# FACULTY OF ENGINEERING

# Syllabus for the

# Final Year Common to Electrical Engineering & Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)

***( w.e.f. Academic Year 2017-18)***

**Swami Ramanand Teerth Marathwada University, Nanded**

# Swami Ramanand Teerth Marathwada University, Nanded

Teaching and Evaluation Scheme for

**Final Year Common to Electrical Engineering & Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

***( w.e.f. Academic Year 2017-18)***

## <u>Semester VII</u>

| Course Code | Course Name | Teaching Scheme | | | Credit Structure | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | L+T | P | MSE | ESE | CE | ESE (POE) |
| **EE401** | Industrial Management & Economics | 4 | | | 3 | | 20 | 80 | | |
| **EE402** | Electrical Drives | 3 | 1 | | 4 | | 20 | 80 | | |
| **EE403** | Power System Operation and Control | 4 | | | 3 | | 20 | 80 | | |
| **EE404** | Switch Gear and Protection | 3 | 1 | | 4 | | 20 | 80 | | |
| **EE405** | Elective-I | 4 | | | 3 | | 20 | 80 | | |
| **EE406** | Electrical Drives Lab | | | 2 | | 1 | | | 30 | 70 |
| **EE407** | Power System Operation and Control Lab | | | 2 | | 1 | | | 30 | 70 |
| **EE408** | Switch Gear and Protection Lab | | | 2 | | 1 | | | 30 | 70 |
| **EE409** | Seminar on In-plant Training | | | 2 | | 1 | | | 30 | |
| **EE410** | Project Phase-I | | | 2 | | 1 | | | 70 | |
| **Total** | | **18** | **2** | **10** | **17** | **5** | **100** | **400** | **190** | **210** |

**<u>Elective-I</u>**

A. Renewable Energy Systems
B. Smart Electric Grid
C. Digital Signal Processing
D. Generalised Theory of Electrical Machines
E. EHV A.C. Transmission System

**Total Credits:22** **Total contact Hours/Week:30**

***MSE-**Mid Semester Exam ***CE-**Continuous Evaluation ***ESE-**End Semester Exam

***Minimum for passing in Theory, Audit and Practical/workshop/Seminar: 40% Each**

# Swami Ramanand Teerth Marathwada University, Nanded

Teaching and Evaluation Scheme for

**Final Year Common to Electrical Engineering & Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

***( w.e.f. Academic Year 2017-18)***

## Semester VIII

| Course Code | Course Name | Teaching Scheme | | | Credit Structure | | Evaluation Scheme | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | L | T | P | L+T | P | MSE | ESE | CE | ESE (POE) |
| **EE411** | High Voltage Engineering | 4 | | | 4 | | 20 | 80 | | |
| **EE412** | Power Quality and Harmonics | 3 | 1 | | 4 | | 20 | 80 | | |
| **EE413** | Industrial Automation | 4 | | | 4 | | 20 | 80 | | |
| **EE414** | Elective-II | 4 | | | 3 | | 20 | 80 | | |
| **EE415** | High Voltage Engineering Lab | | | 2 | | 1 | | | 30 | 70 |
| **EE416** | Power Quality and Harmonics Lab | | | 2 | | 1 | | | 30 | 70 |
| **EE417** | Industrial Automation Lab | | | 2 | | 1 | | | 30 | 70 |
| **EE418** | Project Phase-II | | | 6 | | 4 | | | **100** | **100** |
| **Total** | | **15** | **1** | **12** | **15** | **7** | **80** | **320** | **190** | **310** |

**Elective-II**

A. HVDC and FACTS
B. Restructuring and Deregulation
C. Soft Computing Application in Electrical Engineering
D. Special Topics in Electrical Engineering
E. Non Linear Control System

**Total Credits:22** **Total contact Hours/Week:28**

***MSE-**Mid Semester Exam ***ESE-**End Semester Exam ***CE-**Continuous Evaluation

***Minimum for passing in Theory, Audit and Practical/workshop/Seminar: 40% Each.**

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE401. Industrial Management & Economics**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation** | **ESE** | **MSE** | **Minimum Passing Marks** |
| **Scheme** | **80 Marks** | **20 Marks** | **40%** |

**Course objectives:**

1. To study the industrial management and economics concept.
2. To Introduce Electrical Project Management.

**Course Contents:**

**Unit 1**

**Management Concept:** **(06 Hrs)**

Management, Administration, Organization, Characteristics of management, Managerial objectives, Managerial skills, Principles of management, Types of management, management chart, Project management, MIS.

**Unit 2**

**Industrial Ownership & Psychology:** **(08 Hrs)**

Types, single, Partnership, JSC, Co-Operative, public sector, Private sector, Merits and demerits. Concept of psychology, Scope, Group Dynamic, Difi Behavior, Objectives of Industrial psychology, Motivation, Theory of X and V, Industrial fatigue,

**Unit 3**

**Personal management:** **(06 Hrs)**

Aims, Objectives, Principle of personal management, Recruitment, Selection, Educating, Testing, A. Test, G.D. , P.I., Promotions, Various selections, Tests, Interviews, Techniques, T.A.

**Unit 4**

**Engineering Economics & Financial Management:** **(08 Hrs)**

Wealth, Wants, capital, Income, Demand and supply, Law of substitution, Supply Equilibrium, and price determination. Purpose of investment, Source of finance, Reserve, Surplus, Assets, Liabilities, Trial Blanca, Fanatical statement, Fanatical Ratio.

**Unit 5** **(06 Hrs)**

**Entrepreneurial qualities, Skills, Role of Government, Theory "i" Management:**

Global Management Practices, Information Technology for Management: Management Information Systems.

**Unit 6** **(06 Hrs)**

**Electrical Project Management & Safety:**

Choice & grading of major electrical equipments, and systeming in project management, Economics of single v/s multiple units, Co-ordination of ratings of equipments in electrical projects. The Indian electricity acts and rules, Industrial safety.

**Course Outcomes:**

After completing this course student will have-

1. An ability to function on multidisciplinary teams
2. An ability to identify, formulate, and solve engineering problems
3. An understanding of professional and ethical responsibility
4. An ability to communicate effectively
5. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
6. A recognition of the need for, and an ability to engage in life-long learning
7. A knowledge of contemporary issues
8. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Text/ Reference Books:**


1. Industrial Engineering and Management : O.P. Khanna, Dhanpatrai and Sons, (1992 )
2. Management Today - Principles and practice - Gene, Burton, Manab Thakur- McGraw Hill. (1996).
3. Industrial analysis and management systems by S.Dalela and Manssoorali- Standard Publisher (1997).
4. Count your Chiken's before they Hatch by ArindamChoudhari, Vikas Publishing House, New Delhi, 2001.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE402. Electrical Drives**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 03** | **T: 01** | **P: 00** |
| **Evaluation** | **ESE** | **MSE** | **Minimum Passing Marks** |
| **Scheme** | **80 Marks** | **20 Marks** | **40%** |

**Course Objectives:**

1. To study and analyze the operation of the converter, chopper fed dc drive.
2. To study and understand the operation of both classical and modern induction motor drives.
3. To study and analyze the operation of PMSM and BLDC drives.
4. To analyze and design the current and speed controllers for different drives.

**Course Contents:**

**Unit I:Concept of Electrical Drives: [08 Hrs]**

Electric Drives: Definition, Advantages, Components, selection. Latest trends in DC & AC Drives, Dynamics.Equivalent values of drive parameters. Load Torque: Components, Natures & classification. Steady state stability: Speed torque characteristics, criteria. Load equalization.

**Unit II: Cycloconverters: [06 Hrs]**

Principles of Cycloconverter operation.Single phase to singlephase step up cycloconverter, step down cycloconverter. Three phase to single phasecycloconverter&Three phase to three phase cycloconverter. Output voltage equationfor cycloconverter .

**Unit III: Control of D.C. motor by Converters: [08 Hrs]**

Introduction to thyristor controlled drives,single phase semi and fully controlled converters and three phase semi and fullycontrolled converters connected to D.C. separately excited and D.C. series motors continuouscurrent operation-output voltage and current waveforms, speed andtorque expressions, speed-toque characteristics, problems on converter fed D.C.motors. Four quadrant operation of D.C. motor by dual converters, closed loopoperation of D.C. motor (block diagram only).

**Unit IV: Control of D.C. motor by Choppers: [06 Hrs]**

Time ratio controlled choppers for D.C. series motors, current limit controlled choppers for separately excited D.C. motor, two and four quadrant operation of D.C. motors using choppers.

