



Swaminarayan University

Teaching & Examination Scheme

Course – Faculty of Engineering (Degree)

Branch – Electrical Engineering

Semester – 7th

Subject Code	Subject Name	Category	L	T	P	Total Credit	E	M	I	V	Total Marks
BE100701	Summer Internship	Project	0	0	0	2	0	0	20	80	100
BE105701	Switchgear and protective devices	Professional Core	4	0	2	5	60	40	20	30	150
BE105702	Machine Design	Professional Elective - 3	3	0	2	4	60	40	20	30	150
BE105703	Microcontrollers		3	0	2	4	60	40	20	30	150
BE105704	Power System stability and Control		3	0	2	4	60	40	20	30	150
BE105705	Advanced High Voltage Engineering	Professional Elective - 4	3	0	2	4	60	40	20	30	150
BE105706	Electrical Drives		3	0	2	4	60	40	20	30	150
BE105707	Advance FACTS Devices		3	0	0	3	60	40	0	0	100
BE105708	Digital Signal Processors	Professional Elective - 5	3	0	0	3	60	40	0	0	100
BE105709	Operation and Control in Power System		3	0	0	3	60	40	0	0	100
BE105710	Residential and Commercial Electrical Systems		3	0	0	3	60	40	0	0	100
BE105711	Industrial Instrumentation and Control	Open Elective - 3	2	0	2	3	60	40	20	30	150
BE105712	Fundamentals of IoT		2	0	2	3	60	40	20	30	150
	Total		15	0	8	21					

L=Lecture, T=Tutorial, P=Practical, E=Theory External, M=Theory Internal, I=Practical Internal, V=Practical External

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सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105707

Subject Name : Advance FACTS Devices

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Professional Elective-4
Rationale:	Electrical Power systems are heavily loaded because of the increase in the demand and restructured power system operation. The technical solution of utilizing available power system structure to deliver more power is using the power electronics devices in power systems for reactive power compensation and HVDC. The other uses of power electronics devices in the distribution and at consumer levels are also inevitable. The more and more use of power electronics devices in the power systems at every stage increases the problem of power quality. The course is aimed to provide exposure about power quality; the commonly used power electronics based compensating devices, its impact on Power Quality and various power quality mitigation techniques.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	30	V	
3	0	0	3	60	40	0	0	100



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105707

Subject Name : Advance FACTS Devices

	Electrochemical Reactions Due to Ground Grids, Reactive Power in Power Systems with Harmonic Distortion, Single-Phase Systems, Reliability, Power Quality Data Collection		
2	Static Var Compensators Introduction: Different Static Var Compensators, Increase in Transient Stability Margin, Damping of Power Oscillations, Voltage Support, Static Var Compensator Systems Versus Synchronous Condensers, Capacitors, and Reactors, Shunt and Series Compensation, Fundamentals of Load Compensation, Reactive Power Relationships Between Wye- and Delta-Connected Systems, Static Var Compensators for Transmission Systems, SVC Using a TCR and an FC, SVC Using a TCR and TSC, STATCOM (SVC Using Self-Commutated Inverters), SVC Using a Saturated Reactor (SR), Comparison of Static Var Systems, Specification of SVCs, FACTS Technology, Types of FACTS Controllers, Series Controllers, Shunt Controllers, Combined Series and Shunt Controllers, Case Study, Importance ThreePhase Power Flow Studies for PQ	09	15
3	Control of Static Var Compensators Introduction: Control Systems for SVCs in Transmission System Applications, Voltage Regulation, Gain Supervision, Reactive Power Control and Coordination, Control Signals for System Transient Stability, Power Oscillation Damping, and Subsynchronous Resonance Damping Enhancement, Control Systems for SVCs in Traction Applications, Load Compensation, Voltage Regulation and Balancing, Measurement of Sequence Components, Phase-Locked Oscillator Control System.	06	15
4	Harmonics Introduction: Converter Harmonics, Effect of Transformer Connections, Harmonics When There Is Overlap in the Commutation Process, Direct-Voltage Harmonics, Imperfect System Conditions, Single-Phase Power Supplies, DC Drives, AC Drives, Pulse-Width Modulation (PWM), Telecontrol Signals, Cycloconverters, Transformers, Harmonics in No-Load Exciting Current, Harmonics due to Inrush Current, DC Magnetization, Harmonics in Rotating Machines, Harmonics in Arc Furnace Loads, Harmonics in a Thyristor-Controlled Reactor, TheK-Factor.	06	10
5	Utility Harmonics Regulations and Standards Introduction: Undesirable Effects of the Harmonics, Specification of the Harmonic Limits, Philosophical Differences between IEEE 519-1992 and IEC 61000-Series Standards, IEEE 519-1992, IEC 61000-Series Standards, Assessment Procedure (Harmonic Limits), Summation Laws for Combining Harmonics, General Comments on the Standards, Allocation	06	15



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105707

Subject Name : Advance FACTS Devices

	of Harmonic Voltage or Current or Both Limits to the Customers, Empirical Nature of the Standards, Legal Responsibility for Damages due to Harmonic Problems, Application of the Standards, Application of Standards—B.C. Hydro's Approach, Examples of the Harmonic Studies.		
6	Harmonic Filters: Introduction, Undesirable Effects of Harmonics, Harmonic Sources, Types of Filters, Types of Damped Filters, AC Network Impedance, Overhead Lines, Underground Cables, Transformers, Rotating Machines, Passive Loads, Electronic Loads, Norton Equivalents of Residential Loads, 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.	06	15
7	Monitoring Power Quality: Introduction, Site Surveys, Spectrum Analyzers, Special-Purpose Power System Harmonic Analyzers, Transient-Disturbance Analyzers, Combination Disturbance and Harmonic Analyzers, Flicker Meters, Transducers, Measurement of the Frequency Response of Instrument Transformers, Description of the Instrument Transformers' Tests, Summary of the Conclusions from the Tests, Voltage Transformers, IEC-Recommended Measurement Techniques for Harmonics, Harmonics, RMS Value of a Harmonic Group, RMS Value of a Harmonic Subgroup, Total Harmonic Distortion (THD), Group Total Harmonic Distortion (THDG), Subgroup Total Harmonic Distortion (THDS), Partial Weighted Harmonic Distortion (PWHD), Interharmonics, RMS Value of an Interharmonic Component, RMS Value of an Interharmonic Group, RMS Value of an Interharmonic-Centered Subgroup, Relative and Absolute Harmonic Phase Angle Measurement, Necessity for the Measurement of Harmonic Voltages and Currents, Harmonic Monitoring System, Continuous Harmonic Analysis in Real Time, Presentation of Harmonic	06	15
	Teaching Hours	44	100

