Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical and Electronics Engg**	**Academic Year**	**2019-20**

M E Electrical Engineering (Electrical Power Engineering): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2111: Microprocessor Based Control of Drives**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2111

CO1 **Identify** advantages, different parts and types of Electrical Drives.
CO2 **Choose** control strategies of Electrical Drives
CO3 **Explain** performance of DC Motor Drives, Induction Motor Drives and Synchronous Motor Drives
CO4 **Apply** the knowledge of microprocessor based system to measure and display of parameter of drives system
CO5 **Explain** Microprocessor based control of Different Electrical Drives

Unit No.	Topic/Unit	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Electrical Drives :Introduction. Advantages, Parts, Choice of Electric drives, status of DC & AC drives, Overview of microprocessor based control of drives.	05	08	3	CO1	PSO1 PSO3	SD	G	PE
2	Control of Electric Drives :Modes of Operation, Speed control and drive classifications, Closed loop control of drives.	05	04	5	CO2	PSO1 PSO3			

3	D.C. Motor Drives :Speed Control transformer and uncontrolled rectifier control, Controlled rectifier fed DC drives, Dual converter control of D.C. separately excited motor , Chopper controlled DC drive.	10	20	5	CO3	PSO1 PSO3			
4	Induction Motor Drives :Stator voltage control, variable frequency control from a current and voltage source, Rotor resistance control, Slip power recovery, Variable speed constant frequency generation.	03	12	5	CO3	PSO1 PSO3			
5	(a) Synchronous Motor Drives :True synchronous motor and commutator less motor mode (Control) (b) Electrical Drive System And Components :Electrical Drive Systems, Components for obtaining signals for interlocking and sequencing operations.	03	06	5	CO3	PSO1 PSO3			
6	(a) Microprocessor based Drives :Measurement and display of speed of motor using Microprocessor, Microprocessor controlled chopper fed d.c. motor, Microprocessor based speed control of 3Q thyristor converters using microprocessor. (b)Advanced Topics :Field orientation control, High phase order inverter fed I.M. drives, asynchronised PWM waveform generation for transistorised 60 KVA AC drive. High efficiency controllers for induction motors. Introduction to FACTS devices.	26	50	3, 5	CO4 CO5	PSO1 PSO2 PSO3			

Reference Books

1.	Fundamentals of Electric Drives by G.K. Dubey
2.	Thyristor Control of Electric Drives by V. Subrahmanyam
3	Thyristorised Power Controllers by G.H. Dubey, S.R. Doradla, A. Joshi, RMK Sinha
4.	Electric Drives - Concepts and Applications - by Vedam Subrahmanyam

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2019-20**
M E Electrical Engineering (Electrical Power Engineering): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2111L : Microprocessor Based Control of Drives Laboratory**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**50**
Mode of Transaction		Practical , Term work and Viva		

Course Outcome (CO) ELE 2111L

CO1 **Build** programs for measurement of machine speed.
CO2 **Develop** hardware &programs for interfacing single phase full converter to control speed of DC motor.
CO3 **Prepare** precise reports inclusive of programs and schematic with conclusive remarks.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Lab-01 Write and run program to display speed by interfacing techo-generator through ADC0809 with microprocessor.	06	100	3,6	CO1 CO3	PSO1 PSO2 PSO3	SD	G	PE

2	Mini project: Design and implementation of hardware and software programming using microcontrollers to control speed of DC motor (open loop) by using single phase converter.	33		6	CO2 CO3	PSO1 PSO2 PSO3			

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome (PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2020-21**

ME (Electrical Power Engineering): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2112: Dynamic Analysis and Performance of Synchronous Machine**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2112

CO1 **Relate** Park's transformation to ideal synchronous machine theory to outline various phenomena involved.
CO2 **Prediction** of transient stability studies using Vector diagrams for transient and sub transient states.
CO3 **Diagnose** three phase short circuit armature current oscillogram for conclusion.
CO4 **Design** various excitation systems for actualization of modern excitation systems.
CO5 **Predict** effect of excitation on power system stability to plan modeling of complete exciter generator system.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	The Ideal synchronous machine, Synchronous machine inductances, Time constants of Synchronous machines, Transformation to direct and quadrature axis variables, Basic machine relations in d-q-0 variables, physical interpretation of Park's variables, Steady state analysis, circuit equations in terms of Park's variables, Proof of expression for Park inductance, Steady state power angle characteristics, revised equations of synchronous machine.	11	30	3	CO1	PSO1 PSO3	Emp, SD	G	HV & PE
2	Vector diagram for the transient state, Vector diagram for the sub transient state, Application to transient stability studies	08	10	5	CO1 CO2	PSO1			
3	Sudden three phase short circuit, Description of oscillogram armature currents, field currents, Explanation of short circuit currents andDecrements ,Amplitudes,Analysis of oscillogram	07	10	4	CO2 CO3	PSO1 PSO3			
4	Functions and main excitation components of the generating unit. Control andexcitation configurations, excitation control system definitions like voltagerespective ratio, excited voltage ratings in p .u. and other specification, differenttypes of voltage regulators like electromagnetic, rotating amplifier, magneticamplifier and solid state, exciter build-up for d. c. generator exciter, both for selfand separately excited exciter, different methods for calculation of build up orbuild down of the exciter like integration and analog or digital solutions, solid state exciters, normalization of exciter equations, analysis of non-continuously and continuously regulated system, block diagram of feedback and compensated excitation control system with problems to check stability of the excitation system using root-locus and Routh's criterion, computer representation of excitation systems like type 1, 1s,2, 3 and type 4.	14	30	6	CO4	PSO1 PSO2 PSO3			
5	Transient stability and dynamic stability considerations, effect of excitation ongenerator power limits, transient and dynamic stability, Root-locus analysis of aregulated machine connected to an infinite bus, approximate model of the completeExciter- generator system, linear analysis of the stabilized generator. CapabilityCurve of Synchronous Machine	12	20	6	CO4 CO5	PSO1 PSO2 PSO3			