**Unit V: Control of Induction Motors: [12 Hrs]**

***From Stator side****:* Control of induction motor by A.C. Voltage controllers, waveforms, speed torque characteristics, variable frequency control of induction motor by voltage source, current source invertors and cycloconverters, PWM control, comparison of VSI and CSI operations,

speed —torque characteristics, numerical problems on induction motor drives, closed loop operation of induction motor drives (block diagram only).
***From Rotor side:***Static rotor resistance control, slip power recovery, static ScherbiusDrive, static Kramer drive, their performance and speed — torque characteristics,advantages, applications and problems.

**Unit VI: Synchronous Motor Drives: [04 Hrs]**
Synchronous motor drives. Operation from fixedfrequency supply- variable frequency control - VSI and CSI fed drives- self-controlledsynchronous motor drives employing cycloconverter.

**Course Outcomes:**
After completing this course student will have-
1. Analyze the operation of the converter, chopper fed dc drive.
2. Analyze the operation of both classical and modern induction motor drives.
3. Design the current and speed controllers for a closed loop solid-state d.c motor drive.
4. Select the drives for any particular application .

**Reference Books:**
1. Fundamentals Of Electrical Drives - G.K. Dubey
2. Power Electronics - M.D. Singh & K.B. Khanchandani, T.M.H. Pub. Co.
3. Power Electronics - P.S. Bimbhra
4. Electric Drives - N.K. De, P.K. Sen, P.H.I. pub. Co.
5. Ned Mohan et al, Power Electronics: Converters, Applications, and Design, John Wiley & Sons. Inc., 2nd Edition, 1995
6. Thyristor Control of Electrical Drives -V. Subramanyam, T.M.H. Pub.Co.
7. A first Cource on Electrical Drives - by S.K. Pillai - New Age Internation Ltd.
8. Electric Motor Drives-Modeling Analysis & control- R.Krishanan P.H.I. pub. Co.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

## EE403. Power System Operation and Control

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

**Course Objectives:**

1. To learn the concepts of unit-commitment and load scheduling.
2. To learn Automatic control of power output of generators to maintain the scheduled frequency.
3. To know the single area and two area load frequency control methods.
4. To learn the methods of reactive power compensation in transmission line.
5. To understand the modelling concepts of governor.
6. To learn about the concept of reactive power control.

**Course Contents:**

**Unit-I** **[06 Hrs]**

**Power station control:** Generators and exciters, power transformers-types, selection and characteristic specifications. Excitation systems, excitation control, voltage regulation of transformers.

**Unit-II** **[08 Hrs]**

**Economic operation of power systems:** Methods of loading steam stations. Distribution of load between generator units.Effect of transmission loss. Criteria for optimal loading of power plants, heat rate curve, cost curve, Co-ordination of incremental fuel cost and incremental transmission loss. Economic distribution of load between plants neglecting and considering effect of transmission loss. Methods of loading hydro electric power plants.Economic loading of combined thermal and hydroelectric plants. Long range load dispatching.

**Unit-III** **[08 Hrs]**

**Load frequency control:** Importance of frequency control, Definition of control area – single area control, representation of an isolated power system, steady state response, dynamic response, uncontrolled case. Load frequency control of two area system – interconnected system. Flat frequency control, real power balance for load changes, flat tie line and flat frequency control, tie line bias control, speed governors, governor characteristics, A.G.C.

**Unit-IV** **[08 Hrs]**

**Modern trends in power station design and operation:**.Loading of hydro units, hydro thermal scheduling. Loss Coefficients, Load forecasting – Unit commitment. Generation allocation control. Priority- list methods and introduction to dynamic programming approach.

**Unit-V** **[08 Hrs]**

**Reactive power control:** Overview of reactive power control – power control- reactive power compensation in transmission systems- advantages and disadvantages of different types of compensating equipments for transmission system, uncompensated and compensated transmission lines. special compensation
equipment: shunt capacitors, reactors, tap changing transformers, static VAR compensators

**Unit-VI** **[06 Hrs]**

**Preventive, emergency and restorative control** : Introduction to energy management system (load dispatch center), introduction to state-estimation, SCADA, preventive control: generation rescheduling, load tripping, emergency control: under-frequency load tripping, generator tripping, controlled system separation (islanding), restorative control: resynchronization, start-up power.

**Course Outcomes:**

The students will be able to-

1. Calculate the economic load dispatch for a given generator and load specifications.
2. Model the governor system.
3. Identify the blocks in a load frequency control system.
4. Calculate the amount of reactive power to be compensated in a transmission system.

**Reference Books:**

1. Power System Operation and Control – P.S.R. Murthy,Tata McGraw Hill
2. Economic Operation of Power Systems – L.K. Kirchmayer,Wiley Eastern Ltd.
3. Power System Operation and Control – D. Vijaya Kumar Scitech Publications pvt. Ltd
4. Elements of Electrical Power Station Design and Control – M.V Deshpande, Easterm Economy Edition
5. Power System Analysis– A.R. Bergen, Prentice Hall Inc.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE404. Switch Gear and Protection**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 03** | **T: 01** | **P: 00** |
| **Evaluation** | **ESE** | **MSE** | **Minimum Passing Marks** |
| **Scheme** | **80 Marks** | **20 Marks** | **40%** |

**Course Objectives:**

1. To describe the need of protective Relaying and operating principles of different types of relays.
2. To elaborate construction and working principle of different types of Circuit Breakers.
3. Study different type of faults in transformer, alternator and various protective schemes related to them.
4. Learn transmission line protection schemes, and characteristics of different types of distance relays

**Course Contents:**

**Unit 1** **(06 Hrs)**

**Fundamentals of Power System Protection:**

Principles of protection and switchgear, different types of switchgear, modes of classification, ratings and specifications. Protective Relaying: Need of protective relaying in power system, General idea about protective zone, Primary and backup protection, Desirable qualities of protective relaying.

**Unit 2** **(08 Hrs)**

**Relays:**

Classification of relays, Principle of working and characteristics of attracted armature, balanced beam, induction, disc and cup type relays, induction relays, Setting characteristics of over current; directional, differential, percentage differential and distance (impedance, reactance, mho) relays.

**Static & Digital Relaying:**

Overview of Static relay, block diagram, operating principal, merits & demerits of static relay. Numerical Relays :-Introduction, Block diagram of numerical relay, Sampling theorem, Anti – Aliasing Filter, Block diagram of PMU

**Unit 3** **(10 Hrs)**

**Arc Phenomenon and Circuit Breakers:**

Principles of circuit interruption, arc phenomenon, Restricting and recovery voltage. Arc quenching methods. Capacitive, inductive current breaking, resistance switching, Auto reclosing. Circuit Breakers:- Classification of C.B.s – air break, air blast, vacuum, minimum oil and bulk oil, SF6 C.B. L.T. switchgear:- MCB, MCCB, HRC fuses, type construction and application. Circuit breaker ratings, rewirable and H. R. C. fuses, their characteristics and applications.

**Unit 04:** **(08 Hrs)**

**A) Bus bar Protection:** Differential protection of bus bars. Selection of C.T. ratios for bus bar protection.High impedance differential relay.

**B) Transmission line**: over current protection for feeder using directional &non-directional over-current relays, Introduction to distance protection, impedance relay, reactance relay, mho relay & Quadrilateral Relays, Introduction to PLCC, block diagram, advantages, disadvantages, three stepped distance protection, Effect of arc resistance, and power swing on performance of distance relay. Realisation of distance relays (impedance, reactance and mho relay) using numerical relaying algorithm (flowchart, block diagram), Introduction to Wide Area Measurement (WAM) system.

**Unit 05:** **(08 Hrs)**

**A) Transformer Protection –** Types of faults in transformer. Percentage differential protection in transformers, Restricted E/F protection. Incipient faults, Buchholz relay. protection against over fluxing. Protection against inrush current,

**B) Alternator Protection –** Various faults in Alternator, abnormal operating conditions- stator faults, longitudinal percentage differential scheme and transverse percentage differential scheme. Rotor faults- abnormal operating conditions, inter turn fault, unbalance loading, over speeding, loss of excitation, protection against loss of excitation using offset Mho relay, loss of prime mover.

**Unit-06:** **(06 Hrs)**

**Insulation Co-Ordination and Over Current Protection**:

Definitions (Dry flashover voltage FOV), WEF FOV, Impulse FOV, insulation, co-ordinating insulation and protective devices.Basic impulse insulation (BIL), Determination of line insulation. Insulation levels of substation equipment. Lightning arrester selection and location.Modern surge diverters and Necessity of power system earthing, Method of earthing the neutral, Peterson coil, earthing of transformer.

