forecasting, economic feasibility of energy projects.		CO2
	Energy Planning and Policy: National and international energy policies, integrated energy planning, energy security, role of regulatory bodies.		CO4
II	**Sustainable Energy Strategies:** Renewable vs. non-renewable energy planning, climate change policies, economic incentives for sustainable energy development.	15	CO2
	Introduction to Energy Economics: Basics of energy supply and demand, energy balance, primary and secondary energy sources.		CO3
III	**Energy Markets and Pricing:** Market structures, energy pricing mechanisms, demand forecasting, economic feasibility of energy projects.	10	CO3
	Energy Planning and Policy: National and international energy policies, integrated energy planning, energy security, role of regulatory bodies.		CO4
IV	**Sustainable Energy Strategies:** Renewable vs. non-renewable energy planning, climate change policies, economic incentives for sustainable energy development.	10	CO1
	Total Hours	45	

Text Books:

1. *Rai G.D: Non-Conventional Energy Sources, Khanna Publishers.*

2. *Begamudre R. D: Energy Conversion Systems, New Age International Publishers.*

Reference Books:

1. *M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications,2006.*
2. *D.S. Chauhan,"Non-conventional Energy Resources" New Age International.*
3. *C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.*
4. *Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.*
5. *Odfrey Boyle,"Renewable Energy Power For A Sustainable Future", Oxford University Press.*
6. *Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.*
7. *John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.*

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CURRICULUM

Programme	M.Tech. (Power Electronics and Sustainable Energy)	Academic Year of Regulation				2025-26		
Department	Electrical Engineering	Semester				I		

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 5106	Advanced Power Electronics and Drives Laboratory	0	0	2	1	20	30	50	100	

Course Objectives	1. To provide a comprehensive understanding of advanced converter and electric drive systems. 2. To model, analyze, and control power electronic converters and motor drives using modern control theories. 3. To design and implement high-speed, high-voltage **gate driver circuits** for power semiconductor devices (MOSFET, IGBT, SiC, GaN). 4. To apply digital, intelligent, and real-time control for precision drive performance. To prepare students for research and development in advanced converter–drive systems for EVs, renewable energy, and high-power industrial applications.	Course Outcomes	CO1	Demonstrate advanced understanding of modern power converters, modulation, and control strategies.	Understanding/ Comprehension
			CO2	Model converter–machine systems and analyse dynamic behaviour using advanced simulation tools.	Understanding/ Comprehension
			CO3	Design **gate driver circuits** and protection interfaces for modern power devices.	Identify/ Knowledge/ Analyzing
			CO4	Develop intelligent digital controllers using DSP, FPGA, and embedded platforms.	Understanding Analyzing

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

	SYLLABUS		
No.	Content	Hours	COs
I	Determination of complete torque speed characteristics of three phase induction machine in braking, motoring and generation regions and its calibration.	2	CO1
II	Understanding the effect of rotor resistance on the load characteristics of a wound–rotor induction motor.	2	CO2
III	Determination of equivalent circuit parameters, prediction of performance. Verification from actual load test. (b) Separation of losses of Induction motors and estimation of efficiency.	2	CO3
IV	Speed control of Induction motor–Conventional, electronic. Solid state speed control using	2	CO3
V	V constant, (ii) V/f constant, (iii) slip–energy injection.	2	CO3
VI	Load characteristic of Induction generator working in (i) Grid connected mode (ii) Self Determination of equivalent circuit parameters of a single phase Induction motor. Prediction of torque–speed characteristic. Verification from load test.	2	CO4
VII	Determination of torque step rate characteristic of a stepper motor. Determination of operating range.	2	CO4
VIII	Understanding the effect of rotor resistance on the load characteristics of a wound–rotor induction motor.	2	CO4
	Total Hours	16	

Text Books:

1. N. Mohan, T. M. Undeland, and W. P. Robbins, *Power Electronics: Converters, Applications and Design*, Wiley.
2. B. K. Bose, *Modern Power Electronics and AC Drives*, Pearson Education.
3. R. W. Erickson and D. Maksimovic, *Fundamentals of Power Electronics*, Springer.
4. Fang Lin Luo and Hong Ye, *Advanced DC–DC Converters*, CRC Press.

Reference Books:

1. Ned Mohan, *Advanced Electric Drives: Analysis, Control, and Modeling Using MATLAB/Simulink*, Wiley.
2. Bimal K. Bose, *Power Electronics and Motor Drives – Advances and Trends*, Elsevier.
3. Marian K. Kazimierczuk, *Pulse-Width Modulated DC–DC Power Converters*, Wiley.
4. Fang Lin Luo, *Soft Switching PWM Inverters: Technology, Performance and Application*, Springer.