Reference Books

1.	Electric Machinery by A.E. Fitzerald and Charles Kingsley (II Edition)
2.	Power System Stability Vol.III by Edward Wilson Kimbark
3	Power System Control and Stability by P.M. Anderson & A.A, Fouad
4.	Power System Stability and Control by P. Kundur

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2020-21**

M E Electrical Engineering (Electrical Power Engineering): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2112L:Dynamic Analysis and Performance of Synchronous Machine**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 1956 Year of Syllabus Revision: 2007 and 2013-14	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva		

Course Outcome (CO) ELE2112L

CO1 **Utilize** various equipment, devices, for practicals of Synchronous machine.
CO2 **Perform or Simulate** experiment to achieve desired objective synchronous machine as outlined below.
CO3 **Formulate** precise report inclusive of observation, calculations, results & conclusion.
CO4 **Demonstrate** ability related to practical on the dynamic analysis and performance of Synchronous machine.

No.	Experiment	Contact hours	weightage	BT Level	CO	PSO
1	Prove that Self and mutual inductance of Synchronous machine are cyclic in nature	3	100%	5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
2	Estimate parameters of Synchronous machine from Open CKT and Short CKT Test and to find voltage regulation by synchronous impedance method	3		5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
3	Estimate parameters of Synchronous machine from Open CKT and Short CKT Test and to find voltage regulation by MMF method	3		5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
4	Compare voltage regulation by Zero power factor method with others for voltage regulation	3		6	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
5	Develop Load angle characteristic of synchronous motor with various excitation levels and loads	3		6	CO1	PSO1

					CO2 CO3 CO4	PSO2 PSO3
6	Prove that X_d'' and X_q'' determine negative sequence reactance of synchronous generator by Static test	3		5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
7	Predict X_d and X_q of synchronous machine with respect to Xd'' and Xq'' by slip test.	3		6	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
8	Evaluate Voltage response ratio for DC excitation system	3		5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
9	Design and simulate Static excitation system or DC excitation system with PSS or Compensator	15		6	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome (PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2020-21**
ME (Electrical Power Engineering): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2112: Dynamic Analysis and Performance of Synchronous Machine**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2112

CO1 **Relate** Park's transformation to ideal synchronous machine theory to outline various phenomena involved.
CO2 **Prediction** of transient stability studies using Vector diagrams for transient and sub transient states.
CO3 **Diagnose** three phase short circuit armature current oscillogram for conclusion.
CO4 **Design** various excitation systems for actualization of modern excitation systems.
CO5 **Predict** effect of excitation on power system stability to plan modeling of complete exciter generator system.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	The Ideal synchronous machine, Synchronous machine inductances, Time constants of Synchronous machines, Transformation to direct and quadrature axis variables, Basic machine relations in d-q-0 variables, physical interpretation of Park's variables, Steady state analysis, circuit equations in terms of Park's variables, Proof of expression for Park inductance, Steady state power angle characteristics, revised equations of synchronous machine.	11	30	3	CO1	PSO1 PSO3	Emp, SD	G	HV & PE
2	Vector diagram for the transient state, Vector diagram for the sub transient state, Application to transient stability studies	08	10	5	CO1 CO2	PSO1			
3	Sudden three phase short circuit, Description of oscillogram armature currents, field currents, Explanation of short circuit currents andDecrements ,Amplitudes,Analysis of oscillogram	07	10	4	CO2 CO3	PSO1 PSO3			
4	Functions and main excitation components of the generating unit. Control andexcitation configurations, excitation control system definitions like voltagerespective ratio, excited voltage ratings in p .u. and other specification, differenttypes of voltage regulators like electromagnetic, rotating amplifier, magneticamplifier and solid state, exciter build-up for d. c. generator exciter, both for selfand separately excited exciter, different methods for calculation of build up orbuild down of the exciter like integration and analog or digital solutions, solid state exciters, normalization of exciter equations, analysis of non-continuously and continuously regulated system, block diagram of feedback and compensated excitation control system with problems to check stability of the excitation system using root-locus and Routh's criterion, computer representation of excitation systems like type 1, 1s,2, 3 and type 4.	14	30	6	CO4	PSO1 PSO2 PSO3			
5	Transient stability and dynamic stability considerations, effect of excitation ongenerator power limits, transient and dynamic stability, Root-locus analysis of aregulated machine connected to an infinite bus, approximate model of the completeExciter- generator system, linear analysis of the stabilized generator. CapabilityCurve of Synchronous Machine	12	20	6	CO4 CO5	PSO1 PSO2 PSO3			

Reference Books

1.	Electric Machinery by A.E. Fitzerald and Charles Kingsley (II Edition)
2.	Power System Stability Vol.III by Edward Wilson Kimbark
3	Power System Control and Stability by P.M. Anderson & A.A, Fouad
4.	Power System Stability and Control by P. Kundur

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2020-21**

M E Electrical Engineering (Electrical Power Engineering): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2112L:Dynamic Analysis and Performance of Synchronous Machine**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 1956 Year of Syllabus Revision: 2007 and 2013-14	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva		

Course Outcome (CO) ELE2112L

CO1 **Utilize** various equipment, devices, for practicals of Synchronous machine.
CO2 **Perform or Simulate** experiment to achieve desired objective synchronous machine as outlined below.
CO3 **Formulate** precise report inclusive of observation, calculations, results & conclusion.
CO4 **Demonstrate** ability related to practical on the dynamic analysis and performance of Synchronous machine.