**Course Outcomes:**

After completing this course student will have-

1. Students will able to use mathematical tools and engineering knowledge to study the importance of protection needs.
2. Students will able to design protection controls as per requirement.
3. Students will understand their responsibility in designing protective schemes.
4. Learner will able to design and use protection equipments economically and understand its impact on environment.
5. Students will have an ability to use technical skills, and modern engineering tools necessary for engineering practice.

**Reference Books:**

1. S. Rao, "Switchgear Protection & Power Systems", Khanna Publications
2. Y. G. Paithankar, S. R. Bhide, "Fundamentals of Power System Protection", Prentice Hall of India
3. Badri Ram, D. N. Vishwakarma, "Power System Protection & Switchgear", Tata McGraw Hill Publishing Co. Ltd.
4. BhaveshBhalja, R.P. Maheshwari, N.G. Chothani," Protection and Switchgear", Oxford University Press, 2011 Edition.
5. J. Lewis Blackburn , Thomas J. Domin, "Protective Relaying: Principles and Applications", Fourth Edition, CRC Press.
6. Prof. Dr S.A. Soman, IIT Mumbai , A Web course on "Digital Protection of power_System" http://www.cdeep.iitb.ac.in/nptel/Electrical%20Engineering/Power%20System%20Protection/Course_home_L27.html
7. A.G. Phadke and J.S. Thorp , Computer relaying for Power System, Research Studies Press LTD, England.(John Willy & Sons Inc New York)
8. Crussel Mason, "The Art and Science of Protective Relaying", Wiley Eastern Limited.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE405 Elective-I (A) Renewable Energy Systems**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

## Course objectives:

1. To enhance the awareness of non-conventional energy sources and their importance in present era.
2. To introduce various renewable energy technologies and to make platform for students in research of renewable energy systems.

## Syllabus:

**Unit 1**

**Introduction to Sustainable energy sources:** **(06 Hrs)**

Renewable Sources of Energy, Advantages and disadvantages of non-conventional energy sources over conventional, Wave energy conversion systems, Tidal energy conversion systems, clean coal power plants, Biomass to electrical energy conversion, Geo-Thermal energy harvesting, Biomechanical energy harvesting, Bio-chemical and photosynthesis techniques.

**Unit 2**

**Distributed Generation:** **(08 Hrs)**

Distributed Generation with Fossil Fuels, Concentrating Solar Power (CSP) Technologies, Biomass for Electricity, Micro- Hydropower Systems, Fuel Cells, Fuel Cell Thermodynamics: Enthalpy, Gibbs free energy and Fuel Cell Efficiency, Types of Fuel Cells, Hydrogen Production. Economics of Distributed Resources, Economics of Distributed Resources, Energy Economics, Energy Conservation Supply Curves, Combined Heat and Power (CHP), Integrated Resource Planning (IRP) and Demand-Side Management (DSM).

**Unit 3**

**Photovoltaic Systems-I**: **(06 Hrs)**

Introduction of solar systems, introduction to Photovoltaic Materials and Electrical Characteristics, Introduction to the Major Photovoltaic System Types, Current–Voltage Curves for Loads, Grid-Connected Systems: Interfacing with the Utility, DC and AC Rated Power, The “Peak-Hours” Approach to Estimating PV Performance.

**Unit 4**

**Photovoltaic Systems-II**: **(06 Hrs)**

Capacity Factors for PV Grid-Connected Systems¸ Grid-Connected System Sizing, Grid-Connected PV System Economics: System Trade-offs, Dollar-per-Watt Ambiguities, Amortizing Costs, Stand-Alone PV Systems, PV-Powered Water Pumping, PV systems – off grid systems and scope for inclusive growth of rural India. Grid autonomy.Bi-directions metering.Calculation of system details.

**Unit 5**

**Wind Energy Systems:** **(08 Hrs)**

Historical Development of Wind Power, Types of Wind turbine electrical generators, Power in the Wind, Impact of Tower Height, Maximum Rotor efficiency, Speed control for Maximum Power, Average Power in the wind, Wind turbine power converters, Wind Turbine Economics, Simple Estimates of Wind Turbine Energy, Specific Wind Turbine Performance Calculations, Environmental Impacts of Wind Turbines. Change in wind pattern and forecasting the power generation based on the wind pattern.

**Unit 6**

**Environmental Issues:** **(06 Hrs)**

Global warming and climate change, Carbon trading, concept of Carbon credits, Carbon dioxide sequestration, Atmospheric pollutants, nuclear waste disposal, Impact of renewable energy sources. Kyoto Protocol, Ozone depletion.

**<u>Course Outcomes:</u>**

After completing this course student will have-

1. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
2. Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.
3. List and describe the primary renewable energy resources and technologies.
4. Convert units of energy—to quantify energy demands and make comparisons among energy uses, resources, and technologies.

## Text/ Reference Books:


1. Dr. Sukhatme, “Solar Energy”, Tata McGraw Hills
2. G. D. Rai, “Non Conventional Energy Sources”, Khanna Publication
3. Gilbert M. Masters, “Renewable and Efficient Electrical Power Systems”, Wiley – IEEE Press, August 2004
4. Paul Gipe, “Wind Energy Comes of Age”, John Wiley & Sons Inc.
5. S. Rao, Dr. B. B. Parulekar, “Energy Technology – Non Conventional, Renewable and Conventional”, Khanna Publication
6. Siegfried Heier, Rachel Waddington, “Grid Integration of Wind Energy Conversion Systems”, Wiley Publications
7. A Web Course on ‘Non-Conventional Energy Systems’ by Prof. L. Umanand, IISc Bangalore. (http://nptel.iitm.ac.in)

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE405 Elective-I (B) Smart Electric Grid**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

**Course objectives:**

1. This course seeks to provide an understanding of why Smart Grids are critical to the sustainability and growth of India's electricity network.
2. To enable a shift from today's situation to the intelligent, profitable, efficient, reliable, consumer orientated grid required to meet the challenges of the future with minimum impact to the environment.

**Syllabus:**

**Unit 1**

**Introduction:** **(06 Hrs)**

What is driving the move towards Smart Grids globally and in India? What is a Smart Grid? Overview of how Indian power market is organized, operated and challenges being faced. Overview of how the Indian GENERATION, TRANSMISSION and DISTRIBUTION business is operated and controlled and some of the challenges being faced.

**Unit 2**

**Smart Grid Technologies -I:** **(06 Hrs)**

Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading(AMR), Outage Management System(OMS), Plug in Hybrid Electric Vehicles(PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers. Smart Substations, Substation Automation, Feeder Automation.

**Unit 2**

**Smart Grid Technologies -II:** **(06 Hrs)**

Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System(WAMS), Phase Measurement Unit(PMU).
(Field Visit to National Load Dispatch Center)

**Unit 4**

**Electrifying rural India through Smart grid:** **(06 Hrs)**

Electrifying India's rural community and the challenges being faced.(Developing technology and systems that will enable smarter rural electrification, Financing programmes, Virtual power plants, Solar power, Geothermic power), Smart Utilities (case studies), Presentation on the Smart Grid Maturity Model (SGMM), Architecture for smart grids.

**Unit 5**

**Power Quality Issues in Smart Grid: (06 Hrs)**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

**Unit 6**

**Information and Communication Technology for Smart Grid: (06 Hrs)**

Advanced Metering Infrastructure (AMI), Home Area Network (HAN) Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, ZigBee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid. Broadband over Power line (BPL). IP based protocols.

**Course Outcomes:**

After completing this course student will have-

1. Acquire in-depth understanding on recent development of power grids, i.e. smart grid
2. Apply advanced analysis tools in planning and operation of smart grids
3. Acquire skills in presentation and interpretation of results in written form.

**Text/ Reference Books:**


1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and Demand Response", CRC Press
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of Electric Utilities", Island Press; 1 edition 8 Jun 2010
4. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks." Institution of Engineering and Technology, 30 Jun 2009
5. Gil Masters, Renewable and Efficient Electric Power System, Wiley-IEEE Press, 2004.
6. A.G. Phadke and J.S. Thorp, Synchronized Phasor Measurements and their Applications, Springer Edition, 2010.
7. Grid wise Alliance website http://www.gridwise.org/
8. IEEE Transaction on Smart Grid.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE405 Elective-I (D) Generalised Theory of Electrical Machines**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

**Course Objectives:**

1. To gain knowledge of operation and performance of synchronous reluctance motors.
2. To learn operation and performance of stepping motors.
3. To understand operation and performance of switched reluctance motors.
4. To familiarize with operation and performance of permanent magnet brushless D.C. motors.
5. To illustrate operation and performance of permanent magnet synchronous motors.