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CURRICULUM

Programme	M.Tech. (Power Electronics and Sustainable Energy)		Academic Year of Regulation		2025-26
Department	Electrical Engineering		Semester		I

Course Code	Course Name	Credit Structure					Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total		
EE – 5108	Photovoltaic System Laboratory	0	0	2	1	20	30	50	100		

Course Objectives	1. impart the knowledge of Pumped hydro power plants. 2. enable the students to do analysis of different types of machines for micro hydro power generation. 3. make students capable of analysis of performance of CFT and grid connection of isolated hydro power plants.	Course Outcomes	CO1	Able to understand the basic operation of pumped storage hydro power plants,	Understanding/ Comprehension
			CO2	Able to illustrate the installation of micro hydro power plants using various machines.	Understanding/ Comprehension
			CO3	Able to interpret and analyze the synchronization of power plant with grid	Identify/ Knowledge/ Analyzing
			CO4	Able to interpret and analyze the operation of synchronous generator for micro hydro power plants.	Understanding Analyzing

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS

No.	Content	Hours	COs
I	To perform a detailed study on the pumped storage hydro power plant.	2	CO1
II	To operate the 3- phase 2.2 kW SEIG as micro hydro power plant.	2	CO2
III	To operate the 3- phase 5.5 kW SEIG as micro hydro power plant.	2	CO3
IV	To operate a parallel operation of two micro hydro power plants.	2	CO3
V	To synchronize the given power plants with grid using dark & bright lamp method.	2	CO3
VI	To study Cross Flow Turbine (CFT) for micro hydro power plants.	2	CO4
VII	To operate of 3- phase synchronous generator for micro hydro power plant.	2	CO4
VIII	To synchronize synchronous machine based micro hydro plant to grid.	2	CO4
	Total Hours	16	

Text Books:

1. T. Jiandong, "Mini hydropower", John Wiley, 1997

2. H. Wagner and J. Mathur, "Introduction to Hydro energy Systems : Basics, Technology and Operation", Springer, 2011

Reference Books:

1. R. K. Bansal, "A textbook of fluid mechanics and hydraulic machines", Laxmi publications, 2005, New Delhi

2. Z. Hussian, M. Z. Abdullah, "Basic Fluid Mechanics and Hydraulic Machines", Wiley 2012

3. P. K. Nag, "Power Plant Engineering", 3rd Edition, Tata McGraw Hill, 2008

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Programme	M.Tech. (Power Electronics and Sustainable Energy)	Academic Year of Regulation	2025-26
Department	Electrical Engineering	Semester	II

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 5206	Photovoltaic System Laboratory	0	0	2	1	20	30	50	100	

Course Objectives	1. To provide hands-on experience with solar photovoltaic modules and system components. 2. To familiarize students with measurement, testing, and performance evaluation of PV systems. 3. To study I–V and P–V characteristics under various operating conditions. 4. To analyze MPPT algorithms, charge controllers, and inverter performance. 5. To develop skills in installation, safety, and monitoring of standalone and grid-tied PV systems.	Course Outcomes	CO1	Identify components of solar PV systems and understand their operation.	Understanding/ Comprehension
			CO2	Measure and analyze I–V and P–V characteristics of PV modules under varying conditions.	Understanding/ Comprehension
			CO3	Evaluate the performance of charge controllers, MPPT algorithms, and PV inverters.	Identify/ Knowledge/ Analyzing
			CO4	Assess the performance of standalone/grid-connected PV systems through experiments.	Understanding Analyzing

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS			
No.	Content	Hours	COs
I	Familiarization with Solar PV Systems	2	CO1
II	Series and Parallel Connection of Modules	2	CO2
III	MPPT and Charge Controllers	2	CO3
IV	PV Inverter Testing	2	CO3
V	Performance Evaluation of a Standalone PV System	2	CO3
Total Hours		10	

Text Books:

1. C. S. Solanki, *Solar Photovoltaics: Fundamentals, Technologies and Applications*, PHI.

2. Mukund R. Patel, *Solar Photovoltaic Systems: Design and Installation*, CRC Press.

3. Messenger & Ventre, *Photovoltaic Systems Engineering*, CRC Press.

Reference Books:

1. Wenham et al., *Applied Photovoltaics*, Routledge.
2. James P. Dunlop, *Photovoltaic Systems*, ATP.
3. Roger Messenger, *Photovoltaic Science and Technology*, Taylor & Francis.
4. PVsyst / MATLAB documentation for PV system simulation.