No.	Experiment	Contact hours	weightage	BT Level	CO	PSO
1	Prove that Self and mutual inductance of Synchronous machine are cyclic in nature	3	100%	5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
2	Estimate parameters of Synchronous machine from Open CKT and Short CKT Test and to find voltage regulation by synchronous impedance method	3		5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
3	Estimate parameters of Synchronous machine from Open CKT and Short CKT Test and to find voltage regulation by MMF method	3		5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
4	Compare voltage regulation by Zero power factor method with others for voltage regulation	3		6	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
5	Develop Load angle characteristic of synchronous motor with various excitation levels and loads	3		6	CO1	PSO1

					CO2 CO3 CO4	PSO2 PSO3
6	Prove that X_d'' and X_q'' determine negative sequence reactance of synchronous generator by Static test	3		5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
7	Predict X_d and X_q of synchronous machine with respect to Xd'' and Xq'' by slip test.	3		6	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
8	Evaluate Voltage response ratio for DC excitation system	3		5	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3
9	Design and simulate Static excitation system or DC excitation system with PSS or Compensator	15		6	CO1 CO2 CO3 CO4	PSO1 PSO2 PSO3

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2019-20**

M E Electrical Engineering (Electrical Power Engineering): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2114: Reactive Power Control in Power System**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2114

CO1 **Outline** Reactive power control basics to predict power transmission system performance.
CO2 **Rank** Reactive power control methods and their performance on transmission lines
CO3 **Design** FACT devices component, their modelling, and application.
CO4 **Predict** Compensation, filters requirements with respect to disturbance, harmonics.
CO5 **Plan** Reactive Power Management.

Unit No.	**Topic/Unit**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	Power System Concepts of Reactive Power; Need for its control.	02	2	3,4	CO1,	PSO1 PSO2	SD	G	PE
2	Theory of Steady State Reactive Power Control in Electric Transmission systems. Fundamentals of V-Q analysis and control, Study of various line compensation techniques, series, shunt (Passive or active), Composite series and shunt Load Compensation, Load Symmetrizing, P. f. correction	08	18	3,4	CO1,2	PSO1 PSO2			
3	Reactive Power Compensation and Dynamic performance of Transmission Systems. Effects of various reactive power control devices, sub synchronous resonance and methods of its control	06	10	5,6	CO1,2	PSO1 PSO2			
4	Principles of Static Var Systems, Thyristor Controlled Reactor (TCR), Thyristor. Switched Capacitor (TSC), TSC-TCR, Saturated Reactor	06	10	5,6	CO3	PSO1 PSO2 PSO3			
5	Modeling of Static Var Systems and their control, Modeling of different SVS Configurations, Design of controllers, Voltage Controller, Auxiliary Controller, Applications of SVS, Improvement of dynamic stability with SVS alone, SVS with generator excitation control, Enhancement of transient stability, Damping of torsional oscillations, SVS for dynamic reactive power support at HVDC terminals, Load compensation, Specifications of SVS	09	17	5,6	CO3	PSO1 PSO2 PSO3			
6	Compensation performance under system disturbance: Small perturbations, Abnormal conditions (faults, load rejections etc., overloads (Temporary over voltages).	05	10	5,6	CO4	PSO1 PSO2 PSO3			
7	System Studies: Stability studies, dynamic behavior studies, control system verification, dynamic performance evaluation, overvoltage control	05	10	5,6	CO4	PSO1 PSO2 PSO3			
8	Harmonics and Filters : Harmonic generation in SVS, deleterious effects of harmonics, filter systems, design of filters	07	15	5,6	CO4	PSO1 PSO2 PSO3			
9	Reactive Power Management: Placement of SVS in power systems, discussion of methodology of reactive power Planning with a case study.	04	08	5,6	CO5	PSO1 PSO2 PSO3			

Reference Books

1.	T.J.E. Miller : Reactive Power Control in Electric Systems - Wiley Inter science, 1982
2.	R.M. Mathur : Static compensation for reactive power control, Cantext publications, Winnipeg, CANADA - 1984
3	IEEE Tutorial : Reactive Power : Basics, Problems and Solutions, IEEE Power Engg Society, 1987
4.	IEEE Tutorial : Power Electronics Applications in Power Systems, IEEE Power Engg, Society - 1978
5.	IEEE 1976 winter : Analysis and Control of Sub synchronous Meeting & Tesla Resonance Symposium Publication
6.	Research Papers in Technical Journals.
7.	Understanding Facts, by N G Hingorani & Laszlo Gyugyi
8.	FACTS Controllers in Power Transmission & Distribution by K.R. Padiyar