**Unit01: Generalised Machine Theory: (6 Hrs)**

Energy in singly excited magnetic field systems, determination of magnetic force and torque from energy.Determination of magnetic force and torque from co-energy, Forces and torques in systems with permanent magnets.MMF of distributed winding, Magnetic fields production of EMFs in rotating machines.

**Unit 02 : Permanent Magnet Synchronous and brushless D.C. Motor Drives: (6 Hrs)**

Synchronous machines with PMs, machine configurations. Types of PM synchronous machines Sinusoidal and Trapezoidal. EMF and torque equations Torque speed characteristics Concept of electronic commutation, Comparative analysis of sinusoidal and trapezoidal motor operations. Applications

**Unit 03: Control of PMSM: (6 Hrs)**

abc-αβ and αβ-dq transformations, significance in machine modelling, Mathematical Model of PMSM (Sinusoidal), Basics of Field Oriented Control (FOC), Control Strategies: constant torque angle, unity power factor.

**Unit 04: Reluctance Motor: (6 Hrs)**

Principle of operation and construction of Switch Reluctance motor, Selection of poles and pole arcs , Static and dynamics Torque production, Power flow, effects of saturation, Performance, Torque speed characteristics, Synchronous Reluctance, Constructional features; axial and radial air gap motors; operating principle; reluctance torque; phasor diagram; motor characteristics Introduction to control of Reluctance Drive. Applications.

**Unit 05: Stepper Motor: (6 Hrs)**

Construction and operation of stepper motor, hybrid, Variable Reluctance and Permanent magnet, characteristics of stepper motor, ; Static and dynamics characteristics, theory of torque production, figures of merit; Concepts of lead angles , micro stepping , Applications selection of motor.

**Unit 06: Linear Electrical Machines** **(6 Hrs)**

Introduction to linear electric machines.Types of linear induction motors, Constructional details of linear induction motor, Operation of linear induction motor. Performance specifications and characteristics Applications .

**<u>Learning Outcomes:</u>**

Students will be able to

1. Reproduce principal of operation of PMSM, Stepper motor, SRM, Switch reluctance and linear motors.
2. Develop torque speed and performance characteristics of above motors.
3. Enlist application of these motors.
4. Demonstrate various control strategies.

**Text/ Reference Books:**


1. K. Venkatratnam, ‘Special Electrical Machines’, University Press
2. A.E. Fitzgerald Charles Kingsley, Stephen Umans, ‘Electric Machinery’, Tata McGraw Hill Publication
3. T.J.E. Miller, ‘Brushless Permanent magnet and Reluctance Motor Drives’ Clarendon Press, Oxford 1989.
4. V. V. Athani, ‘Stepper Motors: Fundamentals, Applications and Design’, New age International, 1997.
5. R Krishnan, **‘**Permanent Magnet Synchronous and Brushless D.C. Motor Drives’ CRC Press.
6. Ion Boldea, **‘**Linear Electric Machines, Drives and maglevs’ CRC press
7. Ion Boldea S. Nasar, ‘Linear Electrical Actuators and Generators’, Cambridge University Press.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE405 Elective-I (E) EHV A.C. Transmission System**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

**Course Objectives:-**

1. To understand the need of EHV and UHV systems.
2. To describe the impact of such voltage levels on the environment
3. To know problems encountered with EHV and UHV transmissions
4. To know methods of governance on the line conductor design, line height and phase etc.

**Unit 01 EHV ac transmission lines (6 Hrs)**

Need for EHV transmission lines, Power handling capacity and line loss, Examples on giant power pools and number of lines, Mechanical considerations in line performance, Vibrations Travelling wave equations, transmission reflection attenuation and distortion of travelling waves, transmission and reflection coefficients and examples.

**Unit 02 Calculation of line and ground parameters (6 Hrs)**

Resistance of conductors, effect of temperature on overhead conductors, temperature rise of conductors and current carrying capacity, Properties of bundled conductors, Inductance of current carrying single conductor, Inductance of EHV line configurations, Line capacitance calculations. Sequence inductances and capacitances, Diagonalization.

**Unit 03 Voltage gradient of conductors (6 Hrs)**

Electrostatic Field of a point charge and its properties, Field of sphere gap, Field of line charges and their properties, Corona inception gradients, charge potential relations for multi-conductor lines, Maximum charge condition on three phase line.

Surface voltage gradient on conductors-single conductor, two conductors and multi-conductor bundle, Maximum surface voltage gradient, Mangoldt formula, design of cylindrical cage for corona gradients

**Unit 04 : Electrostatic and magnetic fields of EHV lines (6 Hrs)**

Electric shock and threshold currents, Effects of high electrostatic fields on humans, animals and plants, Calculation of electrostatic field of single circuit of three phase line, Profile of electrostatic field of line at ground level.

Electrostatic induction on un-energized circuit of a double circuit line. Insulated ground wire and induced voltage in insulated ground wires.

Magnetic field calculation of horizontal configuration of single circuit of three phase lines, Effects of power frequency magnetic fields on human health

**Unit 05: Corona and its effects (6 Hrs)**

Corona formation, corona inception voltage, visual corona voltage, critical field for corona inception and for visual corona under standard operating condition and conditions other than standard operating conditions.

Power loss due to corona, corona loss formulae, corona current waveform, charge-voltage diagram and corona loss, increase in effective radius of conductor and coupling factors, attenuation of travelling waves due to corona loss. Audible noise operation and characteristics limits for audible noise, AN measurement and meters, microphone, weighting networks. Formulae for audible noise and use in design, relation between single phase and three phase AN levels.

Design of cylindrical cages for corona experiments-single conductor concentric with cylinder, single conductor with eccentricity.

**Unit 06: (6 Hrs)**

**A) Design of EHV lines**

Design of EHV lines based upon steady state limits and transient over voltages, design factors under state. Design examples: steady state limits.

Line insulation design based on transient over voltages

**B) Extra high voltage cable transmission**

Classification of cables, Typical insulation thickness for ehv cables, Properties of cable insulation materials.

**Course Outcomes:**

After completing this course student will have-

1. Highlight need for EHV ac transmission.
2. Calculate line and ground parameters.
3. Enlist problems encountered in EHV transmission.
4. Express issues related to UHV transmission discussed.

**Text/ Reference Books:**

1) RakoshdasBegamudre “Extra high voltage transmission”, New Age International publishers.
2) S. Rao , “EHV AC and DC Transmission” Khanna publications.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

## EE406. Electrical Drives Lab

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 00** | **T: 00** | **P: 02** |
| **Evaluation Scheme** | **CE 30 Marks** | **POE 70 Marks** | **Minimum Passing Marks 40%** |

**Term work:**
**It will consist of a record of at least *SIX* of the following experiments based on the prescribed syllabus.**

1. Speed control of dc motor using dc chopper.
2. Speed control of dc motor using single- phase converter.
3. Speed control of dc motor using 3- phase converter.
4. Speed control of single- phase induction motor using ac regulator.
5. Speed control of Three- phase induction motor using Stator voltage controller.
6. Speed control of Three- phase induction motor using static rotor resistance control.
7. Simulation of Chopper fed DC drive
8. Simulation of DC drive using single phase converter
9. Simulation of three phase IM drive.

**Practical Examination:**
The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

## EE407. Power System Operation and Control Lab

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 00** | **T: 00** | **P: 02** |
| **Evaluation Scheme** | **CE 30 Marks** | **POE 70 Marks** | **Minimum Passing Marks 40%** |

**Term work:**
Term work shall consist of:
1.Assignment on economic load sharing between generator units, transmission loss and stability.
2. Study of any one Hydro/ Steam station – one drawing sheet layout of concerned power station.
3. A report on visit to load dispatch center.
4. Drawing sheet on different excitation control systems for power stations.
5. MATLAB Simulink for single area load frequency control.