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CURRICULUM

Programme	Masters in Power Electronics and Sustainable Energy		Academic Year of Regulation		2025-26
Department	Electrical Engineering		Semester		II

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 5201	Advanced control systems	3	0	0	3	20	30	50	100	

Course Objectives	• Understand the principles of modern control system design and analysis. • Explore state-space representation and advanced stability analysis techniques. • Analyze nonlinear control systems and their applications. • Study optimal and adaptive control strategies. • Gain insight into real-world applications of advanced control techniques.	Course Outcomes	CO1	Explain the fundamental concepts of modern control systems.	Remembering
			CO2	Analyze state-space models and their stability characteristics.	Understanding
			CO3	Apply advanced control techniques to engineering problems.	Applying
			CO4	Evaluate the performance of nonlinear, optimal, and adaptive control strategies.	Evaluating

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS

No.	Content	Hours	COs
I	**State Space Analysis:** Representation, controllability, observability, canonical forms, solution of state equations.	10	CO1, CO2
II	**Stability Analysis:** Lyapunov stability, Bode and Nyquist criteria, root locus, pole placement, state feedback.	12	CO2, CO3
III	**Nonlinear Control Systems:** Phase plane analysis, describing function method, sliding mode control.	10	CO3, CO4
IV	**Optimal and Adaptive Control:** LQR, Kalman filter, model reference adaptive control, real-time applications.	13	CO3, CO4
	Total Hours	45	

Text Books:

1. K. Ogata, "Modern Control Engineering," Pearson, 2016.
2. B.C. Kuo, "Automatic Control Systems," McGraw-Hill, 2014.
3. G.F. Franklin, J.D. Powell, A. Emami-Naeini, "Feedback Control of Dynamic Systems," Pearson, 2019.
4. M. Gopal, "Control Systems: Principles and Design," McGraw-Hill, 2012.

Reference Books:

1. M. Gopal, "Digital Control and State Variable Methods," McGraw-Hill, 2012.
2. J.J. D'Azzo, C.H. Houpis, "Linear Control System Analysis and Design," McGraw-Hill, 2003.
3. H.K. Khalil, "Nonlinear Systems," Pearson, 2002.
4. D.E. Kirk, "Optimal Control Theory: An Introduction," Dover, 2004.

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CURRICULUM

Programme	M.Tech in Power Electronics and Sustainable Energy	Academic Year of Regulation	2024-25
Department	Electrical Engineering	Semester	II

Course Code	Course Name	Credit Structure				Marks Distribution				
		L	T	P	C	INT	MID	END	Total	Bloom's taxonomy
EE-5202	Generalized Theory of Electrical Machines	3	0	0	3	20	30	50	100	

Course Objectives	1. To introduce the **unified approach** for the dynamic analysis of all types of electrical machines. 2. To develop a deep understanding of **reference frame theory** and **Kron's primitive machine model**. 3. To formulate and solve **mathematical models of DC, induction, synchronous, and modern machines** under steady-state, transient, and fault conditions. 4. To apply generalized theory to **converter-fed and controlled drives**, emphasizing machine–converter interaction. 5. To enable research-level modeling using **simulation platforms (MATLAB/Simulink, ANSYS Maxwell, PSCAD)** and analytical methods. 6. To extend the theory to **emerging machine types** (BLDC, PMSM, SRM, hybrid excitation) used in electric vehicles, aerospace, and renewable systems.	Course Outcomes	CO1	Explain the foundations of generalized theory and electromechanical energy conversion principles.	Understanding / Comprehension
			CO2	Derive and transform voltage, current, and flux linkage equations for multi-phase machines using reference frame theory.	Apply / Analyze
			CO3	Develop dynamic models for DC, induction, and synchronous machines under balanced and unbalanced conditions.	Apply / Evaluate
			CO4	Analyze nonlinear and transient behavior using advanced numerical and computational techniques.	Analyze / Evaluate
			CO5	Apply generalized theory to emerging machine types, inverter-fed drives, and real-time simulation for research applications.	Understand / Evaluate / Create

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Generalized Machine Theory:** Concept of electromechanical energy conversion; limitations of conventional analysis; need for generalized modelling; basic machine elements and coupled circuits. **Transformation of Variables:** Kron's primitive machine model; reference frame transformations (Clark, Park, and arbitrary reference frames); power invariance and orthogonal transformations; transformation matrices for balanced and unbalanced systems.	10	CO1 / CO2
II	**Generalized Equations of Electrical Machines:** Derivation of voltage, flux linkage, and torque equations; dynamic modelling of two- and three-phase machines; steady-state and transient equations in various reference frames.	10	CO2 / CO3
III	**Modelling of DC and AC Machines:** DC machine dynamic model; three-phase induction and synchronous machine models; effects of mutual coupling and saturation; simplified and exact models for simulation.	10	CO3 / CO4
IV	**Performance and Control Analysis:** Torque–speed and stability analysis; transient and fault conditions; inclusion of inverter-fed and sensor less control effects; comparative performance under static and dynamic load. **Extension to Modern Machines and Research Applications:** Application of generalized theory to SRM, PMSM, BLDC, and hybrid machines; modelling in MATLAB/Simulink; numerical methods for nonlinear machine equations; case studies on drive control and renewable integration.	15	CO3 / CO4 / CO5
	Total Hours	45	

Text Books:

1. P. S. Bhimbra, *Generalized Theory of Electrical Machines*, Khanna Publishers.
2. A. E. Fitzgerald, Charles Kingsley Jr., and Stephen D. Umans, *Electric Machinery*, McGraw-Hill.
3. J. Meisel, *Principles of Electromechanical Energy Conversion*, McGraw-Hill.
4. R. Krishnan, *Electric Motor Drives: Modeling, Analysis, and Control*, Prentice Hall.