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Explain various Power Quality terms of Electrical Power System	Understand
CO2	Analyze the application of Static Var Compensators for reactive power compensation in power systems	Analyze
CO3	Analyze the causes of harmonics, their effects, and mitigation	Analyze



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch:Electrical Engineering

Subject Code: BE105707

Subject Name : Advance FACTS Devices

	techniques	
CO4	Evaluate performance of power systems under various power quality issues using monitoring tools	Evaluate

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	3	3	3	3
PO2 Discipline knowledge	2	3	3	3
PO3 Experiments and practice	-	2	3	3
PO4 Engineering tools	-	-	-	2
PO5 The engineer and society	-	1	2	2
PO6 Environment and sustainability	-	-	-	-
PO7 Ethics	-	-	-	-
PO8 Individual and team work	-	-	-	-
PO9 Communication	2	-	-	-
PO10 Life-long learning	1	1	1	2

CO\PSO MATRIX

CO \ PSO	PSO1(Power Systems Design & Analysis.)	PSO2(Use of Simulation/Software Tools)
CO1	3	1
CO2	3	2
CO3	3	2
CO4	3	3

Reference Books -

1. R. Sastry Vedam, Mulukulta S Sarma “Power Quality VAR Compensation in Power Systems” CRC Press Indian Edition Indian reprint 2013
2. C.Sankaran, “Power Quality”, First Indian reprint, CRC press
3. T. K. Nagsarkar and M. S. Sukhija “Power System Analysis” Oxford University Press



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105705

Subject Name : Advance High Voltage Engineering

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Professional Elective-4
Rationale:	Electrical power transmission is trending towards higher and higher voltages. Under such scenario, the conceptual understanding related to insulation, testing the HV devices is must for every electrical engineer. The subject deals with HV test generating devices, measurement devices, over voltages including lightning and non-destructive testing as well

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	30	V	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105705

Subject Name : Advance High Voltage Engineering

	processes – secondary effects, photoelectric emission, electron emission by positive ion and excited atom impact, thermionic emission, field emission, Townsend second ionization coefficient, secondary electron emission by photon impact, examples - transition from non-self-sustained discharges to breakdown, the Townsend mechanism, examples - the streamer or ‘kanal’ mechanism of spark, examples - the sparking voltage–Paschen’s law, penning effect.		
3	Breakdown in liquid and solid dielectrics: Liquid as insulators, breakdown in liquids - electronic breakdown, suspended solid particle mechanism, cavity breakdown, examples - static electrification in power transformers, transformer oil filtration, transformer oil test, alternative liquid insulations like vegetable oils, esters and silicon oils - breakdown in solids, intrinsic breakdown, streamer breakdown, electromechanical breakdown, edge breakdown and treeing, thermal breakdown, erosion breakdown, tracking - breakdown of solid dielectrics in practice, partial discharges in solid insulation. Generation of high voltages: Generation of high direct voltages, half and full wave rectifier circuits, voltage multiplier circuits, Van de Graff generators, electrostatic generators, examples - generation of alternating voltages, testing transformers, cascaded transformers, resonant transformers, examples - impulse voltages, Standard lightning and switching surge and associated parameters and their corrections, design and construction of impulse voltage generator circuits, Marx circuit, operation, examples - impulse current generator.	14	20
4	Measurement of high voltages: High direct voltage measurement, peak voltage measurements by spark gaps, sphere gaps, reference measuring systems, uniform field gaps, rod gaps, factors affecting sphere gap measurements, examples - electrostatic voltmeters - ammeter in series with high ohmic resistors and high ohmic resistor voltage dividers - generating voltmeters and field sensors - the measurement of peak voltages, the Chubb–Fortescue method, high-voltage capacitors for measuring circuits - voltage dividing systems and impulse voltage measurements. Numericals Over voltages, and insulation coordination: The lightning mechanism, energy in lightning, nature of danger - examples - insulation coordination, insulation level, statistical approach to insulation coordination, correlation between insulation and protection levels.	10	20



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105705

Subject Name : Advance High Voltage Engineering

5	Non-destructive test techniques: Measurement of d.c. resistivity - dielectric loss and capacitance measurements, the Schering bridge, current comparator bridges, Tan Delta measurement, Partial-discharge (PD) measurements - the basic PD test circuit, Dissolved gas analysis - Key gas method, Duval's triangle. Machine winding: Frequency Response Analysis Method (FRA)- Introduction, Sweep Frequency Response Analysis (SFRA), procedure, methods of interpretation of signature. High voltage testing: Testing of insulators and bushings, testing of isolators and circuit breakers Testing of cables, testing of transformers - testing of surge diverters	10	20
	Teaching Hours	35	100

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Apply numerical methods for engineering problem	Applying
CO2	Recall breakdown mechanism for dielectric materials in solid, liquid and gaseous state	Remembering
CO3	Classify insulation test techniques	Understanding
CO4	Examine methods for generation of test high voltage and its measurement	Analyzing

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	3	3	3	3
PO2 Discipline knowledge	2	-	2	3
PO3 Experiments and practice	2	-	2	3
PO4 Engineering tools	2	-	-	2
PO5 The engineer and society	2	-	1	2
PO6 Environment and sustainability	-	-	-	-
PO7 Ethics	-	-	-	-
PO8 Individual and team work	-	-	-	-
PO9 Communication	-	-	-	-
PO10 Life-long learning	1	1	1	2



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105705

Subject Name : Advance High Voltage Engineering

CO\PSO MATRIX

CO \ PSO	PSO1(High Voltage Engineering & Testing Knowledge.)	PSO2(Practical Tools/Simulations Use)
CO1	2	3
CO2	3	1
CO3	3	2
CO4	3	3

Reference Books -

- Kuffel, E., Zaengl W.S., Kuffel J., "High Voltage Engineering: Fundamentals" Butterworth-Heinemann (A division of Reed Educational & Professional Publishing Limited), 2nd Edition, 2000.
- Naidu M. S. and Kamaraju V., "High Voltage Engineering", fourth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2009.
- Rakosh Das Begamudre, "High Voltage Engineering, Problems and Solutions", New Age International Publishers, New Delhi, 2010.
- Dieter Kind, Kurt Feser, "High Voltage Test Techniques", Reed educational and professional publishing ltd. (Indian edition), New Delhi-2001
- M. Khalifa, "High Voltage Engineering-Theory and Practice", Marcel Dekker, Inc. New York and Basel, 1990.
- Hugh M. Ryan, "High Voltage Engineering and Testing", 2nd edition, The Institution of Electrical Engineers, London, United Kingdom, 2001
- Wadhwa C.L., "High Voltage Engineering", third edition, New Age publishers, New Delhi, 2010.
- Haddad, D. Warne, "Advances in High Voltage Engineering", IET Power and Energy, Series 40, 2007.
- Sivaji Chakravorti, Debangshu Dey, Biswendu Chatterjee, "Recent Trends in the Condition Monitoring of Transformers", Springer, 2013.
- Alston L L, High Voltage Technology, Oxford University Press, 2008