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**		**Academic Year**	**2019-20**
M E Electrical Engineering (Electrical Power Engineering): Regular Programme			
Year	**I**	~~**Core**~~ **/ Elective ~~/ Foundation~~** **ELE 2115 : Digital Simulation of Power Systems**	**Credits / Hours per week**	**05**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2115

CO1 **Choose** numerical methods for solving power system problems/equations
CO2 **Discuss** methods to exploit the sparse nature of power system matrices and their applications in power system analysis
CO3 **Develop** algorithms and computer methods to solve load flow and optimal load flow problems
CO4 **Explain** concept of power system security and function of energy control centers and use of computers in their functioning
CO5 **Formulate** mathematical models and algorithms to estimate power system behavior using computers

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	**Network matrices:** Network formulation, Network equations, Development of bus admittance and impedance matrices, Development of loop impedance and admittance matrices, Primitive network graph theory, Matrix representation of graph, Formation of Ybus and Zbus using graph theory	14	30	6	CO1 CO2	PSO1 PSO3	SD	G	PE
2	**Load flow studies:** Formulation of load flow problem, Solution techniques using Ybus Power flow through lines, transformers and phase shifters, Gauss Seidel method, Newton Raphson method ,Computational aspects of large scale systems, Sparsity of Jacobian, Sparsity oriented programming, Gaussian elimination and optimal ordering, Decoupled power flow algorithms, Fast decoupled method	16	30	6	CO1 CO2 CO3 CO4 CO5	PSO1 PSO3			
3	**Fault Analysis:** Applicaton of symmetrical components to balanced and unbalanced faults, One open conducor and two open conductor faults, Simultaneous faults on symmetrical 3-phase system, Unsymmetrical 3-phase circuits	16	30	6	CO1 CO2 CO5	PSO1 PSO2 PSO3			
4	α, β and zero components of 3-phase system	06	10	6	CO1 CO5	PSO1 PSO3			

Reference Books

1.	Computer Methods in Power System by Stagg and EI Abiad
2.	Computer Techniques in Power System Analysis by M A Pai
3.	Computer Aided Power System Analysis by R N Dhar
4.	Advance Power System Analysis and Dynamics by L P Singh
5.	Power System Operation and Control by P K Murthy
6.	Energy Systems Theory by O I Elgerd
7.	Solution of large networks by Matrix Methods - Hmer Brown
8.	'SPARSITY' by Brameller, Alen & Haman

_Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2019-20**

M E Electrical Engineering (Electrical Power Engineering): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2115L : Digital Simulation of Power Systems Laboratory**	**Credits / Hours per week**	**03**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**50**
Mode of Transaction		Practical , Term work and Viva		

Course Outcome (CO) ELE 2115L

CO1 **Develop** algorithms and computer methods to solve various power system problems
CO2 **Formulate** algorithms to exploit the sparse nature of power system matrices and their applications in power system analysis
CO3 **Propose** methods/techniques for operation and control of practical large scale power systems using software tools

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Develop algorithm and code for formation of the bus admittance matrix	3	100	6	CO1	PSO1 PSO3	SD	G	PE

2	Formulate algorithm and develop program to solve a set of linear simultaneous equations using the Shipley's Inversion technique	4		6	CO1	PSO1 PSO3			
3	Formulate algorithm and develop program to solve a set of linear simultaneous equations using the Gauss Elimination method	3		6	CO1	PSO1, PSO3			
4	Formulate algorithm and develop program to solve a set of linear simultaneous equations using the LU decomposition method	3		6	CO1	PSO1 PSO2 PSO3			
5	Develop algorithm and program to form the bus admittance matrix using graph theory	3		6	CO1	PSO1 PSO3			
6	Develop algorithm and program to solve the power flow problem by Gauss Seidel method	4		6	CO1 CO3	PSO1 PSO2 PSO3			
7	Develop algorithm and program to solve the power flow problem by Gauss Seidel method when the bus admittance matrix is stored as per sparsity scheme - 2	4		6	CO1 CO2 CO3	PSO1 PSO3			
8	Develop algorithm and program to construct and store the bus admittance matrix as per sparsity scheme - 3	4		6	CO1 CO2	PSO1 PSO3			
9	Develop algorithm and program to solve the power flow problem by Gauss Seidel method when the bus admittance matrix is stored as per sparsity scheme - 3	4		6	CO1 CO2 CO3	PSO1 PSO3			
10	Develop algorithm and program to construct the bus impedance matrix	4		6	CO1 CO3	PSO1 PSO3			
11	Develop program to analyze short circuits on power system	3		6	CO1 CO3	PSO1 PSO3			

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2019-20**

M E Electrical Engineering (Electrical Power Engineering): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2113: POWER SYSTEM MANAGEMENT & PLANNING**	**Credits / Hours per week**	**04**
Semester	**I**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2113

CO1 **Build** the load forecast for the future year
CO2 **Estimate** the state of the power system for minimizing error
CO3 **Determine** configuration of network in planning model of power system
CO4 **Categorized** the automation used in transmission and distribution system
CO5 **Estimate** the parameter of the power system network for better performance

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Load forecasting, problems facing electrical industries, technology options, and different techniques of load forecasting.	14	30	6	CO1	PSO1 PSO3	SD	G	PE