Reference Books:

1. Adkins and Harley, *General Theory of Electrical Machines*, Chapman and Hall.
2. M. G. Say, *Performance and Design of AC Machines*, Pitman.
3. D. P. Kothari and I. J. Nagrath, *Electric Machines*, Tata McGraw-Hill.
4. P. C. Krause, O. Wasynczuk, and S. D. Sudhoff, *Analysis of Electric Machinery and Drive Systems*, Wiley–IEEE Press.
5. C. Concordia, *Synchronous Machines: Theory and Performance*, Wiley.
6. IEEE Transactions on *Energy Conversion*, *Power Electronics*, and *Industrial Electronics* (for research publications).

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Programme	Master of Technology in Power Electronics and Sustainable Energy	Academic Year of Regulation	2025-26
Department	Electrical Engineering	Semester	II

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE - 5203	Renewable Energy Resources	3	0	0	3	20	30	50	100	

Course Objectives	1. Introduce the fundamental concepts of energy economics and planning. 2. Analyze the economic principles governing energy production, consumption, and markets. 3. Evaluate energy policies and their impact on national and global energy security. 4. Understand the role of renewable and non-renewable energy resources in sustainable development.	**Course Outcomes**	CO1	Understand fundamental concepts of energy economics.	Remembering
			CO2	Analyze energy markets, pricing, and demand-supply models.	Understanding
			CO3	Apply economic principles to energy planning and policy evaluation.	Applying
			CO4	Evaluate the impact of energy policies and sustainability strategies.	Evaluating

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS

No.	Content	Hours	COs
I	**Introduction to Energy Sources:** Principles of renewable energy; energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy (IOE).	10	CO1, CO2
II	**Solar Energy:** Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder.Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant. Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.	12	CO2, CO3
III	**Wind Energy:** Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and muliblade system. Vertical axis- Savonius and darrieus types. **Hydropower plant**: Introduction, Principle of power generation, classifications, types of turbines, advantages and its disadvantages. **Biomass Energy:** Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft) .	10	CO3, CO4
IV	**Tidal Power:** Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations. **Ocean Thermal Energy Conversion:** Principle of working, OTEC power stations in the world, problems associated with OTEC. **Green Energy:** Introduction, Fuel cells: Classification of fuel cells – H2; Operating principles, Zero-energy Concepts, Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.	13	CO3, CO4
	Total Hours	45	

Text Books:

1. A. Gupta, "Energy Economics: Concepts, Issues, Markets and Governance," Springer, 2019.
2. S. Awerbuch, "Handbook of Energy Finance: Theories, Practices, and Simulations," Springer, 2021.
3. P. Stevens, "Energy Economics: A Modern Introduction," Routledge, 2020.
4. A.V. Kneese, "Economics and the Environment: A Materials Balance Approach," Routledge, 2021.

Reference Books:

1. T. Jamasb and M.G. Pollitt, "The Future of Electricity Demand: Customers, Citizens, and Loads," Cambridge University Press, 2011.
2. R. Fouquet, "Handbook on Energy and Climate Change," Edward Elgar Publishing, 2013.
3. B. Parida, S. Iniyan, and R. Goic, "A Review of Renewable Energy Technologies," Renewable and Sustainable Energy Reviews, 2011.
4. A. Hens, "Sustainability Science: An Introduction," Springer, 2020.

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CURRICULUM

Programme	Masters in Power Electronics and Sustainable Energy		Academic Year of Regulation		2025-26
Department	Electrical Engineering		Semester		II

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE 5204	Power Quality Improvements	3	0	0	3	20	30	50	100	

Course Objectives	The course is designed to meet with the objectives of: 1. Demonstrate knowledge of Electrical and Electronic circuits, Electrical Machines, Power Systems, Control Systems, and Power Electronics for solving problems in electrical and electronics engineering. 2. Analyze, design, test and maintain electrical systems to meet the specific needs of the Industry and society. 3. Conduct investigations to address complex engineering problems in the areas of Electrical Machines, Power Systems, Control Systems and Power Electronics. 4. Apply appropriate techniques, resources and modern tools to provide solutions for problems related to electrical and electronics engineering.	Course Outcomes	Students on successful completion this module will be able to:	
			CO1	differentiate and explain the various power quality issues and its sources,	Understanding/ Comprehension
			CO2	students will be well acquainted with the methods of designing of converters for improving power quality issues,	Understanding/ Comprehension
			CO3	students will be substantially prepared to learn about harmonics, its sources and remedies.	Identify/ Knowledge/ Remember
			CO4	Students will able to monitor the power quality issue in the power system networks	Understanding/ Comprehension