List of Practical -

- Testing of transformer oil according to IS: 6792
- Testing of solid insulation with tape electrodes
- Generation of High D.C. Voltages and measurement through sphere gaps
- Generation of High A.C. voltages and measurement through sphere gaps
- Generation of High A.C. voltages through cascaded transformers



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105705

Subject Name : Advance High Voltage Engineering

- Impulse voltage generation through Marx generator
- Impulse voltage generation through simulation
- Trace the field through electrolytic tank
- Generation and visualization of corona in corona cage
- Capacitance and loss factor measurement
- A report on visit to high voltage laboratory

Major Equipment -

Multi stage Impulse voltage generator, Multi stage Impulse current generator, High voltage AC and DC generating source (Min 100kV), Partial Discharge Measurement setup, Corona setup, Electrostatic generator, Cascade transformer, Resonant Transformer, Two to three sets of sphere gap assembly of various diameters, Faraday cage, Oil test kit, Solid insulation test kit, Schering bridge, DC resistivity measurement test kit, Surface resistance measurement test kit, Paschen's law test kit



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105708

Subject Name : Digital Signal Processor

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Professional Elective-5
Rationale:	Many Electrical and Power Electronics Applications require complex control schemes and signal processing. Hence, for such applications, embedded processor having very good control capacity and signal processing capacity both are required. So, special processors combining both these capacities are used in such applications. They are Digital Signal Controllers (DSC). They combine the best features of microcontrollers (MCU) and powerful digital signal processing (DSP) capabilities in one single chip Considering this, it becomes necessary for any electrical and power electronics engineer involved in product development to understand the concepts of Digital Signal Processing (Theoretical). Also they should understand Digital Signal Controllers from practical implementation point of view. This subject includes both of these.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	I	V	
3	0	0	3	60	40	0	0	100

Detailed Syllabus -

Unit	Content	Hours	% Of Weight
1	Introduction: Signals: Classification – Continuous & Discrete Time Signals – Basic Operations on Signals & Sequences – Elementary Signals - Discrete Time Systems & Properties of System, Impulse response of DT-LTI system, Linear Convolution. Sampling of Continuous Time Signals – Sampling Theorem – Aliasing & its Effects, Signal reconstruction.	06	10
2	Discrete Time systems and implementation: Concepts of Z transformation, properties of Z transformation etc., Block diagram / signal flow graph representation of DT System,	09	20



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105708

Subject Name : Digital Signal Processor

	Structures for realization of FIR & IIR Systems – Direct, Cascade, Parallel & Linear phase.		
3	Fourier series and Fourier Transform of DT signals: Concepts of Discrete Time Fourier series, Discrete Time Fourier Transforms –Properties, Analysis of DT-LTI systems using DTFT etc. DFT- Relationship of DFT & other transforms, Properties, Frequency spectrum using DFT, Analysis of LTI system using DFT, DFT as Linear Transformation. FFT– DIT Radix-2 FFT, DIF Radix-2 FFT, Computation of Inverse DFT using FFT	04	10
4	Representation of Numbers in digital system: (Floating point, Fixed-point representation), Types of arithmetic in digital system, Quantization effect & Errors therein, Concept of Limit Cycle Oscillations & Scaling	04	10
5	Architecture of DSP and C2000 family Features of Processors: Types of architecture, Concepts of DMA, MAC, Pipelining etc., introduction to DSP architecture. Peripherals available in DSP IC chips, requirements of on chip hardware for power electronics applications. Introduction to C2000 family of microcontrollers: Comparison of C2000 real time microcontrollers like PICOLO, DELFINO, 28M3x etc., with reference to on chip peripherals, processing capacity, applications etc.	08	20
6	Code Composer Studio: Introduction to CCS as IDE for TI processors, Basics of CCS, Multiprocessing with CCS, Testing Program, debugging Breakpoints, points, using file I/O, Memory map, Watch window, Integrated editor, project environment Software Development and Programming: Overview, description, object module, program loading and running, Assembler, Assembler directives, Macros, Linker, using C language Writing program for some simple objectives like initializing peripheral, timer interrupt and ISR for timer interrupt, PWM generation etc. for C2000 microcontrollers	09	15
7	TI 320F28X Digital Signal Controllers: TMS320F28335 Introduction, Functional Overview, Memory map, brief description of available peripherals, register maps, device emulation registers, interrupts, system control, On chip Peripherals of TMS320F28335(or any other C2000 Family processor): Timers, PWM generation, ADC, Serial Communication, GPIO, Flash Memory	08	15
	Teaching Hours	38	100



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch:Electrical Engineering

Subject Code: BE105708

Subject Name : Digital Signal Processor

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Understand concepts of Digital Signal Processing implementation requirements of Power Electronics systems	Understand
CO2	Select appropriate Digital Signal Processor / Controller for a given application	Apply
CO3	Apply concepts of Digital Signal Processing to practical application	Apply
CO4	Apply the software development tools in a real-time embedded application	Apply

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	3	2	2	2
PO2 Discipline knowledge	2	3	3	2
PO3 Experiments and practice	-	2	3	3
PO4 Engineering tools	-	-	2	2
PO5 The engineer and society	1	2	3	3
PO6 Environment and sustainability	-	-	-	-
PO7 Ethics	-	-	-	-
PO8 Individual and team work	-	-	1	1
PO9 Communication	-	1	1	1
PO10 Life-long learning	1	1	2	3

CO\PSO MATRIX

CO \ PSO	PSO1(Power Electronics and Control Systems.)	PSO2(Embedded & Real-Time Systems)
CO1	3	2
CO2	2	3
CO3	3	3
CO4	2	3



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105708

Subject Name : Digital Signal Processor

Reference Books –

- DSP-Based Electromechanical Motion Control (Power Electronics and Applications Series), Hamid A. Toliyat (Author), Steven G. Campbell, CRC press
- TI technical documents: Code Composer Studio User's Guide, Document no. SPRU328B (Data Manual 28335), SPRS439M (TI 28335 Data sheet), SPRUI07 (Technical Reference Manual), SPRU513V (Discrete TMS320C28x Assembly Language Tools User's Guide), SPRU514V (TMS320C28x Optimizing C/C++ Compiler v20.12.0.STS) , SPRAC71A (C28x Embedded Application Binary Interface), SPRU566N (C2000 Real-Time Control Peripherals)
- The DSP Handbook Algorithms, Applications and design techniques, Andrew Bateman, Iain Paterson-Stephens, Pearson Education
- C the complete reference, Herbert Scheldt