2	State estimation in power system, Maximum likelihood weighted least square estimation, matrix formulation, state estimation of AC network and using orthogonal decomposition, advanced topics and applications	12	20	5	CO2	PSO1			
3	Reliability of generation, transmission and distribution. Maintenance scheduling of generating units in power systems by different methods. Generation and network planning, fundamental economic analysis, generation planning optimization, Heuristic approach for network planning.	08	15	6	CO3	PSO1 PSO3			
4	Distribution automation, Project planning communication sensors, supervisory control and data acquisition. Consumer information services.	08	15	4	CO4	PSO1 PSO2 PSO3			
5	Power quality, events and variation, voltage dips other power quality & issues. Optimization of distribution system, Costing of scheme, typical network, voltage level, network modeling, application of linear programming for network synthesis, Economic loading and worse case loading of Distribution transformers.	10	20	6	CO5	PSO1 PSO3			

Reference Books

1.	Modern Power System Planning : By X. Wang and J.R. McDonald
2.	Power generation, operation and control : By Wood and wollenberg
3	Electric Power Distribution: By A.S. Pabla
4.	Power System Analysis – Stevension & Grainger
5.	Power System Analysis & Planning By Ahmed EI-Abiad-McGraw Hill Publication.
6.	Least Cost Electric Utility Planning – 1989-By Harr G. Stoll - John Willey & Sons

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2020-21**

ME (Electrical Power Engineering): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2211: Economic Operation of Power System**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2007 Year of Syllabus Revision: 2014	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2211

CO1 **Interpret** Economic dispatch, scheduling of economic dispatch, Co-ordination equation, Interchange of power and energy.
CO2 **Determine** Thermal Coordination, Hydro , Hydro Thermal coordination and generation with limited energy supply
CO3 **Formulate** Mathematical techniques of Optimization and interpretation for economic dispatch
CO4 **Plan** Unit commitment by different techniques,
CO5 **Modify** Economic dispatch and unit commitment using restructured power system
CO6 **Design** Automatic Generation and Voltage control with restructured power system.

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Economic dispatch, input output characteristics, cost function, incremental cost,Generation scheduling for economic dispatch without	11	30	2	CO1 CO2	PSO1	Emp, SD	G	HV& PE

	and with transmissionlosses. Penalty factor and ITL(incremental transmission loss). Loss efficient. Derivation of loss coefficient byvarious methods. Co-ordination equation and generation scheduling. Interchangeof power and energy, Generation with limited energy supply includingenvironmental aspects					PSO2 PSO3			
2	Thermal system Dispatching with network losses considered. The Lambda-Iteration method, gradient method, Newton's method, evolutionary computing etc. Economic dispatch withpiecewise linear cost functions and dynamic programming. Optimization withinconstraints, Slack variable method.	11	10	6	CO2 CO3	PSO1 PSO2 PSO3			
3	Unit commitment by different methods, like dynamic programming, evolutionary computing, etc	06	15	6	CO3 CO4	PSO1 PSO2 PSO3			
4	Hydro thermal co-ordination by different techniques like evolutionary computing etc	05	15	6	CO2 CO3 CO4	PSO1 PSO2 PSO3			
5	Economic load dispatch in restructured power system	04	5	6	CO5	PSO1 PSO2 PSO3			
6	Automatic generation and voltage control, structure of control system, Dynamicincremental state variable model, MW frequency control problem, FundamentalCharacteristics of power mechanism, simplified mathematical model, automaticvoltage control, single area and two-area load frequency control. Use of controllers in feedback loop. Automatic voltage and Load frequency control loop in restructured power system.	15	25	6	CO5 CO6	PSO1 PSO2 PSO3			

Reference Books

1.	Electric Energy System Theory, An Introduction – Olle I Elgerd
2.	Power Generation, Operation and Control – Wood and Wollen Berg, Third edition
3.	Power System Optimization – D P Kothari and Dhillon
4.	Power System Analysis Operation & Control – A Chakravati and S. Halder
5.	Optimization of Power System Operation – Jizhong Zhu

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2019-20**
M E Electrical Engineering (Electrical Power Engineering): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **ELE 2212: Power System Dynamics**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2212

CO1 Estimate performance of generator connected to infinite bus with advance features
CO2 Develop criteria for different power system stabilities
CO3 Determine voltage stability using different methods
CO4 Evaluate the system performance using Eigen Properties
CO5 Estimate the system stability by energy function method

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	Generator connected to Infinite Bus Small signal analysis. Linearization. Flux decay and Rotor-angle transfer functions. Closed	10	20	6	CO1	PSO1 PSO3	SD	G	PE

	loop analysis Root-locus diagrams. Small signal stability in presence of fast acting exciter voltage regulator. Power System stabilizer. Root locus analysis								
2	(a) Transient stability (Angle-stability) of multimachine system for large disturbances. Computer based algorithms for delta and omega trajectories for first swing computations. (b) Midterm & Long term transient stability analysis. 'Unstability' in subsequent cycles : effect of Generation controllers. Simulatiions & solution techniques.	16	30	6	CO2	PSO1 PSO2 PSO3			
3	Voltage Stability : Basic Concepts : Classification. Static & dynamic voltage stability P-IVI, Q-IVI curves. Reverse effect of O.L.T.C.. Continuation power flow. Stability margins. Local & global bi-furcation. Voltage collapse.	07	10	5	CO3	PSO1 PSO2 PSO3			
4	Further Topics on small signal analysis : State space representation. Linearization Analysis of stability. Eigen properties of state Matrix. Modal Matrices. Computation of eigen values & participation factor. Controllability & observability. Complex frequency. Eigen properties & transfer function. Illustration of application to single machine-infinite bus system.	10	20	5	CO4	PSO1 PSO3			
5	Energy function methods. Physical and mathematical aspects. Lyspunov's method. Modelling issues. Energy function formulation. Potential energy boundary surface.	09	20	6	CO5	PSO1 PSO2 PSO3			