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS

No.	Content	Hours	COs
I	**Introduction of the Power Quality problem, Terms used in Power Quality:** Definition, Bad power, Good power, Voltage, Voltage sag – definition, causes of voltage sag, voltage sag magnitude, and monitoring, theoretical calculation of voltage sag magnitude, Sag, Swell, Surges, Harmonics, Long Interruptions, Short interruptions, over voltages, under voltages, spikes, voltage fluctuations, Transients, Interruption, overview of power quality phenomenon, Remedies to improve power quality, power quality monitoring.	10	CO1 CO2 CO3
II	**Harmonics:** Introduction, Harmonic Sources from Commercial Loads ,Single Phase Power Supplies, Fluorescent Lighting, Adjusting speed drives for HVAC and Elevators, Harmonic Sources from Industrial Loads, Locating Harmonic Sources, Power System Response Characteristics, System Impedance, Capacitor Impedance ,Parallel Resonance ,Series Resonance, Effects of Harmonics, Harmonic Distortion, Voltage and Current Distortion, Harmonic Indices, Total Harmonic Distortion, Total Demand Distortion, Devices for controlling Harmonic Distortion.	10	CO2 CO3
III	**Sources for Electric Power Quality problem in power system:** Poor load power factor, Non-linear and unbalanced loads Overview of mitigation methods – from fault to trip, reducing the number of faults, reducing the fault clearing time changing the power system, installing mitigation equipment, improving equipment immunity, different events and mitigation methods. System equipment interface – voltage source converter, series voltage controller, shunt controller, combined shunt and series controller.	15	CO2 CO3
IV	**Power Quality Monitoring:** Introduction,Monitoring Consideration,Monitoring as part of a facility site survey ,Determining what to monitor ,Choosing Monitoring Locations,Options for Permanent Power Quality Monitoring Equipment,Find the Sources of Disturbance,Power Quality Measurement Equipment, Disturbance Analyzers,Spectrum analyzers and Harmonic Analyzer,Flicker Meters, Application of Expert Systems for Power Quality Monitoring,Basic Design of an Expert System for Monitoring Applications ,Future Applications.	10	CO3 CO4
	Total Hours	45	

Text Books:

1. *Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.Wayne Beaty, "Electrical Power Systems Quality", McGraw Hill, 2003.*
2. *Jos Arrillaga, Neville R. Watson, " Power System Harmonics"- John Wiley & Sons, 2003.*
3. *G.T.Heydt, "Electric Power Quality", Stars in a Circle Publications, 1994(2nd edition).*
4. *Arindam Ghosh "Power Quality Enhancement Using Custom Power Devices", Kluwer Academic Publishers, 2002.*

Reference Books:

1. *"Understanding Power Quality Problems" by Math H J Bollen. IEEE Press.2019*
2. *David D. Shipp and William S. Vilcheck, "Power Quality and Line Considerations for Variable Speed AC Drives", IEEE Transactions on Industry Applications, Vol. 32, March / April – 1996*

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CURRICULUM

Programme	Masters in Power Electronics and Sustainable Energy		Academic Year of Regulation	2025-26
Department	Electrical Engineering		Semester	II

Course Code	Course Name	Credit Structure				Marks Distribution				
		L	T	P	C	INT	M ID	END	Total	Bloom's taxonomy
EE – 5205	Soft Computing Techniques in Power Electronics and Renewable Energy	3	0	0	3	20	30	50	100	

Course Objectives	1. Introduce the fundamentals of classical and modern optimization methods for power system applications. 2. Understand mathematical modelling of optimization problems encountered in power systems. 3. Study evolutionary, metaheuristic, and intelligent optimization techniques. 4. Apply optimization tools for economic dispatch, unit commitment, OPF, and renewable integration. 5. Expose students to simulation and software-based implementation of modern optimization algorithms.	Course Outcomes	CO1	Explain the need, principles, and classifications of optimization techniques in power systems.	Understand / Apply
			CO2	Formulate power system optimization problems such as ED, UC, and OPF using appropriate models.	Analyze
			CO3	Evaluate and compare classical, evolutionary, and metaheuristic optimization algorithms.	Analyze / Evaluate
			CO4	Apply modern optimization techniques (GA, PSO, DE, ANN, Fuzzy, Hybrid) to power system problems.	Apply / Create
			CO5	Analyze case studies of renewable energy integration, congestion management, and planning using optimization tools.	Evaluate / Create

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
5	CO5															
(Average)																