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105706

Subject Name : Electric Drives

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Professional Elective-4
Rationale:	Electric motor is inevitable part of industries. High precision Control of this electric motors for various industrial applications are needed. Electric drive using power electronic converters with suitable control strategy can control the speed and torque of electric motor precisely. The course is aimed to provide exposure about the commonly used power electronic converters for electric drive applications and various control strategies used for the purpose of motion control.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	30	V	
3	0	2	4	60	40	20	30	150

Detailed Syllabus -

Unit	Content	Hours	% Of Weight
1	Power Converters for AC drives: PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H bridge as a 4-Q drive	10	20
2	Induction motor drives: Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC).	10	20
3	Synchronous motor drives: Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.	07	10
4	Permanent magnet motor drives: Introduction to various PM motors, BLDC and PMSM drive configuration,	06	15



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105706

Subject Name : Electric Drives

	comparison, block diagrams, Speed and torque control in BLDC and PMSM.		
5	Switched reluctance motor drives: Evolution of switched reluctance motors, various topologies for SRM drives, comparison, Closed loop speed and torque control of SRM.	06	20
6	DSP based motion control: Use of DSPs in motion control, various DSPs available, realization of some basic blocks in DSP for implementation of DSP based motion control.	06	15
	Teaching Hours	53	100

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Select appropriate power electronic converters for drive applications	Apply
CO2	Analyze the vector control strategies for AC motor drives	Analyze
CO3	Select appropriate control strategies for electric drives	Apply
CO4	Evaluate performance of electric drives under different control strategies	Evaluate

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	2	3	2	3
PO2 Discipline knowledge	2	3	2	3
PO3 Experiments and practice	3	3	3	3
PO4 Engineering tools	-	2	-	2
PO5 The engineer and society	3	3	3	3
PO6 Environment and sustainability	-	-	-	-
PO7 Ethics	-	-	-	-
PO8 Individual and team work	-	-	-	-
PO9 Communication	1	-	1	1
PO10 Life-long learning	1	2	1	2

CO\PSO MATRIX

CO \ PSO	PSO1(Application of Power Electronics to Drives.)	PSO2(Simulation & Real-Time Control)
CO1	3	2



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105706

Subject Name : Electric Drives

CO2	3	3
CO3	3	2
CO4	3	3

- Select appropriate power electronic converters for drive applications.
- Analyze the vector control strategies for ac motor drives.
- Select appropriate control strategies for electric drives.
- Evaluate performance of electric drives under different control strategies.

Reference Books -

- B. K. Bose, “Modern Power Electronics and AC Drives”, Pearson Education, Asia, 2003.
- P.C. Krause, O. Wasynczuk and S.D. Sudhoff, “Analysis of Electric Machinery and Drive Systems”, John Wiley & Sons, 2013.
- H. A. Taliyat and S. G. Campbell, “DSP based Electromechanical Motion Control”, CRC press, 2003. 4. R. Krishnan, “Permanent Magnet Synchronous and Brushless DC motor Drives”, CRC Press, 2009.

List of Practical -

- PWM inverter fed three phase induction motor control using PSPICE/MATLAB/PSIM software
- VSI fed induction motor drive analysis using MATLAB/PSPICE/PSIM software
- Study of V/f control operation of three phase induction motor
- Study of vector controlled three phase induction motor drive.
- Study of permanent magnet synchronous motor drive fed by PWM inverter using simulation software. 6. Study of BLDC motor drive fed by PWM inverter using simulation software.
- Study of SRM motor drive fed by PWM inverter using simulation software.
- Regenerative/ Dynamic breaking operation for AC motor using simulation software
- PC/PLC based AC/DC motor control operation

Major Equipment -

Power semiconductor devices, power electronic converter kits, CRO/DSO, choke coil, load bank, voltage and current probes, Simulation software like Scilab, MATLAB, PSIM etc. along with necessary toolbox.



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105711

Subject Name : Industrial Instrumentation and Control

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Open Elective-3
Rationale:	Automation is playing a key role in Industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn basic of automation, how system works and importance of PLC, SCADA and robots in automation. This course will provide opportunity to learn industrial automation techniques.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	30	V	
2	0	2	3	60	40	20	30	150

Detailed Syllabus -

Unit	Content	Hours	% Of Weight
1	Introduction: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: modbus & profibus. Role of computers in measurement and control.	04	20
2	Automation components: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control. .	06	20
3	Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation,	07	20



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105711

Subject Name : Industrial Instrumentation and Control

	Application of PLC to process control industries.		
4	Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.	07	20
5	Overview of Industrial automation using robots: Basic construction and configuration of robot, Pick and place robot, Welding robot. Internet of things for plant automation and overview of Industry 4.0	06	20
	Teaching Hours	30	100

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Explain automation components and systems application	Understand
CO2	Identify suitable industrial automation hardware for a given application	Apply
CO3	Measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity, and pH	Apply
CO4	Integrate SCADA with PLC Systems	Apply

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	3	2	2	2
PO2 Discipline knowledge	2	3	2	2
PO3 Experiments and practice	-	3	3	3
PO4 Engineering tools	-	1	1	2
PO5 The engineer and society	-	1	1	2
PO6 Environment and sustainability	-	-	-	-
PO7 Ethics	-	-	-	-
PO8 Individual and team work	-	-	-	-
PO9 Communication	-	1	1	1
PO10 Life-long learning	1	2	2	2



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105711

Subject Name : Industrial Instrumentation and Control

CO\PSO MATRIX

CO \ PSO	PSO1(Automation System Design & Selection.)	PSO2(Instrumentation & Process Control)
CO1	3	2
CO2	3	3
CO3	3	3
CO4	3	3

Reference Books -

- Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
- Process Control Instrumentation Technology By. C.D. Johnson, PHI
- Industrial control handbook, Parr, Newnem
- Programmable logic controller, Dunning, Delmar

List of Experiments -

- Use industrial grade sensors and transducer introduction and characteristics like proximity detector, linear encoder, rotary encoder, touch sensor, force sensor, accelerometer, RTDs, loadcells and LVDT for measurement
- Use Various actuators such as relay, solenoid valve, process control valve and motors for control applications
- Simulate analog and digital function blocks
- Relay logic diagram and ladder logic diagram
- Understand and perform experiments on timers and counters
- Logic implementation for traffic Control Application
- Logic implementation for Bottle Filling Application
- Tune PID controller for heat exchanger using DCS
- FBD for autoclavable laboratory fermentor
- Develop graphical user interface for the plant visited by you
- Industrial visit report

Major Equipment -

- ADC, DAC and Controller, Switches, LEDs, Solenoid valves
- Relay, motor
- PLC with software
- MATLAB® or LABView®



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105711

Subject Name : Industrial Instrumentation and Control

- AC Servo drives and DC Servo drives
- Zigbee and Bluetooth based short range automation system.



