Course Scheme and Syllabus for Honour Degree

in

Electrical Engineering

Department of Electrical & Instrumentation Engineering

Sant Longowal Institute of Engineering & Technology
Longowal-148106

Phone: 01672-253119/253120 Fax: 01672-280057

Website: www.sliet.ac.in

Dr. Rishabh Verma Dr. Gurmeet Singh Dr. Charanjiv Gupta Dr. M. S. Manna Prof. Manpreet Kaur Prof. A.S. Arora

Prof. Sanjay Marwaha Prof. J.S. Dhillon Dr. Chetan Vasudeva Er. Baljit Singh Prof. Mukesh Pathak Prof. Surita Maini

Annexure-B

Scheme of Honor Degree Program in Electrical Engineering

Semester-V							
S. No.	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	HDEE-611	Modelling and control of Electrical Machines	3	1	0	4	4
2	HDEE-612	Micro-grid Systems	3	1	0	4	4
		Total	3	1	0	4	4

Semester-VI							
S. No.	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	HDEE-621	Advanced Electrical Machines	3	1	0	4	4
		Total	3	1	0	4	4

Semester-VII							
S. No.	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	HDEE-711	Power System Operation and Control	3	1	0	4	4
		Total	3	1	0	4	4

Semester-VIII							
S. No.	**Sub Code**	**Subject Name**	**L**	**T**	**P**	**Hrs.**	**Credits**
1	PHEE-721	Project Honors	0	0	8	8	4
		Total	0	0	8	8	4

Subject Code : HDEE-611
Title of the course : Modelling and control of Electrical Machines

L	T	P	Credits	Hrs
3	1	0	4	4

Course Outcomes:
After successful completion of course, the students should be able to
CO 1: **Describe** the revolving field and reference frame theory
CO 2: Design mathematical model of three-phase AC machines and parameters in different reference frame
CO 3: Examine the transient performance of three-phase AC machines in different reference frames
CO 4: Design the modeling of AC machines
CO 5: Apply modern control techniques in electrical machines for different applications

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL6	BL3	BL3	BL1, BL2

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	1	2	3	-	-	-	3	2	1	2
CO2	2	3	2	2	2	-	-	-	3	2	2	2
CO3	2	-	2	3	2	-	1	-	3	2	2	2
CO4	2	2	3	2	3	1	-	-	3	2	3	2
CO5	3	3	3	2	3	1	-	-	3	2	3	2

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	Generalized transformations, Physical model, Different reference frame, Primitive machine, dynamic variable, Formulation of dynamic equations of a generalized machine in arbitrary reference frame	10
	Analysis of induction machines, Space vector, induction motor modeling in arbitrary reference frame and in field oriented frame, Performance analysis	12
Unit-2	Analysis of synchronous machine, Modeling, Operational impedances, Time constants, torque expression, Asynchronous damping,	10
	Steady state and transient performance, Phasor diagram and power angle characteristics.	10

Recommended Books-

1. Bimbhra, P.S., Generalized Theory of Electric Machines, Khanna Publishers (2006).
2. Kraus, P.C., Analysis of Electric Machine,
3. Bruzzese, Claudio. Theory of Electrical Machines. N.P., Società Editrice Esculapio, 2022.
4. Mukerji, Saurabh Kumar, et al. Electromagnetics for Electrical Machines. United Kingdom, Taylor & Francis Group, 2020.

Subject Code : HDEE-612
Title of the course : MICRO-GRID SYSTEMS

L	T	P	Credits	Hrs
3	1	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO 1: **Express** the knowledge of Microgrid Technology, issues and standards
CO 2: **Describe** about operational issues of Grid connection of DG systems
CO 3: **Explain** the operation, control and modeling of Microgrids
CO 4: **Describe** the reliability of Microgrid Technology
CO 5: **Examine** issues and standards of DGs

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2, BL6	BL1. BL2	BL2, BL3, BL4	BL1. BL2	BL1

CO/PO Mapping : (Strong(S) / Medium(M) / Weak(W) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	1	-	-	-	1	2	-	-	2
CO2	2	1	1	-	3	2	2	1	2	2	1	3
CO3	-	3	2	3	2	2	2	1	3	2	1	3
CO4	-	2	1	1	3	-	2	2	2	1	1	2
CO5	-	2	1	1	2	-	3	1	2	2	1	2

