SCHEME & SYLLABUS OF

UNDERGRADUATE DEGREE COURSE

Electrical Engineering

VII & VIII Semester

Effective for the students admitted in year 2021-22 and onwards.

Teaching and Examination Scheme

4th Year – VII Semester

S. No.	Category	Code	Course Title	Contact hrs./week			Marks				Cr
				L	T	P	Exam Hrs.	IA	ETE	Total	
THEORY											
1	DC	7EE4-01	Electrical Drives	3	0	0	3	30	70	100	3
2	DE-4	7EE5-11	Micro and Smart Grid Systems	2	0	0	3	30	70	100	2
		7EE5-12	Renewable Energy Systems								
		7EE5-13	Fundamentals of Power Quality Improvement								
3	UE-1		Elective Group-I	3	0	0	3	30	70	100	3
			Sub Total	**8**	**0**	**0**		**90**	**210**	**300**	**8**
PRACTICAL & SESSIONAL											
4	DC	7EE4-20	Computer Based Power System Lab	0	0	2		60	40	100	1
5	UI	7EE7-30	Industrial Training (45 days)	0	0	1		60	40	100	3
6	UI	7EE7-50	Minor Project	0	0	3		60	40	100	2
7	UGE	7EE8-00	*Co-Curricular Activities*	0	0	2		60	40	100	1
			Sub- Total	**0**	**0**	**14**		**240**	**160**	**400**	**7**
			TOTAL OF VII SEMESTER	**8**	**0**	**14**		**330**	**370**	**700**	**15**

Teaching and Examination Scheme

4th Year – VIII Semester

S. No.	Category	Code	Course Title	Contact hrs./week			Marks				Cr
				L	T	P	Exam Hrs.	IA	ETE	Total	
THEORY											
1	UE-2		Elective Group-II	3	0	0	3	30	70	100	3
			Sub Total	**3**	**0**	**0**		**30**	**70**	**100**	**3**
PRACTICAL & SESSIONAL											
2	UI	8EE7-40	Seminar	0	0	2		60	40	100	2
3	UI	8EE7-50	Major Project	0	0	3		60	40	100	4
4	UGE	8EE8-00	*Co-Curricular Activities*	0	0	4		60	40	100	2
			Sub- Total	**0**	**0**	**16**		**180**	**120**	**300**	**8**
			TOTAL OF VIII SEMESTER	**3**	**0**	**16**		**210**	**190**	**400**	**11**

Syllabus

B.Tech. (Electrical Engineering)

IV Year VII Semester

7EE4-01: Electrical Drives	
Credit: 3	**Max Marks: 100 (IA: 30, ETE: 70)**
3L+ 0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand the dynamics of electric drives and loads and power converters for AC drives.

CO-2: Learn about the starting, braking-regenerative braking, dynamic braking and plugging of DC drive. Also able to explain Controlled Rectifier fed DC drives and Chopper Controlled DC drives.

CO-3: Know the induction motor drives and CSI/VSI controlled induction motor drives.

CO-4: Analyze the control of synchronous motor drive.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course	**1**
2.	**Dynamics of Electric Drives:** Fundamental torque equations, speed-torque conventions and multiquardant operation, equivalent values of drive parameters, nature and classification of load torques, steady state stability, load equalization, close loop configurations of drives	**3**
3.	**DC Drives:** Speed torque curves, torque and power limitation in armature voltage and field control, Starting, Braking-Regenerative Braking, dynamic braking and plugging. Speed Control-Controlled Rectifier fed DC drives, Chopper Controlled DC drives.	**7**
4.	**Induction Motor Drives-I:** Starting, Braking-Regenerative braking, plugging and dynamic braking. Speed Control-Stator voltage control, variable frequency control from voltage source, Voltage Source Inverter (VSI) Control.	**9**
5.	**Induction Motor Drives-II:** Variable frequency control from current source, Current Source Inverter (CSI) Control, Cycloconverter Control, Static rotor resistance control, Slip Power Recovery- Stator Scherbius drive, Static Kramer drive.	**9**
6.	**Power Converters for AC drives:** PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, Diode rectifier with	**9**

	boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices	
7.	**Introduction to Synchronous Motor Drive:** Control of Synchronous Motor-Separately Controlled and VSI fed Self-Controlled Synchronous Motor Drives. Dynamic and Regenerative Braking of Synchronous Motor with VSI.	**3**
	Total	**41**

Suggested Books:

1. G. K. Dubey: Fundamentals of Electrical Drives, Narosa Publishing House, New Delhi.
2. V. Subrahmanyam: Thyristor Control of Electric Drives, Tata McGraw Hill, New Delhi.
3. V. Subrahmanyam: Electric Drives- Concepts and Applications, Tata McGraw Hill.
4. S. K. Pillai: A First Course on Electrical Drives, Wiley Eastern limited, India.