SYLLABUS			
No.	Content	Hours	COs
I	**Introduction to Optimization in Power Systems** Optimization concepts: objective functions, constraints, feasible region; classification of optimization problems; linear and nonlinear optimization; unconstrained and constrained optimization; convexity, KKT conditions. Applications in power systems: economic dispatch, unit commitment, optimal power flow, capacitor placement, loss minimization, reliability and planning.	13	CO1
			CO2
II	**Classical Optimization Techniques** Linear Programming (LP): formulation, simplex method, duality. Nonlinear Programming (NLP): gradient-based methods, Lagrange multipliers. Quadratic Programming (QP) and dynamic programming: applications to ED and UC. Interior-point methods for OPF.	16	CO2
			CO3
III	**Evolutionary and Metaheuristic Optimization Techniques** Genetic Algorithm (GA): encoding, fitness, selection, crossover, mutation; applications in OPF and UC. Particle Swarm Optimization (PSO): velocity–position update, variants, power system applications. Differential Evolution (DE): mutation strategies, applications. Simulated Annealing (SA), Tabu Search (TS), Ant Colony Optimization (ACO). Comparison of metaheuristics.	8	CO3
			CO4
IV	**Intelligent and Hybrid Optimization Techniques** Fuzzy logic and fuzzy optimization; fuzzy ED and reactive power control. Artificial Neural Networks (ANN): training, validation, forecasting applications. Hybrid methods (GA–PSO, ANN–PSO, Fuzzy–GA). Application to renewable power forecasting, grid integration, and planning.	8	CO3
			CO4
			CO5
	Total Hours	45	

Text Books:

1. Kalyanmoy Deb, *Optimization for Engineering Design*, Prentice Hall of India.

2. Jizhong Zhu, *Optimization of Power System Operation*, Wiley-IEEE Press.

3. S. Sivanagaraju & G. Sreenivasan, *Power System Operation and Control*, Pearson.

4. Kalyanmoy Deb, *Optimization for Engineering Design*, Prentice Hall of India.

Reference Books:

5. Kalyanmoy Deb, *Multi-Objective Optimization Using Evolutionary Algorithms*, Wiley.

6. James Kennedy & Russell Eberhart, *Swarm Intelligence*, Morgan Kaufmann.
7. D. P. Kothari & I. J. Nagrath, *Modern Power System Analysis*, McGraw-Hill.
8. S. Chakrabarti, M. Pant & C. A. C. Coello, *Metaheuristics for Power Systems*, Springer.

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CURRICULUM

Programme	M.Tech. (Power Electronics and Sustainable Energy)			Academic Year of Regulation				2025-26
Department	Electrical Engineering			Semester				II

Course Code	Course Name	Credit Structure				Marks Distribution			
		L	T	P	C	INT	MID	END	Total	Bloom's taxonomy
EE – 5206	Advanced Control System Laboratory	0	0	2	1	20	30	50	100	

Course Objectives	1. Provide hands-on experience with advanced control techniques used in modern engineering systems. 2. Implement system modeling, identification, and controller design using software and real-time platforms. 3. Analyze stability, performance, and robustness of various advanced control schemes. 4. Develop skills in simulation, tuning, and validation of controllers for linear and nonlinear systems.	Course Outcomes	CO1	Model and analyze dynamic systems using simulation and real-time tools.	Understanding/ Comprehension
			CO2	Design and implement PID, state-space, and optimal controllers.	Understanding/ Comprehension
			CO3	Evaluate system stability and performance using frequency-domain and time-domain methods.	Identify/ Knowledge/ Analyzing
			CO4	Implement advanced control algorithms (LQR, adaptive, robust control) in hardware/software environments.	Understanding Analyzing

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS			
No.	Content	Hours	COs
I	System Modeling and Identification Using MATLAB/Simulink	2	CO1
II	PID Controller Design and Tuning	2	CO2
III	State-Space Control: State Feedback and Observer Design	2	CO3
IV	Optimal Control Using LQR	2	CO3
V	Frequency-Domain Analysis Using Bode, Nyquist, and Nichols Plots	2	CO3
	Total Hours	10	

Text Books:

1. K. Ogata, "Modern Control Engineering," Pearson, 2016.

2. B.C. Kuo, "Automatic Control Systems," McGraw-Hill, 2014.

3. G.F. Franklin, J.D. Powell, A. Emami-Naeini, "Feedback Control of Dynamic Systems," Pearson, 2019.

4. M. Gopal, "Control Systems: Principles and Design," McGraw-Hill, 2012.

Reference Books:

1. M. Gopal, "Digital Control and State Variable Methods," McGraw-Hill, 2012.
2. J.J. D'Azzo, C.H. Houpis, "Linear Control System Analysis and Design," McGraw-Hill, 2003.
3. H.K. Khalil, "Nonlinear Systems," Pearson, 2002.
4. D.E. Kirk, "Optimal Control Theory: An Introduction," Dover, 2004.