**Practical Examination:**
The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE408. Switch Gear and Protection Lab**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 00** | **T: 00** | **P: 02** |
| **Evaluation Scheme** | **CE 30 Marks** | **POE 70 Marks** | **Minimum Passing Marks 40%** |

**Term work:**
**It will consist of a record of at least *Six*of the following experiments based on the prescribed syllabus.**

1. Study of earth fault relay
2. Study of switchgear testing kit.
3. Study of directional over current relay
4. Short circuit analysis of a simple power system up tosix buses ( using MATLAB/Mipower software)
5. Relay coordination ( using MATLAB/Mipower software)
6. Motor protection design ( using MATLAB/Mipower software)
7. Transient stability analysis ( using MATLAB/Mipower software)
8. Transmission line protection.
9. Study and use of relay testing kit.
10. Study and testing of moulded case circuit breaker.
11. Study of typical oil circuit breaker.
12. Mertz-price protection of transformer.
13. Characteristics of rewirable fuse and H.R.C. fuses.

**Practical Examination:**
The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

## EE409.Seminar on In-plant Training

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 00** | **T: 00** | **P: 02** |
| **Evaluation Scheme** | **CE** | **POE** | **Minimum Passing Marks** |
| | **30 Marks** | **00 Marks** | **40%** |

**Term work:**

A Talk will be delivered by the student based on Industrial training work undertaken by the student during summer vacation after 3rd year. **Industrial work of each student** will be evaluated by two teachers appointed by Head of the Institution for giving term work marks.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

## EE410.Project Phase-I

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 00** | **T: 00** | **P: 02** |
| **Evaluation** | **CE** | **POE** | **Minimum Passing Marks** |
| **Scheme** | **70 Marks** | **00 Marks** | **40%** |

The student shall take up a project in the field closely related to Electrical Engineering. An individual can undertake project . Preferably, a group of 3 students should be formed for project work.

The project work should be based on the knowledge acquired by the student during the graduation and preferably it should meet and contribute towards the needs of the society. The project aims to provide an opportunity of designing and building complete system or subsystems based on area where the student likes to acquire specialized skills.

Project work in this semester is an integral part of the project work. In this, the student shall complete the partial work of the project which will consists of problem statement, literature review, project overview and scheme of implementation. As a part of the progress report of project work, the candidate shall deliver a presentation on the advancement in Technology pertaining to the selected project topic.

Guidelines for **VIIth** Semester for Project work

1. To identify the problems in industry and society.
2. Perform Literature survey on the specific chosen topic through research papers, Journals, books etc. and market survey if required.
3. To narrow down the area taking into consideration his/her strength and interest. The nature of project can be analytical, simulation, experimental, design and validation.
4. To define problem, objectives, scope and it’s outcomes.
5. Data collection, simulation, design, hardware if any need to be completed.
6. Presentation based on partially completed work.
7. Submission of report based on the work carried out.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE411. High Voltage Engineering**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

**Course Objectives:**

1. The course covers the breakdown mechanisms in gaseous, liquid and solid insulation.
2. Methods of generation and measurement of high voltage, impulse voltage and impulse current are also covered.
3. This course lays a foundation for higher studies in high voltage engineering.

**Course Contents:**

**Unit 1**

**Breakdown in Gaseous Medium: (06 Hrs)**

Townsend mechanism of breakdown in gases, streamer (kanal) mechanism of breakdown in gases, derivation of breakdown criterion for Townsend and streamer mechanisms.Paschen's law for breakdown voltage in gases, effect of pressure and gap distance on breakdown voltage.

**Unit 2**

**Breakdown in Liquid and Solid Insulation: (06 Hrs)**

Comparison of pure and commercial liquids for insulation, breakdown in pure liquids, effect of hydrostatic pressure on breakdown strength.

Breakdown in commercial liquids - suspended particle theory, cavitation and bubble theory, thermal breakdown, stressed oil volume theory.

Types of breakdown mechanisms in solids - intrinsic, electromechanical, treeing and tracking, thermal breakdown, electrochemical, breakdown due to internal discharges.Breakdown in composite dielectrics, applications of solid dielectrics like paper, mica, glass and ceramics.

**Unit 3**

**Generation of High Voltages: (06 Hrs)**

Generation of high D.C. voltages by rectifiers, voltage doubler and multiplier circuits, electrostatic machines - Van de Graaff generator, electrostatic generator.

Generation of high A.C. voltages by cascade transformer set, resonant transformer, Tesla coil for generation of high frequency A.C. voltage.

**Unit 4**

**Generation Of Impulse Voltage and Current: (06 Hrs)**

Standard impulse wave shape, analysis of model and commercial impulse generation circuits, wave shape control, Marx circuit, tripping and control of impulse generation.Generation of switching surges, generation of impulse current.

**Unit 5**

**Measurement Of High Voltage and Current: (06 Hrs)**

Peak voltage measurement by Chubb - Fortescue method, spark gaps, sphere gap, uniform field gap, rod gap, electrostatic voltmeter, measurement of high voltage by an ammeter in series with high impedance, use of rectifier and voltage divider.Measurement of high A.C., D.C. and impulse currents by resistive shunts- Hall generator, current transformer with electro-optical signal converter.

**Unit 6**

**High Voltage Testing and Partial Discharges: (06 Hrs)**

High voltage testing of-insulators, bushings, circuit breakers, cables, transformers, lightning arrestors and power capacitors. Phenomenon of partial discharges (PD), internal and surface discharges, effects of PD. PD detection - straight detection method, wide band and narrow band detection circuits. Bridge detection method, calibration of PD detectors

**Course Outcomes:**

After completing this course student will have-

1. Reproduce concepts in breadth with various concepts of breakdown phenomenon of solid, liquid and gaseous materials along with various causes of overvoltage and protection from them.
2. List and reproduce various methods of generation and measurement of DC, AC and impulse high voltage.
3. Demonstrate an ability to carry various DC. AC and impulse testing on high voltage equipments and materials.
4. Apply safety measures, earthing, shielding for layout of HV apparatus required in High voltage laboratory.

**Reference Books:**


1. 'High Voltage Engineering Fundamentals' by E. Kuffel& W.S. Zaengl, Pergamon Press, 1992
2. 'High Voltage Engineering' by M.S. Naidu & V. Kamaraju, Tata Mc-Graw Hill, 2002
3. 'High Voltage Engineering' by C.L. Wadhwa, New Age, 2007
4. 'High Voltage Engineering' by E. Kuffel& Abdullah

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE412. Power Quality and Harmonics**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 03** | **T: 01** | **P: 00** |
| **Evaluation** | **ESE** | **MSE** | **Minimum Passing Marks** |
| **Scheme** | **80 Marks** | **20 Marks** | **40%** |

**Course Objectives:**

1. Introducing conceptual ideas of power quality issues & their solution, and harmonics related aspects and their mitigation.
2. PQ monitoring, influence of grounding practices, harmonics measurements and design considerations of filter circuits.

**Course Contents:**

**Unit 01: Basics of power quality and standards (6 Hrs)**

Introduction and importance of Power Quality, symptoms of poor power quality. Various power quality issues such as transients, short duration voltage variations, long duration voltage variations, voltage imbalance, voltage fluctuations, voltage flicker and waveform distortion. Relevant power quality standards such as IEEE 1159- 2009 and IEEE 519- 2014.Grounding and power quality issues.

**Unit 02: Voltage sag (6 Hrs)**

Origin of voltage sags and interruptions, voltage sag characteristics- magnitude, duration, phase angle jump, point on wave initiation and recovery, missing voltage. Area of vulnerability, equipment behaviour under voltage sag, ITIC curve, voltage sag monitoring and mitigation techniques.

**Unit 03: Transient Over Voltages and Flickers (6 Hrs)**

Classification of transients, sources of transient over voltages, computer tools for transient analysis, techniques for over voltage protection.

Voltage flickers – sources of flickers, quantifying flickers and mitigation techniques.

**Unit 04: Fundamentals of Harmonics (6 Hrs)**

Harmonic distortion – voltage and current distortion, power system quantities under non sinusoidal condition – active, reactive and apparent power, power factor – displacement and true power factor, harmonic phase sequences and triplen harmonics, harmonic indices, sources of harmonics, effect of harmonic distortion.

**Unit 05 : Measuring and control of harmonics (6 Hrs)**

Concept of point of common coupling and harmonic evaluation, principles of controlling harmonics, Harmonic study procedures and computer tools for harmonic analysis, Devices for controlling harmonic distortion design of filters for harmonic reduction.

**Unit 06 : Measuring and solving power quality problems (6 Hrs)**

Introduction, power quality measurement devices – harmonic analyzer, transient disturbance analyzer, oscilloscopes, data loggers and chart recorders, true rms meters, power quality measurements, number of test location, test duration, instrument setup and guidelines.

