HONORS IN ELECTRICAL ENGINEERING

SCHEME OF INSTRUCTION AND EVALUATION w.e.f. 2025-2026

S. No.	Code	Course Title	Scheme of Instruction			Contact Hrs/Wk	Scheme of Evaluation			Credits	Sem.
			L	T	P		Hrs	CIE	SEE		
Theory											
1	HR501EE	Modern Control Theory	3	-	-	3	3	40	60	3	V
2	HR601EE	Energy Storage Systems and Applications	3	-	-	3	3	40	60	3	VI
3	HR602EE	Restructured Power Systems	3	-	-	3	3	40	60	3	VI
4	HR701EE	Control and Integration of Renewable Energy Sources	3	-	-	3	3	40	60	3	VII
5	HR702EE	Real-Time Applications in Power Systems	3	-	-	3	3	40	60	3	VII
6	HR861EE	HR- Project Work	3	-	-	6	6	50	50	3	VIII
Total			**18**	**-**	**-**	**21**	**21**	**250**	**350**	**18**	

Course Code	Course Title						Course Type
HR 701 EE	CONTROL AND INTEGRATION OF RENEWABLE ENERGY SOURCES						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives:	
1.	To understand electric power Generation, Transmission and Distribution
2.	To study Power System Operation and Control

Course Outcomes:
Upon completion of this course, the students will be able to:

CO1	Understand different renewable energy sources and storage devices.
CO2	Model and simulate renewable energy sources.
CO3	Apply various MPPT techniques for wind and solar energy generation
CO4	Analyze and simulate control strategies for grid connected and off-grid systems
CO5	Develop converters to comply with grid standards to obtain grid integration

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	3	3	1	1	2	1	2	3	3	3
CO2	3	2	3	3	3	3	1	1	2	1	2	1	3	3
CO3	3	2	3	3	3	3	1	1	1	2	1	1	3	3
CO4	3	2	3	3	3	3	1	2	2	2	1	1	3	3
CO5	3	2	3	3	3	3	1	2	2	2	2	1	3	3

UNIT I	INTRODUCTION

Electric grid, Utility ideal features, Supply guarantee, power quality, Stability and cost; Importance & Effects of Renewable Energy penetration into the grid, Boundaries of the actual grid configuration, Consumption models and patterns

UNIT II	DYNAMIC ENERGY CONVERSION TECHNOLOGIES

Introduction, types of conventional and nonconventional dynamic generation technologies, principle of
operation and analysis of reciprocating engines, gas and micro turbines, hydro and wind based generation technologies

UNIT III	STATIC ENERGY CONVERSION TECHNOLOGIES
Introduction, types of conventional and nonconventional static generation technologies; Principle of operation and analysis of fuel cell, photovoltaic systems and wind generation technologies; MPPT techniques and its classifications, principle of operation and partial shading effects; Storage Technologies - batteries, fly wheels, super capacitors and ultra-capacitors.	
UNIT IV	**CONTROL ISSUES AND CHALLENGES**
Linear and nonlinear controllers, predictive controllers and adaptive controllers, Load frequency and Voltage Control, PLL, Modulation Techniques, Control of Diesel, PV, wind and fuel cell based generators, Dimensioning of filters, Fault-ride through Capabilities.	
UNIT V	**INTEGRATION OF ENERGY CONVERSION TECHNOLOGIES**
Introduction & importance, sizing, Optimized integrated systems, Interfacing requirements, Distributed versus Centralized Control, Grid connected Photovoltaic systems – classifications, operation, merits & demerits; Islanding Operations, stability and protection issues, load sharing, operation & control of hybrid energy systems, Solar Photovoltaic applications. IEEE & IEC Codes and standards for renewable energy grid integrations	

Text Books:	
1.	Renewable and Efficient Electric Power Systems, G. Masters, IEEE-John Wiley and Sons Ltd. Publishers, 2013,2nd Edition
2.	Microgrids and Active Distribution Networks, S.Chowdhury, S. P. Chowdhury, P.Crossley, IET Power Electronics Series, 2012.
3.	Integration and Control of Renewable Energy in Electric Power System, Ali Keyhani Mohammad Marwali, Min Dai, John Wiley publishing company, 2010, 2nd Edition.
Reference Books:	
1.	Solar Photovoltaic: Fundamentals, technologies & Applications, Chetan Singh Solanki, PHI Publishers, 2019, 3rd Edition.
2.	Solar PV Power: Design, Manufacturing and Applications from Sand to Systems, Rabindra Kumar Satpathy, Venkateswarlu Parmuru, Academic Press, 2020.
3.	Control of Power Inverters in Renewable Energy and Smart Grid Integration, Quing-Chang Zhong, IEEE-John Wiley and Sons Ltd. Publishers, 2013,1st Edition.
4.	Power Conversion and Control of Wind Energy Systems, Bin Wu, Yongqiang Lang, NavidZargari, IEEE- John Wiley and Sons Ltd. Publishers,2011,1st Edition.
5.	Report on "Large Scale Grid Integration of Renewable Energy Sources - Way Forward" Central Electricity Authority, GoI, 2013.

Course Code	Course Title						Course Type
HR 702 EE	REAL-TIME APPLICATIONS IN POWER SYSTEMS						Core
Prerequisite	Contact hours per week			Duration of SEE (Hours)	Scheme of Evaluation		Credits
PSOC	L	T	P		CIE	SEE	
	3	-	-	3	40	60	3

Course Objectives

- To prepare the students to understand
- The concept of state estimation and also the solution techniques of the state estimation problem.
- The methodology for detection and identification of bad data from the available measurements in the Energy control centre.
- The concepts of power system security and methods for analyzing the system security.
- The need of computer control of power system and necessity of different softwares available in Energy control centre.