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105702

Subject Name : Machine Design

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Professional Elective -3
Rationale:	Electrical machines serve as the backbone for the electrical power sector. The knowledge of electrical machines design is essential for manufacturing as well as the pre-installation performance analysis. The design is also essential for the practicing engineers in the research and development field. This subject deals with design of electrical machines including basics of computer aided design.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	30	V	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105702

Subject Name : Machine Design

	calculations, Leakage reactance of poly phase machines, Magnetizing current, Short circuit current, Circle diagram, Operating characteristics.		
4	Design of synchronous machines: Sizing of a synchronous machine, Main dimensions, Design of salient pole machines, Short circuit ratio and its significance, Shape of pole face, Armature design, Armature parameters, Estimation of air gap length, Design of rotor, Design of damper winding, Determination of full load field mmf, Design of field winding, Design of turbo alternators.	10	20
5	Computer aided design: Need for CAD analysis, Synthesis and hybrid methods, Design optimization methods, Variables, Constraints and objective function, Problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines Permanent Magnet Synchronous Machines, Brushless DC Machines and Switched Reluctance Machines.	10	20
	Teaching Hours	45	100

Course Outcomes -

CO No	Course Outcome Description	RBT Level
CO1	Select appropriate design parameters according to applications and rating of electrical machines	Apply
CO2	Design the AC machines as per the given specifications	Create
CO3	Evaluate the performance parameters of electrical machines using design parameters	Evaluate
CO4	Formulate the optimum design problem and solve it with computer-aided tools	Create

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	3	3	3	3
PO2 Discipline knowledge	2	3	3	3
PO3 Experiments and practice	2	3	2	3
PO4 Engineering tools	-	2	2	3
PO5 The engineer and society	2	3	2	3
PO6 Environment and sustainability	-	-	-	-
PO7 Ethics	-	-	-	-
PO8 Individual and team work	-	-	-	-



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105702

Subject Name : Machine Design

PO9 Communication	-	-	1	1
PO10 Life-long learning	1	2	2	3

CO\PSO MATRIX

CO \ PSO	PSO1(Electrical Machine Design Principles)	PSO2(Use of Simulation & CAD Tools)
CO1	3	2
CO2	3	3
CO3	3	3
CO4	3	3

Reference Books -

- K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 2010
- R. K. Agarwal, "Principles of Electrical Machine Design", S. K. Kataria and Sons, 2009
- M.G. Say, "Theory & Performance & Design of A.C. Machines", CBS Publishers, 2005
- S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
- K. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2015.
- Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package

List of Practical -

- Electrical machine design problems should be given for practice to the students. At least 8-10 design problems with different ratings should be practiced by the students
- Computer aided design problems 1-2 should be practiced by the students
- 3D visualization of various electrical machine components should be demonstrated to students during lab sessions using open source software.

Major Equipment –

Charts and cut section models of various electrical machines, CAD softwares like ANSYS etc.

List of Open Source Software/learning website –

E-materials available at the website of NPTEL- <http://nptel.ac.in/>



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105703

Subject Name : Microcontroller and Application

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Professional Elective-3
Rationale:	Microprocessor and microcontrollers are used to design and develop processor and computer based automatic smart electronics systems for home and industry application. This subject is devoted to the study of Advanced Microcontrollers which are used to develop and design embedded systems having low cost, low energy consumption with limited memory and having real time response. The students would learn the architecture and programming of ARM Controller in 'C' and in Assembly Language. They would also be able to develop simple applications by interfacing various sensor and actuators with the ARM controller.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks			
L	T	P		Theory Marks		Practical Marks	
				E	M	30	V
3	0	2	4	60	40	20	30



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105703

Subject Name : Microcontroller and Application

3	Design of induction motors: Arithmetic Instructions, Logic Instructions, Rotate and Barrel Shifter, Shift and Rotate Instructions in ARM Cortex, BCD and ASCII Conversions.	05	15
4	Design of synchronous machines: Looping and Branch Instructions, Calling Subroutine with BL, ARM Time Delay and Instruction Pipeline, Conditional Execution Signed Numbers Concept, Signed Number Instructions and Operations, IEEE 754 floating point standards Overview of C compilers and Optimization, Basic 'C' data types, C looping Structures, Register Allocation.	12	30
5	Computer aided design: ARM Processor Exception and Modes, Vector Table, Exception Priorities, Link Register Offsets, Interrupts, Assigning Interrupts, Interrupt Latency, IRQ and FIQ exceptions, Basic Interrupt Stack Design and Implementation About STM32F401 Nucelo board, PWM and the Interrupt on STM32F401, Mbed C Programming Environment.	08	15
6	Interfacing of STM32F401: Board, Interfacing LED and LCD, Serial port terminal application, Interfacing of temperature sensor, Interfacing of LDR light sensor, Speaker interfacing, Microphone interfacing, Speed control of DC motor using STM32, Accelerometer and its interfacing with STM32, Bluetooth interfacing, Interfacing of gas sensor with STM32.	12	15
	Teaching Hours	45	100

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Describe the basics of RISC machine and ARM controller	Remembering
CO2	Develop assembly language/embedded C-language code for a given problem	Apply
CO3	Use ARM development boards and its exception and interrupt handling functionality	Apply
CO4	Evaluate the various unsupervised learning algorithms using appropriate dataset	Evaluating
CO5	Interface microcontroller development board with sensors and display devices for a given application	Apply



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105703

Subject Name : Microcontroller and Application

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5
PO1 Basic knowledge	3	2	2	3	2
PO2 Discipline knowledge	2	3	3	3	2
PO3 Experiments and practice	-	3	3	3	3
PO4 Engineering tools	-	2	2	3	2
PO5 The engineer and society	1	3	3	3	3
PO6 Environment and sustainability	-	-	-	-	
PO7 Ethics	-	-	-	-	
PO8 Individual and team work	-	-	-	-	
PO9 Communication	-	1	1	1	1
PO10 Life-long learning	1	2	2	2	2

CO\PSO MATRIX

CO \ PSO	PSO1(Embedded Systems & ARM Programming.)	PSO2(AI/ML & Data-Driven Applications)
CO1	3	1
CO2	3	2
CO3	3	1
CO4	2	3
CO5	3	2

Reference Books –

- ARM, System-on-chip architecture by Steve Furber, Addison Wesley Publications
- ARM Assembly Language Programming & Architecture by Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, Janice Mazidi E-book available
- Arm system Developer's Guide –Designing and Optimizing System Software by Andrew Sloss, Dominic Symes and Chris Wright – Morgan Kaufman Publishers
- NPTEL course entitled “Embedded system Design with ARM” by Indranil Sengupta & Kamalika Datta

List of Practical -

- Introduction to ARM architecture
- Assembly language programming of ARM using data transfer, arithmetic and logical group instructions. (Use of ARM Keil is recommended)
- Assembly language programming of ARM using branching group (Use of ARM Keil is recommended)