Reference Books

1.	Power System Dynamics and Stability by P.W. Sauer and M.A. Pai. – PHI
2.	Power System Analysis by Stevension.
3.	P. Kunduv – Power System Stability & Control – TMH
4.	K.R. Padiyar - Power System Dynamics, Stability & Control
5.	Anderson fand - Power System Stability and Control.
6.	Modern Power System Analysis by Nagrath & Kothari

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**		**Academic Year**	**2019-20**
M E Electrical Engineering (Electrical Power Engineering): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **ELE2213: Restructured Power Systems**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2213

CO1 **Explain** market models in deregulated power systems and their working
CO2 **Discuss** the behavior of various market players in participating in power markets
CO3 **Elaborate** on the complexities arising in transmission of power in an open access era
CO4 **Explain** the need of ancillary services in operating and maintaining electrical power systems
CO5 **Explain** concept of power system security and function of energy control centers and use of computers in their functioning in deregulated markets

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)
1	**Fundamentals of restructured power systems:** Market Models	06	15	6	CO1	PSO1 PSO3	SD	G	PE

	Role of Gencos, Transcos, Distcos, Role of ISO, Market Operator								
2	**Competitive wholesale electricity markets:** Marketplace mechanism – Bilateral trading, Poolco, Power exchange Energy auction – Market clearing price Issues in deregulation – Network Congestion, Optimal Bidding, Transmission Pricing, Ancillary Service Management, Risk Assessment and Hedging Market participants: Consumer's perspective, Retailer's perspective Producer's perspective	12	25	6	CO1 CO2	PSO1 PSO3			
3	**Transmission open access:** Centralised trading over a transmission network – Unconstrained transmission Centralised trading over a transmission network – Constrained transmission Tracing of power Nodal prices Transmission loss and Transmission pricing Congestion Management	14	30	6	CO1 CO3	PSO1 PSO2 PSO3			
4	**Ancillary services:** Management of ancillary services Market based mechanisms for ancillary services Cost allocation of ancillary services Reactive power as an ancillary service System security	10	15	6	CO1 CO4	PSO1 PSO3			
5	**Distributed Generation in restructured markets:** Market regulation The power pool Technical issues Implications and opportunities for network operators and generators Connection and use of system charges	06	10	6	CO1 CO5	PSO1 PSO3			
6	**Control paradigms for deregulation**	04	05	6	CO1 CO5	PSO1 PSO3			

Reference Books

1.	Understanding Electric Utilities and Deregulation – Lovin Philipson, H. Lee Wills
2.	Power System Restructuring and Deregulation – Loi Lee Lai
3.	Fundamentals of Power System Economics – Kirschen and Strabac
4.	Power System Restructuring – Marija Ilic
5.	Operation of Restructured Power System – K. Bhattacharya, Daadler, Boolen

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME (Electrical Power Engineering)

Programme Specific Outcome (PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills

Syllabus of Courses

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**		**Academic Year**	**2019-20**
ME PART I (Electrical Power Engineering): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~** **Power System Protection ELE 2214**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 1956 Year of Syllabus Revision: 2007 and 2013-14	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE 2214

CO1 **Estimate** CT, PT behavior to design modern CT, PT. based on basics of protection and types of relay.
CO2 **Differentiate** over current, earth fault and directional relay operation, their construction to design different protection schemes.
CO3 **Explain** various distance protection characteristics to rank generalized math expression for digital algorithms.
CO4 **Discover** pilot relaying principles for transmission line protection to design travelling wave relay
CO5 **Predict** power system equipment protection with differential relays.
CO6 **Plan** power system protection with frequency and voltage relays.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	Evaluation and need of protective relays, primary and back-up protection,classification of relays, C.T., Accuracy, burden, Transient behavior of C.T., C.Tand P.T. equivalent circuit, Design and construction of C.T. and P.T., Summationtransformer, Operating principle and relay construction.	06	10	1,4	CO1	PSO1,3	Emp, Ent & SD	G	HV & PE
2	Over current relays, various o/c relay characteristics, current and time setting calculation, o/c protective schemes, directional o/c relays using E. magnetic staticand up based Earth fault and phase fault protection, directional earth fault relay.	05	15	4,6	CO1,CO2	PSO1, 3			
3	Various distance protection schemes using X, Z, Y offset, angle-impedance relaychs using E. m., Static and µp based relays with the help of A.C. and P.C.,Polarized quantity sampling comparator for X, Y, offset mho Ch, effect of loadvariation Rf and power swing on performance of distance relays, out of steptripping and blocking relays, effect of line length and source impedance, selectionof distance relays, quadrilateral relay, Elliptical relay, restricted X,Y and Z relays,specially distance schemes Generalized math expression for distance relays,Digital relaying algorithms, like diff equation technique, discrete Fourier transformtechnique, Walsh-Hadamard transform technique, wavelet transform.	15	25	2	CO1,CO3	PSO1, 2,3			
4	Circulating and balanced voltage schemes, carrier aided and acceleration distance protection, Travelling waves relay	05	15	3	CO1,CO4	PSO1, 2,3			
5	Synchronous gen. protection, Power transformer protection, Bus zone protection,Induction motor protection	06	15	6	CO1,CO5	PSO1, 2,3			
6	Over frequency & under frequency detection, load shedding & load Restoration phenomena, digital & static frequency relays & df/dt relays	05	15	6	CO1,CO6	PSO1, 2,3			
7	Protection of system against voltage collapse	03	5	6	CO1,CO6	PSO1, 3			