**Tutorials:**

One hour per week is to be utilized to ensure that the students have properly learnt the topics covered in the lectures. This shall include assignments, quiz, test etc. The teacher may add any other academic activity to this so as to evaluate the student for his/her in-semester performance.

**Course Outcomes:**

After completing this course student will have-

1. Characterize power quality events.
2. Reproduce causes of voltage sag and estimate magnitude of voltage sag.
3. Carry out harmonic analysis and calculate total harmonic distortion.
4. Calculate parameters for passive harmonic filter.

**Reference Books:**


1. “Electrical Power Systems Quality” by Roger C. Dugan, Mark F. Mc Granton & H. Wayne Beety – McGraw Hill
2. ” Power System harmonics” by J. Arnillaga, DA Bradley & PS Bodger – John Wiley Sons
3. “ Power System Harmonics - Fundamentals, Analysis & filter Design” by George J. Wakileh – Springel
4. “ Uninterruptible Power Supplies and Active Filters” by Ali Emadi, AbdolhoreinNasiri&Stoyon B. Bekiarov, CRC Press
5. “ Electric Power Distribution Reliability” $2^{nd}$ Edition Richard E. Brown, CRC Press.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE413. Industrial Automation**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

## Course objectives:

1. It is aimed at introducing the conceptual ideas of programmable logic controllers and SCADA system and PLC functions.
2. To make students familiar with distributed control systems.

**Course Contents:**

**Unit 1**

**Programmable Logic Controllers (PLC): (06 Hrs)**

Introduction, Its advantages, disadvantages, I/O modules, as a computer, its memory and interfacing, Introduction to programming, on – off switching devices, input analog devices. Programming on/ off inputs to produce on/off outputs, relation of digital gate logic to contact/ coil logic, creating ladder diagrams from process control description.

**Unit 2**

**PLC Functions: (06 Hrs)**

A PLC timer functions, PLC counter functions, arithmetic function, comparison function, conversion functions. Master control relay functions, jump functions, data move system, data handling functions.

**Unit 3**

**Functions Working With Bits: (06 Hrs)**

Digital bit functions and applications, sequencer functions, controlling robot with PLC, PLC matrix function.

**Unit 4**

**Advanced PLC functions: (06 Hrs)**

Analog PLC operations, PID control of continuous process, PID modules & tuning, typical PID functions, networking of PLCs, selecting a PLC.

**Unit 5**

**SCADA Systems: (06 Hrs)**

Introduction, evaluation of SCADA , communication technologies, monitoring and supervisory functions, various SCADA architectures, advantages and disadvantages of each system , application of SCADA.

**Unit 6**

**Distributed control Systems (DCS): (06 Hrs)**

Introduction, difference between DCS and centralized computing system. Block diagram of DCS, Data highways, multiplexers and remote sensing terminal units Study of various aspects of DCS like communication protocol etc.

**<u>Course Outcomes:</u>**

After completing this course student will have-

1. Describe working of various blocks of basic industrial automation system.
2. Connect the peripherals with the PLC.
3. Use various PLC functions and develop small PLC programs.
4. Summarize Distributed control system and SCADA system.
5. Use various industrial motor drives for the Industrial Automation.

**Text/ Reference Books:**


1. Gary Dunning, "Introduction to Programmable Logic Controllers" Second Edition, Thomson Delmar learning, 2002.
2. C. D. Johnson, "Process Control Instrumentation Technology" Seventh Edition, Pearson Education, New Delhi 2003.
3. Instrument Engineers Handbook –B. G. Liptak (Ed) Vol-II and III, Chilton book Company.
4. "Programmable Controllers: Principles and Applications", Webb J. W., and Ronald A. Reis Prentice Hall of India Pvt. Ltd. 5$^{th}$ edition, 2005
5. Programmable Logic Controllers, John R. Hackworth and Frederick D. Hackworth, Jr. Third India Reprint 2005

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE414. Elective-II (A) HVDC and FACTS**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

**Course Objectives:**

5. To impart the students with various FACTS devices which are used for proper operation of existing AC system more flexible in normal and abnormal conditions.
6. To deal with the importance of HVDC Transmission and HVDC Converters.
7. To deal with power conversion between Ac to DC and DC to AC.

**Course Contents:**

**Unit 01: General back ground** **(6 Hrs)**

EHVAC versus HVDC transmission, power flow through HVDC link, Graetz circuit, equation for HVDC power flow bridge connection, control of DC voltage and power flow, effects of angle of delay and angle of advance commutation, CIA, CC and CEA control, twelve pulse converter operation Harmonics in HVDC systems.

**Unit02: Multi terminal HVDC system** **(6 Hrs)**

HVDC system layout and placement of components, HVDC protection, grounding, multi terminal HVDC systems, configurations and types.

**Unit 03: HVDC Light** **(6 Hrs)**

Introduction to VSC transmission, power transfer characteristics, structure of VSC link, VSC DC system control, HVDC light technology.

**Unit 04:Fact Concept and FACT controllers:** **(8 Hrs)**

Introduction, Transmission inter connections, Power flow in parallel paths, Power flow in Meshed System.. Basic types, relative importance of different types of controllers, Shunt connected controllers, Series connected controllers, combined series and parallel controllers, other controllers.

**Unit05: Static Shunt and series Compactors:** **(8 Hrs)**

Introduction, Objectives of shunt compensation, Methods of controllable Var generation, Static Var compensators SVC and STATCOM .Comparison between SVC and STATCOM. Objectives of series compensation, Variable impedance type Series compensators, switching converter type series compensators.

**Unit 06:Static voltage and phase angle Regulators: (6 Hrs)**
Introduction, Objectives of voltage and phase angle Regulation, approaches to thyristor Controlled Voltage and phase angle Regulators. IPFC,UPFC

**Course Outcomes:**

After completing this course student will be able to -

1. Understand the operations of different FACTS devices.
2. Select the controllers for different Contingencies.
3. Analyze the different FACTS devices in different stability conditions.
4. Select an appropriate FACTS device for a particular application.
5. Understand the importance of Transmission power through HVDC.
6. Calculate power conversion between Ac to DC and DC to AC

**Reference Books:**


1. Understanding FACTS —Author: Narain G. Hingorani and Laszlo Gyugyi-- IEEE Press, Standard Publishers Distributors –Delhi, 110006.
2. FACTS controllers in power transmission and distribution—K R Padiyar.
3. “Direct Current Transmission”, E.W. Kimbark. Vol. – I John Wiley, New York Edn.1971
4. ”HVDC Power Transmission System” K.R. Padiyar , Wiley Eastern Ltd., New Delhi.
5. ”Power Transmission by Direct Current”, E. Usdimann Springer Ver lag, Berlin Ed.1975.
6. “EHVAC and HVDC Transmission” - S. Rao, Khanna Pub. Delhi.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE414. Elective-II (B) Restructuring and Deregulation**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

## Course objectives:

1. To educate students about the process of restructuring of power system .
2. To familiarize students about the operation of restructured power system .
3. To teach students pricing of electricity.
4. To gain knowledge of fundamental concept of congestion management .
5. To analyze the concept of locational marginal pricing and transmission rights.
6. To provide in-depth understanding of operation of deregulated electricity market systems.

**Unit 01: Power Sector in India (6 Hrs)**

Institutional structure before reforms. Roles of various key entities in India. Necessity of Deregulation or Restructuring. RC Act 1998 and Electricity Act 2003 and its implications for Restructuring & Deregulation. Institutional structure during reform. National Energy policy. Introduction to Energy Exchange and trading of Renewable Energy Credits and Carbon Credits.

**Unit 02: Power Sector Economics (6 Hrs)**

Introduction to various concepts such as capital cost, debt and equity, depreciation, fixed and variable costs, working capital, profitability indices etc. Typical cost components of utilities such as return in equity, depreciation, interest and finance charges, O and M expenses etc. Key Indices for assessment of utility performances. Principles of Tariff setting, Phases of Tariff determination, consumer tariff & non-price issues.

**Unit 03: Power Sector Regulation (6 Hrs)**

Regulatory process in India, types and methods of Regulation, cost plus, performance-based regulation, price cap, revenue cap regulation, rate of return regulation, benchmarking or yardstick regulation. Role of regulatory commission. Considerations of socio economic aspects in regulation.

**Unit 04: Introduction to Power Sector Restructuring (6 Hrs)**

Introduction, models based on energy trading or structural models – monopoly, single buyer, wholesale competition, retail competition. Models based on contractual arrangements – pool model, bilateral dispatch, pool and bilateral trades, multilateral trades, ownership models, ISO models. Competition for the market vs competition in the market, International experience with electricity reform – Latin America, Nordic Pool, UK, USA, China and India. California Energy

Crisis.