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105703

Subject Name : Microcontroller and Application

- LED and LCD interfacing with STM32
- Interfacing of LM35 temperature sensor with STM32F401 Nucleo board
- Interfacing of electric bulb with STM32 through SRD-05DC-SL-C relay
- Interfacing of LDR with STM32 board
- Speed control of DC motor using SMT32
- Bluetooth interfacing with STM32 10. Accelerometer interfacing with STM32



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105709

Subject Name : Operation and Control in Power system

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Professional Elective-5
Rationale:	Demand of electrical energy is increasing day by day due to improvement in the life style of the people in particular and development of the countries in general. Under this scenario, the power system network operates in a stressed condition. Effective management of generation, transmission and distribution of electrical power is necessary for optimal system operation, for loss minimization and to avoid the unwanted power cuts. After the study of power system analysis, the study of power system operation is required. The understanding of automatic generation and control, reactive power characteristics of transmission lines and voltage control, state estimation, load forecasting and restructuring is desired.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	I	V	
3	0	0		3	60	40	0	0

Detailed Syllabus -

Unit	Content	Hours	% Of Weight
1	Automatic Generation Control and Voltage Control: Introduction; Load Frequency Control (Single Area Case); Load Frequency Control and Economic Despatch Control; Two-Area Load Frequency Control; Optimal (Two-Area) Load Frequency Control; Automatic Voltage Control; Load Frequency Control with Generation Rate Constraints (GRCs);	08	15
2	Reactive Power and Voltage Control: Introduction; Reactive power requirement of an uncompensated line; Implication of surge impedance loading; Reactive loss characteristics of transmission line; Operation of a transmission line at no load condition; Operation of a transmission line under heavy loading	10	15



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105709

Subject Name : Operation and Control in Power system

	condition; Voltage regulation of the transmission line and its relation with reactive power; Maximum power transfer in an uncompensated line; Line loadability. Reactive power voltage (Q-V) coupling concept; Operational aspects in reactive power and voltage control; Basic principle of system voltage control; Reactive power flow constraints and their implications in loss of voltage; Power System Voltage Stability : Introduction, Difference between angle stability and voltage stability, Causes of voltage instability, types, proximity and mechanism of voltage stability, Practical aspects of reactive power flow problems leading to voltage collapse in EHV lines.		
3	Power System Security: Introduction; System State Classification; Security Analysis; Contingency Analysis; Sensitivity Factors: generation shift distribution factor, line shift distribution factor	06	15
4	State Estimation: Introduction, Least Squares Estimation: The Basic Solution; Static State Estimation of Power Systems; Tracking State Estimation of Power Systems; Some Computational Considerations; External System Equivalency; Treatment of Bad Data; Network Observability and Pseudo Measurements; Application of Power System State Estimation	08	15
5	Load Forecasting: Introduction: Forecasting Methodology; Estimation of Average and Trend Terms; Estimation of Periodic Components; Estimation of $y_s(k)$: Time Series Approach; Estimation of Stochastic Component: Kalman Filtering Approach; Long-Term Load Predictions Using Econometric Models; Reactive Load Forecasting	06	20
6	Introduction to Power System Deregulation and Restructuring: Introduction, Motivation for Restructuring of power system; Electricity market entities and model; Benefits of Deregulation; Basic terminologies; Deregulation – International scenario; Milestones of deregulation in the world. Indian power sector – Past and present status: Growth of power sector in India – An overview, A time line of the Indian power sector, Players in the Indian power sector, Research and professional bodies	04	20
	Teaching Hours	42	100



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105709

Subject Name : Operation and Control in Power system

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Apply concepts of frequency control and voltage control in small sample single area power system	Apply
CO2	Analyze performance of transmission lines with respect to reactive power requirement for voltage stability	Analyze
CO3	Estimate the state of small sample power system	Evaluate
CO4	Describe concepts of power system security and load forecasting	Understand

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Basic knowledge	3	3	3	2
PO2 Discipline knowledge	3	3	3	2
PO3 Experiments and practice	3	3	3	-
PO4 Engineering tools	2	2	2	-
PO5 The engineer and society	2	3	3	1
PO6 Environment and sustainability	-	-	-	-
PO7 Ethics	-	-	-	-
PO8 Individual and team work	-	-	-	-
PO9 Communication	1	1	1	1
PO10 Life-long learning	2	2	2	1

CO\PSO MATRIX

CO \ PSO	PSO1(Power System Operation & Control.)	PSO2(Power System Analysis & Forecasting)
CO1	3	2
CO2	3	3
CO3	3	3
CO4	2	3

Reference Books -

- Modern Power System Analysis – D. P. Kothari, I. J. Nagrath, TMH Publication
- Electrical Power Systems – P. Venkatesh, B.V. Manikandan, S.C. Raja, A. Srinivasan, PHI
- Power System Analysis – J. J. Grainger, W.D. Stevenson, Mc-GrawHill series publication



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105709

Subject Name : Operation and Control in Power system

- Power Generation Operation and Control – A. J. Wood, B. F. Woolenberg, John Wiley and Sons
- Power System Analysis – Hadi Saadat, Mc-GrawHill series publication
- Advanced Power System Analysis and Dynamics – L. P. Singh, New Age International
- Operation of Restructured Power Systems – K. Bhattacharya, H. J. Bollen, J. E. Daalder, Kluwer academic publishers



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105704

Subject Name : Power System Stability and Control

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Professional Elective-3
Rationale:	Ultimatum of electrical energy is swelling day by day due to upgrading in the life style of the societies of the countries in broad-spectrum. On the other hand, dynamics of power system and it control is becomes a more and more complicated due to increasing in power system complexity. Under this scenario, this syllabus includes various types of stability issues with its improving techniques. This subject is main source for research point of view as a further studies of electrical engineer. With this context, this subject deals with the fundamentals for dynamics of power system and it control of the power system.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	30	V	
3	0	2	4	60	40	20	30	150



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105704

Subject Name : Power System Stability and Control

3	Excitation and Prime Mover Controllers: Excitation System, Excitation System Modelling, Excitation Systems- Standard Block Diagram, System Representation by State Equations, Prime-Mover Control System, Examples	09	20
4	Transmission Lines, SVC and Loads: Transmission Lines, D-Q Transformation using $\alpha - \beta$ Variables, Loads	07	20
5	Dynamics of a Synchronous Generator Connected to Infinite Bus: System Model, Synchronous Machine Model, Application of Model, Calculation of Initial Conditions, System Simulation, Consideration of other Machine Models	10	20
	Teaching Hours	45	100