IV Year VII Semester

7EE5-11: Micro and Smart Grid Systems	
Credit: 2	**Max Marks: 100 (IA: 30, ETE: 70)**
2L+ 0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand the basic concept of smart grid, its importance and present status of development of smart grid.

CO-2: Know about the smart grid technologies EMS, FACTS, HVDC and Wide area monitoring Systems (WAMS).

CO-3: Learn the importance of Advanced Metering Infrastructure, Phasor Measurement Unit (PMU) and Intelligent Electronic Devices (IED).

CO-4: Explain the power quality in smart grids, power quality monitoring and cyber security in smart grids.

CO-5: Explore the microgrids, Microgrid control, Microgrid power flow, DC microgrids, and stability of DC microgrids.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Introduction to Smart Grid**: Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient &Self-Healing Grid, Present development & International policies in Smart Grid.	**5**
3.	**Smart Grid Technologies:** Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, EMS, FACTS and HVDC, Wide area monitoring Systems (WAMS), Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Plug in Hybrid Electric Vehicles (PHEV).	**5**
4.	**Advanced Metering Infrastructure:** Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) and their application for monitoring and protection.	**7**
5.	**Power Quality and Smart Grid:** Power quality and EMC in smart grid, Power Quality issues in grid connected renewable energy sources, Power Quality	**6**

	Conditioners for Smart Grid, Power Quality monitoring, Power Quality Audit, Cyber Security for Smart Grid.	
6.	**Microgrid:** The concept of microgrids, Microgrid control: Centralized control, Primary, secondary and tertiary control, distributed control, Microgrid power flow – Networked microgrid power flow, Formal Analysis of Networked Microgrids Dynamics. **DC Microgrids:** Overview of DC microgrids, Stability of DC microgrids.	**6**
	Total	**30**

Suggested Books:

1. Stuart Borlase: Smart Grid-Infrastructure, Technology and Solutions, CRC Press 2012.
2. Radian Belu: Smart Grid Fundamentals Energy Generation, Transmission and Distribution, CRC Press.
3. Muhammad Kamran: Fundamentals of Smart Grid Systems, Academic Press Inc.
4. Microgrid Technologies: Sharmeela Chenniappan, Sivaraman Palanisamy, P. Sanjeevikumar, Jens Bo Holm-Nielsen, John Wiley & Sons

IV Year VII Semester

7EE5-12: Renewable Energy Systems	
Credit: 2	**Max Marks: 100 (IA: 30, ETE: 70)**
2L+0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Understand the energy scenario, renewable energy sources and their utilization.

CO-2: Explore society's present needs and future energy demands.

CO-3: Study the principles of renewable energy conversion systems.

CO-4: Exposed to energy conservation methods.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	**1**
2.	**Renewable Energy Resources**: Classification of Energy Resources; Conventional Energy Resources–Availability and their limitations; Non-Conventional Energy Resources–Classification, Advantages, Limitations; Comparison of Conventional and Non-Conventional Energy Resources; World Energy Scenario; Indian Energy Scenario; Introduction to Internet of energy (IOE).	**4**
3.	**Solar Energy:** Solar Radiation; Radiation Measurement; Solar Thermal Power Plant; Solar Ponds, Solar Photovoltaic (SPV) systems: Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells; Photovoltaic cell concepts: Cell; module; array; PV Module I-V and P-V Characteristics; Efficiency and Quality of the Cell; series and parallel connections; maximum power point tracking; Applications.	**8**
4.	**Wind Energy:** Properties of wind, availability of wind energy in India, Factor affecting wind power, Wind turbine characteristics, Basic components of wind energy conversion system (WECS), Classification of WECS, Horizontal axis wind turbines: single; double and multi-blade system. Vertical axis wind turbines: Savonius and Darrieus types.	**8**
5.	**Biomass Energy**: Biogas generation, Biomass as a source of energy, Applications of Biomass plants, Biogas for Biomass. **Geothermal Energy**: Geothermal fields, Basic geothermal steam power plant, binary fluid geothermal power plant, Advantages and disadvantages of geothermal energy, Geothermal energy in India.	**5**

6.	**Tidal Power**: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power; advantages and limitations. **Ocean Thermal Energy Conversion:** Principle of working; problems associated with OTEC, Applications, advantages and Limitations of OTEC.	**5**
	Total	**31**

Suggested Books:

1. Non-conventional Energy sources, G. D. Rai, Khanna Publication, Fourth Edition.
2. Begamudre R. D: Energy Conversion Systems, New Age International Publishers
3. Non-Convention Energy Resources, Shobh Nath Singh, Pearson, 2018.
4. Renewable Energy Sources and Their Environmental Impact, S. A. Abbasi and N. Abbasi, Prentice Hall of India, 2001.
5. Energy Technology, S. Rao and Dr. B. B. Parulekar, Khanna Publication.
6. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill, 1996.