**Unit 05: Electricity Markets (6 Hrs)**
Trading – electricity market places, rules that govern electricity markets, peculiarity of electricity as a commodity, various models of trading arrangements – integrated trading model, wheeling trading model, decentralized trading model. Various electricity markets such as spot, day ahead, forward, future options, reserve, ancillary services market. Market operation, settlement process, Market Clearing Price (MCP), Market power, market efficiency. Spot, dynamic and locational pricing.

**Unit 06: Transmission Pricing & Transmission Congestion Issues (6 Hrs)**
Cost components of transmission system, Transmission pricing methods. Cost of transmission services, physical transmission rights. Pricing and related issues. Congestion in power network, reasons for congestion, classification of congestion management, useful definitions. Methods of congestion management, Locational marginal Pricing (LMR), Firm Transmission Right (FTR). Availability based Tariff (ABT) in India.

**<u>Course Outcomes:</u>**
After completing this course student will have
1. Describe the process of restructuring of power system .
2. Identify various operation of restructured power system.
3. Analyze Fundamental concept of congestion management.
4. Analyze pricing and transmission rights of Electricity**.**
5. Analyze various cost components in Generation, transmission, distribution sector and tariff .

**<u>Text/ Reference Books:</u>**

1. Lei Lee Lai, " Power System Restructuring and Deregulation" John Wiley and Sons UK, 2001
2. "Know Your Power:, A citizen Primer on the electricity Sector, Prayas Energy Group, Pune
3. Sally Hunt, "Making Competition Work in Electricity", 2002, John Wiley Inc
4. Steven Stoft, " Power System Economics: Designing Markets for Electricity", John Wiley & Sons, 2002
5. Mohammad Shahidehpour, MuwaffaqAlomoush, "Restructured Electrical Power Systems: Operation Trading and Volatility" CRC Press, 06-Jun-2001.
6. Kankar Bhattacharya, Math Bollen, Jaap E. Daalder, "Operation of Restructured Power Systems" Springer US, 2012.
7. H. Lee Willis, LorrinPhilipson, "Understanding Electric Utilities and De-regulation" CRC Press, 31-Oct-2014.
8. Daniel S. Kirschen, GoranStrbac, "Power System Economics" John Wiely& Sons Publication Ltd. August 2006.
9. Geoffrey Rothwell, Tomas Gomez, "Electricity Economics Regulation and Deregulation" A John Wiley & Sons Publication 2003.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE414. Elective-II (C) Soft Computing Application in Electrical Engineering**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

**Course Objectives:**

1. To enhance knowledge of intelligence system to carry out power system problems.
2. To impart knowledge about Artificial neural network and fuzzy logic programming for electrical engineering applications like load dispatch and load shedding.

**Course Contents:**

**Unit-I Introduction to Artificial Neural Network: [06 Hrs]**

Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Historical Developments. Essentials of Artificial Neural Networks: Artificial Neuron Model, operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures

**Unit-II Classification Taxonomy of ANN**: **[06 Hrs]**

Connectivity, Neural Dynamics (Activation and Synaptic), Learning Strategy (Supervised, Unsupervised, Reinforcement), Learning Rules.

Perceptron Models: Training Algorithms: Discrete and Continuous Perceptron Networks, Perceptron Convergence theorem. Multilayer feed forward Neural Networks

**Unit-III Memory: [06 Hrs]**

Associative Memory, Bi-directional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function, Self-Organizing Maps (SOM) and Adaptive Resonance Theory (ART).

**Unit-IV Introduction to Fuzzy Logic system: [06 Hrs]**

Fuzzy versus crisp, fuzzy sets: membership function, Basic fuzzy set operations, properties of fuzzy sets, fuzzy relations.

**Unit-V Fuzzy Control: [08 Hrs]**

Predicate logic (Interpretation of predicate logic formula, Inference in predicate logic), fuzzy logic (Fuzzy quantifiers, fuzzy Inference), fuzzy rule based system, defuzzification methods

**Unit-VI Introduction to other Intelligent tools: [06 Hrs]**

**Introduction to Genetic Algorithm**: biological background, GA operators, selection, encoding, crossover, mutation, chromosome.

**Expert System:** software architecture, rule base system .

**<u>Course Outcomes:</u>**

The students will be able to-

1. Compare various AI tools
2. Develop algorithms for AI tools
3. Apply AI tools for Applications in electrical engineering.

**Reference Books:**


1. Simon Haykin, "Neural Networks: A Comprehensive Foundation", 2nd Edition, Pearson Education
2. S. Rajsekaram, G. A. VijayalaxmiPai, "Neural Networks, Fuzzy Logic & Genetic Algorithms Synthesis & Applications", Practice Hall India
3. James A. Anderson, "An Introduction to Neural Networks", Practice Hall India Publication
4. Mohamed H. Hassoun, "Fundamentals of Artificial Neural Network", Practice Hall India
5. Kelvin Waruicke, Arthur Ekwlle, Raj Agarwal, "AI Techniques in Power System", IEE London U.K.
6. S. N. Sivanandam, S. Sumathi, S. N. Deepa, "Introduction to Neural Network Using MATLAB 6.0", Tata McGraw Hill
7. JacekZurada, "Introduction to Artificial Neural Network", Jaico Publishing House India

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE414. Elective-II (D) Special Topics in Electrical Engineering**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

**Course Objectives:**

1. To analyze the concept of Deregulation and Restructuring with various market models.
2. To provide in-depth understanding of operation of deregulated power sector.
3. To understand the basic knowledge of different terms & principles of energy audit and management.

**Course Contents:**

**Unit-I** **[06 Hrs]**

**Power Sector in India:** Evolution of integrated, monopoly, state electricity boards (SEBs). Introduction to various institutions in Indian Power Sector such as CEA, Planning commission, PFC, Ministry of Power, State and Central Governments, REC, financial institutions, Utilities & their roles. Challenges before Indian Power Sector. Electricity Act 2003 and various national policies and guidelines under the Act.

**Unit-II** **[10 Hrs]**

**Power Sector Regulation:** Role of regulation and evolution of regulatory commissions in India, Types and methods of regulation (Rate of Return Regulation, Performance Based Regulation, Incentive Regulation, Benchmarking or Yardstick regulation) The regulatory process in India (Composition of RCs, Selection, Authority, Regulatory decision making process) Non Price issues in Regulation such as Externalities (environment etc.), service quality, consumer service, social equity Transparency and public participation in regulatory process.

**Unit-III** [**10 Hrs**]

**Power Sector Restructuring and Market Reform:** Introduction, Models based on energy trading or structural models – Monopoly, Single buyer, wholesale competition, Retail competition etc. Ring Fencing or Accounting separations, Models based on contractual arrangements – Pool model, bilateral dispatch, Pool and bilateral trades, Multilateral trades. Ownership models (Public Sector – State owned and municipal utilities, Co-operatives, Private Sector, Public-Private Partnership)

**Unit-IV** **[06 Hrs]**

**Energy Scenario & Management:** Indian energy scenario, Energy needs of growing economy, Energy pricing in India Energy sector reforms, various forms of energy, Primary and secondary energy, commercial and non commercial energy, Global primary energy reserves, Energy and environment, Necessity of conserving energy, Energy strategy for the future, Electrical energy management, Concept of supply side management and demand side management, Methods of implementing Demand side management and advantages to consumer, utility and society

**Unit-V** **[08Hrs]**

**Energy Audit:** Definition, need of energy audit, types of audit, procedures to follow, data and information analysis, energy consumption – production relationship, pie chart, sankey diagram, cusum technique, least square methods, finding of audit, action plans, bench marking energy performance, energy audit instruments, report writing.

**Unit-VI** **[06 Hrs]**

**Energy Conservation:** Energy conservation in motive power, Illumination, Heating & cooling systems, Pumping systems, thermal power stations and Transmission & Distribution Sector. Cogeneration &Waste heat recovery systems.

**Course Outcomes:**

After completing this course student will have-

1. Describe the process of restructuring of power system.
2. Identify various operation of restructured power system.
3. Knowledge of power sector in India.
4. Learn the preparation of energy audit report & conservation in different electrical system.