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**BASICS OF A MICROGRID:** Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, microgrid systems, Power Electronics interfaces in microgrid systems.	8 hrs
	OPERATIONAL FEATURES OF GRID CONNECTED DG SYTEMS: Grid interconnection issues for grid connected operation of various types of DG systems. Constraints on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Reliability, stability and power quality issues involved in grid connected operation of various DGs.	8 hrs
Unit-2	**OPERATION, CONTROL AND MODELLING OF MICROGRID:** Concept and definition of microgrid, review of sources of microgrids, typical structure and configuration of a microgrid, microgrid implementation in Indian and international scenario, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, communication infrastructure, modes of operation and control of microgrid: grid connected and islanded mode operation, anti-islanding	8 hrs

	schemes. Control techniques for voltage, frequency, active and reactive power control of microgrid system, Computer aided Modelling of microgrid.	
	INTRODUCTION TO RELIABILITY AND MARKET ISSUES OF MICROGRID: Power quality issue, THD reduction techniques, protection and stability analysis of microgrid, regulatory standards, introduction to microgrid reliability. Features of microgrid economy and market. LVDC Microgrid.	8 hrs
	INTERCONNECTION ISSUES AND STANDARDS OF DGs: Concept of distributed generations (DG) or distributed energy resources (DERs), topologies, selection of source, dependence on storage facilities, regulatory standards/ framework, standards for interconnecting DGs to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Grid code and Islanding & non-islanding system.	8 hrs

Recommended Books: -

1. Renewable Energy- Power for a sustainable future, third edition, Edited by Godfrey Boyle, Oxford University Press, 2013.
2. Amirnaser Yezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2009.
3. Dorin Neacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006. New Delhi.
4. Microgrids: Architectures and Control, Nikos Hatziargyriou (Editor), ISBN: 978-1-118- 72068-4, 340 pages, December 2013, Wiley-IEEE Press
5. Microgrids and Active Distribution Networks, S. Chowdhury, S.P. Chowdhury and P. Crossley, The Institution of Engineering and Technology, London, U.K, 2009.
6. Technical literatures- research papers published in power system and power electronics related reputed journals and IEEE standards.

7.Salkuti, Surender Reddy, and Ray, Papia. Next Generation Smart Grids. Singapore, Springer Singapore Pte. Limited, 2022.

8. Belu, Radian. Smart Grid Fundamentals: Energy Generation, Transmission, and Distribution. United States, CRC Press, 2022.

Subject Code : HDEE-621
Title of the course : ADVANCED ELECTRICAL MACHINES

L	T	P	Credits	Hrs
3	1	0	3	3

Course Outcomes:

After successful completion of course, the students should be able to

CO 1: **Study** about DC Permanent magnet machines
CO 2: Learn about the BLDC
CO 3: **Explain** permanent magnet AC machines
CO 4: **Identify** stepping electric machines
CO 5: **Explain** high speed and high power density motors

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL2	BL1. BL2	BL2, BL3, BL4	BL2	BL2, BL3, BL4

CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation):												
COs	Programme Outcomes (POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	-	-	-	2	2	-	1
CO2	1	1	1	-	1	1	-	-	2	1	1	1
CO3	1	2	1	2	1	2	2	-	2	2	2	2
CO4	1	2	2	2	-	2	-	-	2	2	2	2
CO5	1	2	2	2	1	2	2	-	2	2	2	2

Theory:

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Permanent Magnet d.c. Commutator Motors.** Permanent magnet versus electromagnetic excitation, Construction : Slotted-rotor PM d.c. motors, Slotless-rotor PM motors Fundamental equations: Terminal voltage, Armature winding EMF, Electromagnetic torque, Electromagnetic power, Input and output power, Losses , Pole pitch, Air gap magnetic flux density, Armature winding resistance, Armature winding inductance; Sizing procedure, Armature reaction, Commutation, Starting, Speed control, Servo motors, Applications.	12
	D.C. Brushless Motors Fundamental equations: Terminal voltage, Instantaneous current , EMF, Electromagnetic torque of a PM brushless d.c. motor; Concentrated-coil armature winding , Commutation of PM brushless motors, Toque-speed characteristics, Winding losses, Torque ripple: Sources, minimization of torque ripple, Universal brushless motor electromechanical drives, Smart Motors, Applications	10
Unit-2	**Permanent Magnet Radial Flux Synchronous Motors** Construction, Fundamental relationships: Speed, Air gap magnetic flux density, Voltage induced (FMF), Electromagnetic power, Synchronous reactance, Subtransient synchronous reactance, Transient synchronous reactance, Electromagnetic torque, Equivalent field MMF, Armature reaction reactance; Phasor	10