Programme	Master of Technology in Power Electronics and Sustainable Energy	Academic Year of Regulation	2025-26
Department	Electrical Engineering	Semester	III

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 610B	Bio-fuels and decentralized energy systems	3	0	0	3	20	30	50	100	

Course Objectives	1. Understand the fundamental concepts of biofuels and decentralized energy systems. 2. Explore various types of biofuels, their production, and applications. 3. Analyze the design and implementation of decentralized energy systems. 4. Evaluate the sustainability and economic aspects of biofuels and decentralized systems.	Course Outcomes	CO1	Understand biofuel types, production processes, and applications.	Remembering
			CO2	Apply knowledge of biofuel technologies to decentralized energy systems.	Understanding
			CO3	Analyze the efficiency and feasibility of decentralized energy models.	Applying
			CO4	Evaluate sustainability, environmental, and economic impacts of biofuels and decentralized systems.	Evaluating

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS			
No.	Content	Hours	COs
I	Introduction to Biofuels: Types of biofuels (biogas, biodiesel, bioethanol), feedstocks, conversion processes.	10	CO1, CO2
II	Biofuel Production Technologies: Fermentation, pyrolysis, gasification, transesterification, algae-based biofuels.	12	CO2, CO3
III	Decentralized Energy Systems: Microgrids, off-grid solutions, hybrid renewable systems, rural electrification.	10	CO1, CO3
IV	Sustainability and Economic Aspects: Life cycle assessment, policy frameworks, environmental impact, cost analysis.	13	CO3, CO4
Total Hours		45	

Text Books:

1. S. K. Sharma & A. Pandey, "Advances in Biofuels and Bioenergy," Springer, 2020.
2. D. Pimentel, "Biofuels, Solar and Wind as Renewable Energy Systems," Springer, 2016.
3. B. K. Barnwal, "Biomass and Biofuels: Advanced Biorefineries for Sustainable Production," Elsevier, 2021.
4. C. Song, "Introduction to Biofuel Technologies," CRC Press, 2022.

Reference Books:

1. M. Kaltschmitt, "Biomass for Renewable Energy, Fuels, and Chemicals," Academic Press, 2018.
2. J. Twidell & T. Weir, "Renewable Energy Resources," Routledge, 2021.
3. R. Sims, "Bioenergy Options for a Cleaner Environment," Elsevier, 2020.
4. H. Hofbauer, "The Biorefinery Concept: Energy and Material Recovery," Springer, 2019.

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Programme	Master of Technology in Power Electronics and Sustainable Energy				Academic Year of Regulation			2025-26
Department	Electrical Engineering					Semester		III

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 610C	Building energy and green building	3	0	0	3	20	30	50	100	

Course Objectives	• Understand the principles of building energy performance and sustainability. • Analyze energy-efficient building materials and designs. • Explore green building concepts, rating systems, and policies. • Evaluate energy conservation techniques and renewable energy integration in buildings.	Course Outcomes	CO1	Understand the fundamentals of building energy performance and sustainability.	Remembering
			CO2	Analyze energy-efficient materials, HVAC systems, and lighting.	Understanding
			CO3	Apply green building concepts, rating systems, and design methodologies.	Applying
			CO4	Evaluate energy conservation techniques and renewable energy solutions in buildings.	Evaluating

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS			
No.	Content	Hours	COs
I	Introduction to Building Energy: Energy demand, consumption patterns, efficiency indicators, climate-responsive design, energy codes.	10	CO1, CO2
II	Green Building Concepts: Sustainable design principles, passive and active strategies, green building rating systems (LEED, GRIHA, BREEAM).	12	CO2, CO3
III	Energy Systems in Buildings: HVAC systems, natural ventilation, lighting efficiency, thermal comfort, insulation materials.	10	CO3, CO4
IV	Renewable Energy in Buildings: Solar PV, solar thermal, wind energy, geothermal, net-zero energy buildings.	13	CO4
	Total Hours	45	

Text Books:

1. J. K. Nayak and J. A. Prajapati, "Handbook on Energy Conscious Buildings," IIT Bombay, 2006.

2. K. Y. Rao, "Energy Efficient Buildings in India," Tata Energy Research Institute, 2004.

3. O. P. Agrawal, "Green Buildings: Concepts and Practices," CRC Press, 2019.

4. D. A. Bown, "Sustainable Buildings and Energy Efficiency," Wiley, 2015.

Reference Books:

1. A. K. Athienitis, "Modeling, Design, and Optimization of Net-Zero Energy Buildings," Elsevier, 2017.
2. M. Santamouris, "Energy Performance of Buildings: The Role of Energy Efficiency and Renewables," Elsevier, 2010.
3. ASHRAE, "Handbook of HVAC Systems and Equipment," ASHRAE, 2016.
4. J. Twidell and T. Weir, "Renewable Energy Resources," Taylor & Francis, 2015.