**Reference Books:**

1. Electrical Energy Utilization & Conservation- Dr. S.C.Tripathi ,TMC
2. Energy Conservation and Audit- Thumman
3. Energy Audit and Conservation- TERI
4. Guide book for national certification examination for energy managers and energy auditors-Bureau of Energy Efficiency
5. "Know Your Power", A citizens Primer On the Electricity Sector, Prayas Energy Group, Pune
6 Regulation in infrastructure Services: Progress and the way forward - TERI, 2001
7. "Deregulation in Power Industry", Proceedings of a course under Continuing Education Programme held by Department of Electrical Engineering, Indian Institute of Technology, Bombay.

# Swami Ramanand Teerth Marathwada University, Nanded

**Final Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

**EE414 Elective-II (E). Non Linear Control System**

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 04** | **T: 00** | **P: 00** |
| **Evaluation Scheme** | **ESE 80 Marks** | **MSE 20 Marks** | **Minimum Passing Marks 40%** |

**Course Objectives:**

1. To understand the basics of mathematical modelling.
2. To study the stability analysis of linear and non linear system.

**Course Contents:**

**Unit-I**

**Design of compensator via Root locus:** **[07 hrs]**

Introduction to design problem, Approaches &prelimary consideration. Design of lag compensator, lead compensator, lag-lead compensation, feedback compensation.

**Unit-II**

**Design of compensator via frequency response:** **[07 hrs]**

Transient response through gain adjustment lag compensation, lead compensation, lag-lead compensation, physical realization of compensators using active& passive elements.

**Unit-III**

**State space analysis & design:** **[08 hrs]**

Invariance of eigen values, Digonalisation of system matrices having distinct & repeated eigen values, Vander monde & modified Vander monde matrix. Definition of controllability &observability, derivation of controllability &observability matrix, effect of pole zero cancellation on the controllability &observability of the system, pole placement design through state feedback, state feedback with integral control, luenberger observer.

**Unit-IV** **[09 hrs]**

**None linear control systems:**

Different types of non-linearities. Peculiarities of nonlinear systems. Definition of describing function.(D.F.) derivation on D.F.'s for various non-linearities. D.F. analysis of non-linear control systems. Limit cycles. Merit and limitations of D.F. analysis. Phase-plane method. Singular points. Construction of phase-plane plots for non -linear systems by isocline method. Obtaining time-domain response from the phase-plane plots. Stable, semistable and unstable limit cycles

**Unit V** **[09 hrs]**

**Discrete time control systems part-I:**

Basic elements of a discrete data control system & its advantages over the continuous time systems A/D and D/A conversions. Sample and hold device. Pulse transfer function, starred Laplace transforms. Pulse transfer functions of cascaded elements. Pulse transfer function of close loop system Modified Z-transform. Stability analysis of close loop systems in Zdomain. Stability criterion by Jury's test. Stability analysis by bilinear transformation and Routh's stability criterion.

**Unit VI** **[08 hrs]**

**Discrete time control systems part-II:**

Discrete time equivalent of continuous time filters. State space representations of discrete time systems. State Space models from pulse transfer functions. Solution of discrete time state space equations, Design of digital control system, PID controller and frequency domain compensation design.

State variable method.

**Course Outcomes:**

1. At the end of the course students will be able apply the modeling concepts .
2. Students will be equipped with stability analysis of linear and non linear systems .

**Reference Books:**

1. Katsuhiko Ogata, Modern Control Engineering, Prentice Hall of India Pvt Ltd.
2. I.J. Nagrath and M. Gopal, Control system engineering, Wiley Eastern Ltd, 3rd edition.
3. Benjamin C. Kuo, Automatic Control system, Prentice Hall of India Pvt Ltd.
4. Norman Nise, Control system Engineering, 2nd edition, 1995.
5. M. Gopal Digital Control Engineering, Wiley Eastern , 1988.
6. John J. D'Azzo, C. H. Houpis, Linear control system analysis and design (conventional and modern), McGraw Hill International Fourth edition.
7. Stefani, Savant, Shahin, Hostetter, Saunders, Design of feedback Control Systems, College Publishing International, Fourth Edition.

# Swami Ramanand Teerth Marathwada University, Nanded

**FINAL Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

## EE415. High Voltage Engineering Lab

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 00** | **T: 00** | **P: 02** |
| **Evaluation Scheme** | **CE** | **POE** | **Minimum Passing Marks** |
| | **30 Marks** | **70 Marks** | **40%** |

**Term work:**

**It will consist of a record of at least *SIX* of the following experiments based on the prescribed syllabus.**

**Some of the Experiments may be:**

1. Calibration of Electrostatic Voltmeter.
2. L.T. and H.T. Schering Bridge.
3. Testing of solid insulating materials and various insulators.
4. Testing of Transformer Oil.
5. Destructive testing of capacitors and Insulators.
6. Measurement of potential across String of Suspension insulators.
7. Study of Impulse generators.

**Practical Examination:**

The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

# Swami Ramanand Teerth Marathwada University, Nanded

**FINAL Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

## EE416. Power Quality and Harmonics Lab

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 00** | **T: 00** | **P: 02** |
| **Evaluation Scheme** | **CE 30 Marks** | **POE 70 Marks** | **Minimum Passing Marks 40%** |

**Term work:**
**It will consist of a record of at least *Six* of the following experiments based on the prescribed syllabus.**

1. Study of power quality monitor / analyzer
2. Measurement of harmonic distortion of Desktop / computer and allied equipment
3. Measurement of harmonic distortion of CFL or FTL with electronic ballast and magnetic ballast.
4. Measurement of sag magnitude and duration by using digital storage oscilloscope.
5. Design of passive harmonic filter – computer simulation for power electronic application
6. Design of active harmonic filter – computer simulation for power electronic application
7. Simulation studies of harmonic generation sources such as VFD, SVC, STATCOM and FACTS devices and harmonic measurement (THD) by using MATLAB
8. Power quality audit of institute or department

**Practical Examination:**
The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

# Swami Ramanand Teerth Marathwada University, Nanded

**FINAL Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

## EE417. Industrial Automation Lab

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 00** | **T: 00** | **P: 02** |
| **Evaluation Scheme** | **CE 30 Marks** | **POE 70 Marks** | **Minimum Passing Marks 40%** |

**Term work:**

**Term work shall consist of at least six to eight assignment/tutorials/practical based on above syllabus. Some of the experiments may be from the following list.**

1. Study of AB Micrologix 1200c and 1100 PLC
2. Development of simple ladder diagrams like AND/OR gate
3. Developments of Ladder diagram for the controlling motor operation
4. Development of ladder diagram and Simulation for the level control system.
5. Development of Ladder diagram for bottling plant.
6. Study of Software package RSVIEW32 (AB make) for SCADA
7. Development of mimic diagram for a particular process using SCADA software
8. Study of Hybrid controller control logix (AB MAKE)
9. Development of programs for control of processes using Hybrid controller
10. Study of Pane view plus and REVIEWME software package

**Practical Examination:**

The examination will be of three hours duration and will consist of an experiment based on term-work and followed by an oral based on above syllabus.

# Swami Ramanand Teerth Marathwada University, Nanded

**FINAL Year Common to Electrical Engineering &Electrical, Electronics and Power (Revised Syllabus (CGPA), 2014 Course)**

**Effective from 2017-18**

## EE418.Project Phase-II

| | | | |
|---|---|---|---|
| **Teaching Scheme** | **L: 00** | **T: 00** | **P: 06** |
| **Evaluation** | **CE** | **POE** | **Minimum Passing Marks** |
| **Scheme** | **100 Marks** | **100 Marks** | **40%** |

**Course Objectives:**

1. To develop skills for carrying literature survey and organize the material in proper manner.
2. To provide opportunity of designing and building complete system/subsystem based on their knowledge acquired during graduation.
3. To understand the needs of society and based on it to contribute towards its betterment and to learn to work in a team.
4. To ensure the completion of given project such as fabrication, conducting experimentation, analysis, validation with optimized cost.
5. Collect the data in report form and represent and communicate findings of the completed work in written and verbal form.

**Guidelines for VIII$^{th}$ Semester for Project Work:**

The student shall complete the remaining part of the project which is an extension of the work carried out in 7th Semester. Remaining part of the project consists of design, simulation, fabrication of set up required for the project, analysis and validation of results and conclusions.

The student shall prepare duly certified final report of the project work in the standard format.

**Course outcomes:**

Students will be able to-:

1. Work in team and ensure satisfactory completion of project in all respect.
2. Handle different tools to complete the given task and to acquire specified knowledge in area of interest.
3. Provide solution to the current issues faced by the society.
4. Practice moral and ethical value while completing the given task.