IV Year VII Semester

7EE5-13: Fundamentals of Power Quality Improvement	
Credit: 2	**Max Marks: 100 (IA: 30, ETE: 70)**
2L+0T+ 0P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Explain various power quality terms of electrical power system.
CO-2: Analyze the causes of harmonics, its effect on various equipment.
CO-3: Know about the classification and principle of passive and active power filters.
CO-4: Explore the operation and working principle of shunt and series active power filter.

S. No.	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course	**1**
2.	**Concept of Power Quality:** Frequency variations, voltage variations- sag and swell, waveform distortion –dc offset, harmonics, inter-harmonics, notching and noise. **Harmonic indices** (CF, DF, THD, TDD), Displacement and total power factor Overview of power quality standards: IEEE 519, IEEE 1433 and IEC 61000	**3**
3.	**Causes and Effect of Harmonics:** 2-pulse, 6-pulse and 12-pulse converter configurations, input current waveforms and their harmonic spectrum; Input supply harmonics of AC regulator and transformer. Parallel and series resonance, effect of harmonics on static power plant – transmission lines, transformers, capacitor banks, Induction Machines and Communication Lines.	**6**
4.	**Passive Filters:** Introduction, Undesirable Effects of Harmonics, Harmonic Sources, Types of Filters, Types of Damped Filters, Design of Single-Tuned Filters, Filter Performance Evaluation, Design of Damped Filters, Comparison of Tuned and Damped Filters, Filter Component Ratings, Filter Capacitors, Tuning Reactors, Outline of Filter Design.	**6**
5.	**Active Power Filters:** Compensation principle, classification of active filters by objective, system configuration, and power circuit and control strategy. Voltage sourced active filter, current sourced active filter, constant frequency control, constant tolerance band control, variable tolerance band control	**7**

6.	**Shunt Active Filter:** Single-phase active filter, principle of operation, expression for compensating current, concept of constant capacitor voltage control; Three-phase active filter: Operation &analysis; Instantaneous reactive power theory. **Three-phase Series Active Filter:** Principle of operation, analysis and modelling.	**8**
	Total	**31**

Suggested Books:

1. Dugan R. C., McGranaghan M. F. and Beaty H. W., Electrical Power System Quality", McGraw-Hill International Book Company
2. Sankaran C., "Power Quality", CRC Press
3. Singh, Bhim, Ambrish Chandra, and Kamal Al-Haddad. Power quality: problems and mitigation techniques. John Wiley & Sons, 2014.
4. Arrillaga J., Braedlley D. A. and Bodger P. S., "Power System Harmonics", John Wiley and Sons.

IV Year VII Semester

7EE4-20: Computer Based Power System Lab	
Credit: 1	**Max Marks: 100 (IA: 60, ETE: 40)**
0L+ 0T+ 2P	**End Term Exams: 3 hrs.**

Course Outcomes:

Upon successful completion of the course, the students will be able to:

CO-1: Know the load flow numerically using Gauss Seidal, Newton Raphson and Fast Decoupled Method using simulation tool.

CO-2: Analyze the various kind of faults in a power system.

CO-3: Solve the economic load dispatch problem with different methods.

CO-4: Analyze the voltage security analysis and reactive power control.

CO-5: Model a system and observe the steady state and transient analysis using standard software.

S. No.	**List of Experiments**	**Hours**
1.	Perform load flow analysis of a given system multi-bus system by Gauss Seidal method using MATLAB or any available software.	**3**
2.	Perform load flow analysis of a given system multi-bus system by (i) Newton Raphson and (ii) Fast Decoupled Method using MATLAB or any available software.	**3**
3.	Perform the fault analysis of a given system multi-bus system using MATLAB or any available software for the cases: (i) LG Fault (ii) LLG Fault (iii) LL Fault and (iv) 3-Phase Fault	**3**
4.	Study of voltage security analysis.	**3**
5.	Study of overload security analysis and obtain results for the given problem using MATLAB or any software.	**3**
6.	Study of economic load dispatch problem with different methods.	**3**
7.	Study of transient stability analysis using MATLAB/ETAP Software.	**3**
8.	Simulate a problem demonstrating Reactive Power Control.	**3**
9.	Develop mathematical models of grid connected generator and conduct steady state and transient analysis using standard software.	**3**
	Total	**27**