Reference Books

1	1. Protective Relays their Theory and Practice Vol-I and II by A.R. Van C. Warrington
2	Power System Protection Static Relays with up applications by T.S.M. Rao
3	Power System Protection and Switchgear by Badriram and Vishwakarma, **second edition**
4	Applied Protective Relaying by WEC
5	Power System Protection by Patra, Basu and Choudhri
6	Power System Protection and Switchgear by Ravindranath and Chander
7	Digital Power System Protection - Ravindra P. Singh

8	Fundamentals of Power System Protection – Y.G. Paithankar, S.R. Bhide
9	Digital Protection - L.P. Singh

The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Applied Physics**		**Academic Year**	**2019-20**

M.Sc. (Applied Physics): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **Power System Protection ELE 2214**	**Credits / Hours per week**	**03**
Semester	**II**	Year of Introduction: 1956 Year of Syllabus Revision: 2007 and 2013-14	**Maximum Marks / Grade**	**50**
Mode of Transaction		Laboratory Experiments, discussion and viva		

CO for ELE 2214L

CO1 Predict characteristic of various types of microprocessor based relay for power system application.
CO2 Develop protection scheme for various parts of power system.
CO3 Design a relay using digital components like UP, UC etc.
CO4 Formulate a technical document for which includes observations, calculation, and conclusion

No.	Experiment	Contact hours	Weightage	BT Level	CO	PSO
1	Prove various characteristics of Over current and earth fault relay using a personal computer	3	100%	6	1.2.3.4	PSO1,2 &3
2	Prove various characteristics of over voltage and under voltage relay	3	100%	6	1.2.3.4	PSO1,2 &3
3	Predict Protection of Induction motors by Motor protection relay	3	100%	6	1.2.3.4	PSO1,2 &3
4	Compare power measurement by Power relay for P>, P< and reverse power.	3	100%	6	1.2.3.4	PSO1,2 &3
5	Test micro processor based Differential relay for transformer protection	3	100%	6	1.2.3.4	PSO1,2 &3
6	Elaborate up based distance relay for various applications	3	100%	6	1.2.3.4	PSO1,2 &3
7	Demonstrate up based frequency relay for load shedding	3	100%	6	1.2.3.4	PSO1,2 &3
8	Develop characteristics of protective relay using UP, UC on software platform	3	100%	6	1.2.3.4	PSO1,2 &3
9	Digital Simulation	15	100%	6	1,2,3,4	PSO1,2 &3

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

The Maharaja Sayajirao University of Baroda Faculty Technology and Engineering Department of Electrical Engineering		**Academic Year**	**2019-20**
M E Electrical Engineering (Electrical Power Engineering): Regular Programme			
Year	**I**	**Core / ~~Elective / Foundation~~ ELE2215: High Voltage Engineering**	**Credits / Hours per week**	**04**
Semester	**II**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**100**
Mode of Transaction		Lectures and Tutorials		

Course Outcome (CO) ELE2215

CO1 **Interpret** the breakdown mechanism of different dielectric medium; partial discharge and it's behavior, corona and it's factors; HVDC system and its advantages and disadvantages.

CO2 **Estimate** the factors related to behavior of breakdown mechanism of different dielectric medium, corona.

CO3 **Explain** Non Destructive Testing of Materials and electrical apparatus

CO4 **Explain** the working of different high voltage generation techniques; behavior of transient over voltages in power system and protection system against system over voltages.

CO5 **Choose** high voltage generation and measurement techniques.

CO6 **Recommend** high voltage testing techniques

Unit No.	Topic	Contact Hours	Weightage (%)	BT Level	CO	PSO	Elements of Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	Relevance to Local (L)/ National (N)/ Regional (R)/Global (G)	Relation to Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	Dielectrics Review of breakdown mechanism in solid, liquid and gaseous dielectrics, Insulation characteristics of long air gap. Corona - Effects of Corona in power apparatus, Corona loss and its calculations. Radio interference voltage.	16	30	5,5	CO1 CO2	PSO1 PSO2 PSO3	SD	G	PE
2	Transient overvoltages in power system and protection against them. External and internal overvoltages, Mechanism of lightning, Travelling waves and their behavior on transmission lines. Bewleg - Latice diagram, Effects of over voltages on power apparatus. Protection against overvoltages, Lightning arresters, selection and ratings of arrester, insulation co-ordination.	11	20	5	CO4	PSO1 PSO2 PSO3			
3	Generation of High Voltages and High Currents in laboratory Generation of power frequency a.c., d.c. and impulse high voltage. Necessity of high impulse current, Generation of high impulse current.	07	10	5	CO5	PSO1 PSO2 PSO3			
4	Measurement of high voltages and high currents Methods for measurement of power frequency a.c., d.c. and impulse high voltages and high currents	04	10	5,5	CO4 CO6	PSO1 PSO2 PSO3			
5	Non destructive testing of materials and elect apparatus Non-destructive testing methods for measurement of d.c. resistivity, dielectric constant, capacitance and Tan delta in low frequency, power frequency and audio frequency range. Partial discharge measurements in insulation systems.	06	10	5	CO3	PSO1 PSO2 PSO3			
6	High voltage testing of elect apparatus Significance of H.V. tests, atmospheric correction factors, testing of Power system apparatus such as transformers, capacitors, insulators, circuit breakers, cables etc.IS Standards for high voltage tests and measurements.	04	10	5	CO6	PSO1 PSO2 PSO3			
7	H.V.D.C. Transmission System Advantages and disadvantages of H.V.D.C. transmission system, Layout of H.V.D.C. transmission system and design considerations in H.V.D.C. transmission equipments, types of D.C. links.	04	10	5,5	CO1 CO2	PSO1 PSO2 PSO3			