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Understand the fundamental dynamic behavior of power systems and basic stability concepts.	Understand
CO2	Develop mathematical models of synchronous machines for dynamic studies.	Apply
CO3	Analyze the dynamic performance of power system components under disturbance conditions.	Analyze
CO4	Evaluate different stability types such as rotor angle, frequency, and voltage stability and associated control techniques.	Evaluate
CO5	Assess the impact of dynamics and disturbances on power system stability and propose suitable control mechanisms.	Evaluate

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4	CO5
PO1 Engineering Knowledge	3	3	3	3	3
PO2 Problem Analysis	2	3	3	2	2
PO3 Design/Development of Solutions	-	2	3	3	3
PO4 Conduct Investigations of Complex Problems	-	2	2	3	2
PO5 Modern Tool Usage	2	3	2	2	3
PO6 The Engineer and Society	-	-	-	-	1
PO7 Environment and Sustainability	-	-	-	-	-
PO8 Ethics	-	-	-	-	-
PO9 Individual and Team Work	-	-	-	-	-
PO10 Communication	-	-	-	-	-



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105704

Subject Name : Power System Stability and Control

PO11 Project Management and Finance	-	-	-	-	-
PO12 Life-long Learning	1	1	2	2	2

CO\PSO MATRIX

CO \ PSO	PSO1(Power System)	PSO2(Electrical Machines & Control)
CO1	3	2
CO2	3	3
CO3	3	2
CO4	3	2
CO5	3	2

Reference Books -

- K.R.Padiyar, "Power System Dynamics, Stability & Control", BS Publications, Hyderabad - 500 095 - AP., Second Edition, 2008.
- P. Kundur, "Power system stability and control", McGraw Hill Inc, New York, 1995.
- P.M. Anderson and A.A.Fouad, "Power System Control and Stability", Galgotia Publications, New Delhi, 2003 or P.M. Anderson and A. A. Fouad, "Power system control and stability", IEEE
- R. Ramanujam, "Power Systems Dynamics"- PHI Publications.
- M.A.Pai and W.Sauer, "Power System Dynamics and Stability", Pearson Education Asia, India, 2002
- I.J. Nagrath, D.P. Kothari, "Modern Power System Analysis", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1994.
- B.R. Gupta, "Power system operation and control", S. Chand & Company, New Delhi. Edition: 1. Year: 2012.
- A.Chakrabarti, M.L.Soni , P.V.Gupta, U.S.Bhatnagar, "Power system engineering", Dhanpat Rai & Co., New Delhi, 2009

List of Practical -

- Basic study about stability issues in power system (with any one real problem)
- To study mathematical modeling of R-L, R-L-C and complex electrical circuit using MATLAB.
- To study mathematical modeling of 3rd order differential equation.
- To solve differential equations using Euler's and trapezoidal rule.
- To observe variable of rotor angle and to find critical clearing time when fault occurs at:



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105704

Subject Name : Power System Stability and Control

(a) Sending end of the line (b) Mid-point of the line (c) When the fault at mid-point is cleared by removing the faulty line of SMIB system

- To study short circuit analysis of overhead transmission line using MATLAB
- To study and determine fault current for short circuit analysis using ETAP software.
- Find the steady state stability limit of delivered power.
- Compute the equivalent circuit parameters using (a) exact calculation and (b) approximate method

SOFTWARE -

- MATLAB
- ETAP
- Power world simulator
- PSAT (MATLAB open source)
- SCILAB (<http://old.cloud.scilab.in/>)



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105710

Subject Name : Residential and Commercial Electrical System

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	Elective

Prerequisite:	Professional Elective-5
Rationale:	Electricity is the major power source for almost all small scale to large scale industries. Per capita consumption of electricity is an indicator of the growth of a country. In view of this, it is important for the electrical engineers to understand the components of residential, commercial and industrial electrical systems. This subject deals with the introduction to components of industrial electrical systems. The subject also includes selection of ratings for various components based on applications and basics of automation of industrial electrical systems.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	30	V	
3	0	0	3	60	40	0	0	100

Detailed Syllabus -

Unit	Content	Hours	% Of Weight
1	Electrical System Components: LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, Protection components- Fuse, MCB, MCCB, ELCB, Symbols for wiring components, Single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices	06	15
2	Residential and Commercial Electrical Systems: Types of residential and commercial wiring systems, General rules and guidelines for installation, Load calculation and sizing of wire, Rating of main switch, distribution board and protection devices, Earthing system	10	20



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105710

Subject Name : Residential and Commercial Electrical System

	calculations, Requirements of commercial installation, Deciding lighting scheme and number of lamps, Earthing of commercial installation, Selection and sizing of components		
3	Illumination Systems: Understanding various terms regarding light- lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, Various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, Energy saving in illumination systems, Design of a lighting scheme for a residential and commercial premises, Flood lighting	08	15
4	Industrial Electrical Systems: HT connection, Industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks	14	30
5	Industrial Electrical System Automation: Study of basic PLC, Role of automation, Advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation	07	20
	Teaching Hours	45	100

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Explain electrical wiring systems for residential, commercial, and industrial consumers using symbols, drawings, and single-line diagrams.	Understand
CO2	Justify the need and role of industrial electrical system components and automation systems.	Evaluate
CO3	Evaluate the size, rating, and cost of electrical installations for residential and commercial buildings.	Evaluate
CO4	Design appropriate industrial electrical systems with proper protective devices and automation components.	Create



SWAMINARAYAN UNIVERSITY
Program Name: Engineering
Level: Degree
Branch: Electrical Engineering
Subject Code: BE105710
Subject Name : Residential and Commercial Electrical System

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Engineering Knowledge	2	2	3	3
PO2 Problem Analysis	2	3	3	3
PO3 Design/Development of Solutions	-	2	3	3
PO4 Conduct Investigations of Complex Problems	-	-	2	3
PO5 Modern Tool Usage	2	2	3	3
PO6 The Engineer and Society	-	2	-	2
PO7 Environment and Sustainability	-	2	-	2
PO8 Ethics	-	-	-	1
PO9 Individual and Team Work	-	-	-	2
PO10 Communication	2	-	2	2
PO11 Project Management and Finance	-	-	2	2
PO12 Life-long Learning	1	1	2	2

CO\PSO MATRIX

CO \ PSO	PSO1(Power System Design)	PSO2(Industrial Automation & Control)
CO1	3	2
CO2	2	3
CO3	3	2
CO4	3	3

- Explain electrical wiring systems for residential, commercial and industrial consumers through symbols, drawings and SLD
- Justify the need of industrial electrical system components and industrial automation
- Evaluate the size, rating and cost of electrical installations for residential and commercial applications
- Design appropriate electrical system with protective equipment for industrial applications

Reference Books -

- S. L. Uppal and G. C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105710

Subject Name : Residential and Commercial Electrical System

- K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
- S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.
- H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008
- IS Standards : <https://bis.gov.in>



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105701

Subject Name : Switchgear and Protective Devices

w.e.f.Academic Year:	2025-26
Semester:	7 th
Category of the Course:	PCC

Prerequisite:	Professional Core
Rationale:	An electrical power system consists of generators, transformers, and transmission and distribution lines. In the case of an event of a fault, an automatic protective scheme comprising of circuit breakers and protective relays isolate the faulty section protecting the healthy part of the system. The safety of equipment and human beings is the major concern for every protection scheme. Moreover, students must develop skills for operating various controls and switchgear in the power system. They are also required to carry out remedial measures for faults/abnormalities in machines/equipment in the power system using appropriate diagnostic instruments/devices. This course attempts to develop these skills in students and hence it is a core course for all electrical engineers.