Course Outcomes

After the completion of this course, students will be able to:

1. Able to estimate the state of given power system using WLS method for the available measurements in the energy control centre.
2. Able to choose suitable state estimation solution technique for a given power system network.
3. Able to detect and identification of bad data for the set of measurements available in the energy control centre.
4. Able to analyze the security of a given power system using different methods.
5. Able to understand the need of the computer control of power system and also the significance of different software's available in the energy control centre.

Programme Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	–	–	–	–	–	–	1	3	1
CO2	3	3	2	2	3	–	–	–	–	–	–	2	3	2
CO3	3	3	2	3	2	–	–	–	–	–	–	2	3	1
CO4	3	3	3	3	3	2	1	–	1	1	2	2	3	1
CO5	2	2	2	2	3	2	1	1	2	2	2	2	2	1

UNIT I

State Estimation: Introduction, Power system state estimation, Types of measurements, Linear weighted least square (WLS) estimation theory, DC Load flow based WLS state estimation, Linearised model of WLS state estimation of Non-linear AC power systems, sequential and non-sequential methods to process measurements, typical results of state estimation on an Ac network.

UNIT II

Types of State Estimation: State estimation by conventional WLS (normal equations), orthogonal decomposition and its algorithm, hybrid method. Tracking of state estimation, Dynamic state estimation.

UNIT III

Advanced Topics in State Estimation: Detection and identification of bad measurements, estimation of quantities not being measured, Network observability and pseudo-measurements, observability by graphical technique and triangularisation approach, Optimal meter placement, Application of power system state estimation.

UNIT IV

Power System Security Analysis: Concept of security, Security analysis and monitoring, factors affecting power system security, detection of network problems, an overview of security analysis, contingency analysis for generator and line outages by interactive linear power flow (ILPF) method, network sensitivity factors.
Contingency selection

UNIT V

Computer control of Power Systems**:** Need for real-time and computer control of power systems, operating states of a power system, Supervisory control and Data acquisition system (SCADA), implementation considerations, energy control centers, software requirements for implementing the above functions.

References

1. Allen J. Wood and Bruce Woolen berg: Power System Generation, Operation and Control, John Wiley and Sons, 1996.
2. John J. Grainger and William D Stevenson Jr.: Power System Analysis, McGraw Hill ISE, 1994.
3. E. Hands chin: Real-time control of electrical power systems, Elsevier Pub. Co, 1988
4. IEEE Proc. July 1974, Special Issue on Computer Control of Power Systems.

Course Code	Course Title						Core//PE/OE
HR861EE	HR-Project Work						Core
Pre-requisites	Contact Hours Per Week				CIE	SEE	Credits
	L	T	D	P			
	-	-	-	6	50	50	3

Course Objectives

1. Prepare the student for a systematic and independent study of the state of the art topics in a the field of Electrical and Electronics Engineering.
2. To design and develop and implement a comprehensive electrical and electronics engineering project that demonstrates theoretical and practical knowledge.
3. To enhance practical and professional skills.
4. To familiarize tools and techniques of systematic Literature survey and documentation.
5. To encourage students to work with innovative and entrepreneurial ideas.

Course Outcomes : On completion of the course, students will be able to

1. To select the complex engineering problems beneficial to the industry and society to develop solutions with appropriate considerations.
2. To apply modern tools and analyze the results to provide valid conclusions.
3. To communicate effectively the solutions with report and presentation following ethics.
4. To work in teams and adapt for the advanced technological changes
5. To apply management principles to complete the project economically

CO-PO mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3			2	2						3	3
CO2				3	3								3	3
CO3								3		3				
CO4									3			3	2	2
CO5											3			

Oral presentation is an important aspect of engineering education. The objective of the course project is to prepare the student for a systematic and independent study of the state of the art topics in the field of Electrical and Electronics Engineering. Project topics may be chosen by the student with advice and approval from the faculty members.

Students are to be assessed and evaluated as per the following criteria.
Each student is required to:

1. Submit a one-page synopsis at the beginning of the semester for display on the notice board (by 2nd week after commencement of the semester)
2. Give a 20 minutes demo and demonstrate the work through LCD power point presentation followed by a

10 minutes discussion.

3. Submit a report on the project work with list of references and slides used.

- Project reviews are to be scheduled from the 3rd week of the semester to the last week of the semester and any change in schedule should be discouraged.
- Batch size should be ONE.
- Finalization of the projects will be done by the supervisor at the concerned department.
- Two reviews to be conducted – One during 5th week and another during 10^{th} week and final evaluation shall be conducted during 15^{th} to 16^{th} week.
- Students are required to give presentations during the reviews.
- Students are required to submit Project Report.

Distribution of marks for Continuous Internal Evaluation (CIE) - 50 Marks

Evaluation Criteria	**Maximum Marks**
Literature Review	05
Problem Formulation	05
Design/ Methodology	15
Implementation & Results	15
Presentation & Documentation	10

Distribution of marks for Semester End Examination (SEE) – 50 Marks

Evaluation Criteria	**Maximum Marks**
Design/ Methodology	10
Implementation & Results	15
Presentation & Documentation	15
Publication in a conference/ Journal (Published / accepted)(Compulsory)	10