Reference Books

1.	High Voltage Engineering : Prof R S Jha
2.	High Voltage Engineering : Prof Dr M P Chaurasia
3.	High Voltage Engineering : M S Naidu

Bloom's Taxonomy Levels: 1. Remember 2. Understand 3. Application 4. Analysis 5. Evaluation 6. Creation

Programme Name: ME Electrical (Electrical Power Engineering)

Programme Specific Outcome(PSO)

PSO1 Students will be able to apply specialized knowledge in classical as well as modern topics in the broad field of power systems, electrical drives, protection and high voltage engineering, enabling post graduates to analyse, design, operate and integrate electrical systems.

PSO2 Students will be able to apply the knowledge of ethical and management practices required to work in a team as well as a team leader.

PSO3 To inculcate research attitude and life long learning in hard and soft skills.

Syllabus of Courses

	The Maharaja Sayajirao University of Baroda **Faculty Technology and Engineering** **Department of Electrical Engineering**	**Academic Year**	**2019-20**

M E Electrical Engineering (Electrical Power Engineering): Regular Programme

Year	**I**	**Core / ~~Elective / Foundation~~** **ELE2215L : High Voltage Technology Laboratory**	**Credits / Hours per week**	**03**
Semester	**II**	Year of Introduction: 2007 Year of Syllabus Revision: 2012	**Maximum Marks / Grade**	**50**
Mode of Transaction		Practical , Term work , Viva, Field Visit		

Course Outcome (CO) ELE2215L

CO1 **Examine** the design considerations of high voltage laboratory
CO2 **Judge** the performance of horn gap arrester, pin insulator at power frequency.
CO3 **Determine** the breakdown voltage characteristics of different sphere gap arrangement and different non uniform electrode gap configuration.
CO4 **Conclude** the results of the Partial Discharge Test, Capacitance and Tan delta test, Short Circuit Test, Impulse Voltage Test and DC Resistivity Test performed at ERDA
CO5 **Develop** the technical report related to performed experiments.

Unit No.	**Topic**	**Contact Hours**	**Weightage (%)**	**BT Level**	**CO**	**PSO**	**Elements of** Employability (Emp)/ Entrepreneurship (Ent)/ Skill Development (SD)	**Relevance to** Local (L)/ National (N)/ Regional (R)/Global (G)	**Relation to** Gender (G), Environment and Sustainability (ES), Human Values (HV)and Professional Ethics (PE)

1	**Examine** the design consideration of High Voltage Laboratory.	03	100	5,3	CO1 CO5	PSO1 PSO2 PSO3	SD	G	PE
2	**Judge** the performance of Horn Gap Arrester under the application of power frequency supply.	03	100	5,3	CO2 CO5	PSO1 PSO2 PSO3			
3	**Determine** the breakdown voltage characteristics of different sphere gap configuration in the effect of gaseous medium with respect to reference measurement.	03	100	5,3	CO3 CO5	PSO1 PSO2 PSO3			
4	**Determine** the breakdown voltage characteristics of different non-uniform electrode gap configuration in the effect of gaseous medium.	03	100	5,3	CO3 CO5	PSO1 PSO2 PSO3			
5	**Judge** the performance of pin insulator by performing (1) One minute power frequency voltage with stand test. (2) Dry and Wet Power frequency flash over test.	03	100	5,3	CO2 CO5	PSO1 PSO2 PSO3			
6	**Conclude** the result of Partial Discharge Test performed at ERDA	01	100	5,3	CO4 CO5	PSO1 PSO2 PSO3			
7	**Conclude** the result of Capacitance and Tan Delta Test performed at ERDA	02	100	5,3	CO4 CO5	PSO1 PSO2 PSO3			
8	**Conclude** the result of Short Circuit Test performed at ERDA	02	100	5,3	CO4 CO5	PSO1 PSO2 PSO3			
9	**Conclude** the result of Impulse Voltage Test performed at ERDA	02	100	5,3	CO4 CO5	PSO1 PSO2 PSO3			
10	**Conclude** the result of DC Resistivity Test performed at ERDA	02	100	5,3	CO4 CO5	PSO1 PSO2 PSO3			
11	HVE lab internal assessment	06	-	-	-	-			
12	HVE Laboratory seminar	06	-	-	-	-			
13	Discussion of High Voltage Engineering for Industrial application	03	-	-	-	-			