Teaching and Examination Scheme -

Hours per Week			Course Credits	Examination Marks				
L	T	P		Theory Marks		Practical Marks		Total Marks
				E	M	30	V	
4	0	2	5	60	40	20	30	150



सर्व विद्या अधिपतये

SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105701

Subject Name : Switchgear and Protective Devices

2	Overcurrent Protection of the Transmission Line: Introduction, Thermal Relays, Over Current Relays, Types of Relay Characteristics, Application of Definite Time & IDMT O.C. Relays for Protection of Feeder, Relay Coordination, Directional Over Current Relay, Limitations of O.C. Relays [1].	05	15
3	Distance Protection of Transmission Line: Introduction to Distance Protection, Types of Distance Relay, Impedance, Reactance, MHO Relay, Performance of Distance Relay During Normal Load and Power Swing, Effect of Arc Resistance on Reach of Distance Relays, Comparison of Distance Relays, Distance Protection of Transmission line, Reasons for Inaccuracy of Distance Relay	07	20
4	Transformer Protection: Faults and Abnormal Conditions in Transformer, Non-electrical Protection, Overcurrent Protection, Earth Fault Protection, Inter-turn Protection, Differential Protection [4]. Bus-zone Protection: Non-Unit Protection by Back-up Relays, Differential Protection of Busbars, External and Internal Fault, Protection of Three-phase Busbars [1,4] Generator Protection: Various faults & abnormal operation conditions in a Generator, Stator & rotor faults, Transverse differential protection of a Generator, Unbalanced loading, Over speeding, Loss of excitation, Loss of prime mover [1].	17	30
5	Induction Motor Protection: Various faults & abnormal operation conditions in an Induction Motor, Starting of induction motor, Protection of small & large induction motor Current and Voltage Transformer: Construction of Current Transformers, Difference Between CT Cores Used for Measurement and those Used for Protective Relays, Calculation of CT Accuracy, Factors to be Considered while Selecting a CT, Construction of Potential Transformer, Specifications of Voltage Transformer, Capacitor Voltage Transformer.	11	10
6	Circuit Breaker: Classification of switchgear and fields of application and relative merits. Theories of current interruption, Energy balance and recovery rate theories, Air Circuit Breaker(ACB), Air Blast Circuit Breaker (ABCB), Practical systems of arc quenching in oil circuit breakers, Construction and operation of bulk oil, Minimum Oil Circuit Breakers, Recent trends in H.V. Circuit Breakers, Sulphur Hexafluoride Circuit Breaker (SF6), Vacuum Circuit Breaker (VCB), Rating of Circuit Breakers, Testing of	10	10



SWAMINARAYAN UNIVERSITY

Program Name: Engineering

Level: Degree

Branch: Electrical Engineering

Subject Code: BE105701

Subject Name : Switchgear and Protective Devices

	Circuit Breakers, Miniature Circuit Breakers, Earth Leakage Circuit Breakers [3]. Modern Trends in Power System Protection Introduction: to static and digital relays, Introduction to adaptive relays. [6]		
	Teaching Hours	56	100

Course Outcomes-

CO No	Course Outcome Description	RBT Level
CO1	Acquire knowledge of various abnormal conditions in power systems and the role of protective relays.	Remember
CO2	Understand conventional relays, their operating principles, and developments in modern protection schemes.	Understand
CO3	Design appropriate protection systems for power system components to safeguard equipment and personnel.	Create
CO4	Explain the working and construction of instrument transformers and circuit breakers used in protection systems.	Understand

CO\PO MATRIX

CO \ PO	CO1	CO2	CO3	CO4
PO1 Engineering Knowledge	3	3	3	3
PO2 Problem Analysis	2	3	3	2
PO3 Design/Development of Solutions	-	-	3	-
PO4 Conduct Investigations of Complex Problems	-	-	2	-
PO5 Modern Tool Usage	2	2	3	2
PO6 The Engineer and Society	1	-	2	-
PO7 Environment and Sustainability	-	-	-	-
PO8 Ethics	-	-	-	-
PO9 Individual and Team Work	-	-	-	-
PO10 Communication	-	1	2	1
PO11 Project Management and Finance	-	-	2	-
PO12 Life-long Learning	1	1	2	1

CO\PSO MATRIX

CO \ PSO	PSO1(Power System)	PSO2(Electrical Machines & Control)
CO1	3	2



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Program Name: Engineering

Level: Degree

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Subject Code: BE105701

Subject Name : Switchgear and Protective Devices

CO2	3	2
CO3	3	3
CO4	2	3

Reference Books -

- Fundamentals of Power System Protection –Y. G. Parithankar & S. R. Bhide, 2nd edition, PHI
- Power System Protection and Switchgear by Badari Ram , D.N Viswakarma, TMH Publications
- 3. Power system protection and switchgear by Oza, Nair, Mehta, Makwana
- Protection and switchgear, by Bhavesh Bhalja, R.P.Maheshwari, Nilesh hotani, 1st edition, 2011, Oxford Publication
- Power System Protection and Switchgear –B. Ravindranath and M. Chander
- Power System Protection & Switchgear by B. Ram, McGraw Hill
- Power System Protection- Static Relays by T.S.M. Rao Tata McGraw Hill
- Art and Science of Protective Relaying –Russel Masson

List of Practical -

- To check performance/ study of a 3-Phase Differential Relay.
- To check performance/ study of an over current Relay.
- To check performance/ study of the Numerical Protection of induction motor.
- To obtain the operating characteristics of an IDMT relay.
- To study the operating characteristics of directional over current relay.
- To check performance/ study of the operating characteristics of the transformer percentage differential relay.
- To study the magnetic inrush current in a transformer and its protection.
- To study radial feeder protection using two overcurrent and one Earth fault relay.
- To obtain and study the magnetization characteristic of CT.
- To study the protection schemes for different abnormal conditions in an alternator.
- To study Buchholz relay for transformer protection.
- To study generalized block diagram of Numerical Relay

Major equipment -

Electromechanical Relay, Static / Numerical Relay, Testing Panels, CT, PT, Timers, Circuit Breakers.