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CURRICULUM

Programme	Master of Technology in Power Electronics and Sustainable Energy				Academic Year of Regulation			2025-26	
Department	Electrical Engineering					Semester		III	

Course Code	Course Name	Credit Structure					Marks Distribution			Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 610A	Fundamentals of thermal and electrical engineering	3	0	0	3	20	30	50	100	

Course Objectives	• Introduce the fundamental concepts of thermal and electrical engineering. • Understand the principles of thermodynamics and heat transfer. • Analyze electrical circuit fundamentals and energy conversion principles. • Explore the integration of thermal and electrical systems in renewable energy applications.	Course Outcomes	CO1	Understand the fundamental concepts of thermodynamics and electrical engineering.	Remembering
			CO2	Apply thermodynamic and electrical principles to energy systems.	Understanding
			CO3	Analyze thermal and electrical energy conversion processes.	Applying
			CO4	Evaluate the performance of energy systems in renewable applications.	Evaluating

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS			
No.	Content	Hours	COs
I	Fundamentals of Thermodynamics: Laws of thermodynamics, energy interactions, entropy, exergy analysis.	10	CO1, CO2
II	Heat Transfer: Conduction, convection, radiation, heat exchangers, thermal resistance.	12	CO2, CO3
III	Electrical Circuits and Power Systems: Basic circuit analysis, AC/DC circuits, electrical power generation and distribution.	10	CO1, CO3
IV	Energy Conversion and Efficiency: Thermal-to-electrical energy conversion, renewable energy integration, efficiency improvements.	13	CO3, CO4
	Total Hours	45	

Text Books:

1. *Y. A. Çengel and M. A. Boles, "Thermodynamics: An Engineering Approach," McGraw-Hill, 2020.*

2. *J. P. Holman, "Heat Transfer," McGraw-Hill, 2018.*

3. *V. Del Toro, "Electrical Engineering Fundamentals," Pearson, 2019.*

4. *A. E. Fitzgerald, "Electric Machinery," McGraw-Hill, 2015.*

Reference Books:

1. *R. A. Serway and J. W. Jewett, "Physics for Scientists and Engineers," Cengage Learning, 2019.*
2. *S. J. Chapman, "Electric Machinery and Power System Fundamentals," McGraw-Hill, 2012.*
3. *G. F. Hundy, "Refrigeration and Air-Conditioning," Elsevier, 2016.*
4. *R. Saidur, "Energy and Exergy Analysis in Renewable Energy Systems," Elsevier, 2018.*

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CURRICULUM

Programme	Master of Technology in Power Electronics and Sustainable Energy				Academic Year of Regulation			2025-26
Department	Electrical Engineering					Semester		III

Course Code	Course Name	Credit Structure				Marks Distribution				Bloom's taxonomy
		L	T	P	C	INT	MID	END	Total	
EE – 610D	Waste to Energy	3	0	0	3	20	30	50	100	

Course Objectives	- Understand the fundamental principles of waste-to-energy conversion technologies. - Analyze various waste treatment methods and their energy recovery potential. - Explore thermochemical and biochemical conversion technologies for energy generation. - Evaluate economic, environmental, and policy aspects of waste-to-energy systems.	Course Outcomes	CO1	Understand different types of waste and their energy potential.	Remembering
			CO2	Analyze thermochemical and biochemical waste-to-energy processes.	Understanding
			CO3	Apply waste-to-energy technologies for sustainable energy production.	Applying
			CO4	Evaluate economic, environmental, and policy aspects of waste-to-energy systems.	Evaluating

No.	COs	Mapping with Program Outcomes (POs)												Mapping with PSOs		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	CO1															
2	CO2															
3	CO3															
4	CO4															
(Average)																

SYLLABUS

No.	Content	Hours	COs
I	Introduction to Waste-to-Energy: Types of waste, composition, energy content, need for waste-to-energy, global and Indian scenario.	10	CO1, CO2
II	Thermochemical Conversion: Incineration, pyrolysis, gasification, plasma arc gasification; process principles, technologies, advantages, and limitations.	12	CO2, CO3
III	Biochemical Conversion: Anaerobic digestion, landfill gas recovery, bioethanol, and biodiesel production.	10	CO3
IV	Economic, Environmental, and Policy Aspects: Cost-benefit analysis, environmental impacts, emissions control, waste management policies, case studies.	13	CO4
Total Hours		45	

Text Books:

1. S. N. Naik, "Biomass to Biofuels: Strategies for Global Industries," Wiley, 2011.
2. A. V. Bridgwater, "Thermochemical Processing of Biomass: Conversion into Fuels, Chemicals and Power," Wiley, 2013.
3. C. M. Fisk, "Waste to Energy: Technologies and Project Implementation," Elsevier, 2016.
4. R. Murphy, "Renewable Energy from Waste: Fundamentals and Applications," Springer, 2020.

Reference Books:

1. M. Kaltschmitt, H. Hartmann, and H. Hofbauer, "Energy from Biomass: Fundamentals, Processes, and Applications," Springer, 2019.
2. T. M. Letcher, "Waste to Energy: Opportunities and Challenges for Developing and Transition Economies," Academic Press, 2019.
3. P. Chandra, "Biogas Production: Strategies and Applications," Springer, 2021.
4. J. R. Mihelcic, "Environmental Engineering: Fundamentals, Sustainability, Design," Wiley, 2014.