	diagram ,Characteristics, Starting methods, Rotor configurations comparison between synchronous and induction motors ,Applications	
	Axial Flux Motors Force and torque, Performance , Double-sided motor with internal PM disk motor, Stator core Main dimensions , Double-sided motor with one stator ,Single-sided motors, Ironless double-sided motors , Multidisk motors. Applications **Stepping Motors** Features of stepping motors **,** Fundamental equations **:** Step **,** Steady-state torque**,** Maximum synchronizing torque**,** Frequency of the rotor oscillations; PM stepping motors**,** Reluctance stepping motors**,** Hybrid stepping motors: Full stepping , Half stepping**,** Voltage equations and electromagnetic torque Characteristics: Torque-angle charactestics**,** Torque-current characteristics, Torque frequency characteristics; Applications.	10

Recommended Books: -

1. E. G. Janardhanan, 'Special Electrical Machines' PHI Learning Private Limited
2. Irving L. Kosow.'Electrical Machinery and Transformers', Oxford Science Publications.
3. Veinott & Martin,'Fractional & Subfractional hp Electric Motors'.McGraw Hill International Ed.

4. Handbook of Electric Motors. United Kingdom, CRC Press, 2018.

Subject Code : HDEE-711
Title of the course : POWER SYSTEM OPERATION AND CONTROL

L	T	P	Credits	Hrs
3	1	0	4	4

Course Outcomes:

After successful completion of course, the students should be able to

CO 1: Describe the economics of power system operation with thermal and hydro units.
CO 2: Determine various methods of solution to solve the problem of economic dispatch with various constraints.
CO 3: Categorize the hydroelectric plant models and their scheduling problems.
CO 4: Distinguish the requirements and methods of real and reactive power control in power system.
CO 5: Establish the control of generator units, like frequency control or voltage control and various controllers.

Mapping COs/Bloom's Taxonomy Level (BLs)					
COs	CO1	CO2	CO3	CO4	CO5
BLs	BL1. BL2	BL3	BL4	BL4, BL5	BL3

CO/PO Mapping: (Strong(3) / Medium(2) / Weak(1) indicates strength of correlation):														
COs	Program Outcomes (POs)/Program Special Outcome (PSO's)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	3	2	1	2	2	1	3	1	1
CO2	3	2	2	1	1	3	3	1	3	3	3	2	2	2
CO3	3	2	2	1	2	2	3	1	3	3	3	2	3	2
CO4	3	2	2	1	2	3	3	1	3	3	2	1	3	1
CO5	3	3	3	1	2	2	3	1	3	3	3	2	3	1

Theory

Unit	Main Topics and Course Outlines	Hour(s)
Unit-1	**Deregulated Economic Operation of Power Systems:** Economic operation of thermal units, hydro-thermal units under deregulated environment and environmental impacts, Fuel consumption, Characteristics of thermal unit, Incremental fuel rate and their approximation, minimum and maximum power generation limits.	10
	Economic Dispatch: Economic dispatch problem with and without transmission line losses, Unit Commitment, their solution methods. Environmental aspects in Economic dispatch. **Hydrothermal Co-ordination:** Hydro- Scheduling, Plant models, scheduling problems, Hydrothermal scheduling problems and its approach.	10
Unit-2	**Power System Control:** Power system control factors, interconnected operation, tie-line operations, Reactive power requirements, during peak and off peak hours, Elementary ideas of load frequency and voltage, reactive power control; , block diagrams of P-f and Q-V controllers, automatic load frequency control (ALFC), Static and Dynamic performance characteristics of ALFC and automatic voltage regulator (AVR) controllers, Excitation systems.	12
	Power System Security: Factors affecting security, Contingency analysis, Network sensitivity.	10

Recommended Books-

1. I.J. Nagrath and D.P. Kothari, Power System Engineering, 2nd Edition, Tata McGraw Hill, 2007.
2. O.L. Elgerd, Electric Energy Systems Theory: An Introduction, 2nd Edition, Tata McGraw Hill, 1983.
3. P. Kundur, Power System Stability & Control, Third Reprint, Tata McGraw Hill, 2007.
4. P.S.R. Murthy, Power System Operation and Control, Tata McGraw Hill, 1984.
5. W.D. Stevenson, JR. and John J. Grainger, Power System Analysis, McGraw Hill, 2007.
6. Springer Handbook of Power Systems. Germany, Springer Singapore, 2021.

Departmental BOS Committee Members:

1 Dr. Rishabh Verma 2. Dr. Mohan Kashyap 3. Dr. Manpreet Singh Manna

4 **Dr. Charanjiv Gupta 5. Dr. Gurmeet Singh**