# NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

# Syllabus for

# Final Year Electrical Engineering

# Faculty of Engineering and Technology

# Teachers, Paper Setters and Examiners Guidelines Manual

# SEMESTER – VII and VIII

# W.E.F 2015 – 2016

**North Maharashtra University, Jalgaon**

**Syllabus Structure For Final Year Electrical Engineering w.e.f year 2015-16**

**Semester –VII**

| Course Code | Name of the Course | Group | Teaching Scheme | | | | Evaluation Scheme | | | | Total | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory | | Practical | | | |
| | | | Theory Hrs /week | Tutorial Hrs /week | Practical Hrs /week | Total | ISE | ESE | ICA | ESE | | |
| | Industrial Drives & Control (TH) | D | 3 | _ | _ | 3 | 20 | 80 | _ | _ | 100 | 3 |
| | High Voltage Engineering(TH) | D | 3 | _ | _ | 3 | 20 | 80 | _ | _ | 100 | 3 |
| | Interdisciplinary Elective (TH) | E | 3 | _ | _ | 3 | 20 | 80 | _ | _ | 100 | 3 |
| | Elective – I (TH) | E | 3 | _ | _ | 3 | 20 | 80 | _ | _ | 100 | 3 |
| | Power System Operation And Control(TH) | D | 3 | _ | _ | 3 | 20 | 80 | _ | _ | 100 | 3 |
| | Industrial Drives & Control (LAB) | D | _ | _ | 2 | 2 | _ | _ | 25 | 25 (PR) | 50 | 1 |
| | High Voltage Engineering (LAB) | D | _ | _ | 2 | 2 | _ | _ | 25 | 25 (OR) | 50 | 1 |
| | Elective – I (LAB)# | E | _ | _ | 2 | 2 | _ | _ | 25 | 25 (PR) | 50 | 1 |
| | Project – I (LAB) | D | _ | _ | 2 | 2 | _ | _ | 25 | 25 (OR) | 50 | 2 |
| | Seminar – II | D | _ | _ | 2 | 2 | _ | _ | 25 | _ | 25 | 2 |
| | Industrial Visit | D | _ | _ | _ | _ | _ | _ | 25 | _ | 25 | 1 |
| | **Total** | | **15** | **0** | **10** | **25** | **100** | **400** | **150** | **100** | **750** | **23** |

**ISE: Internal Sessional Examination ESE: End Semester Examination ICA : Internal Continuous Assessment**

| | Interdisciplinary Elective | | Elective – I |
|---|---|---|---|
| 1 | Energy Audit & Conservation | 1 | Industrial Electrical Engineering |
| 2 | Renewable Energy Sources | 2 | Digital Signal Processing |
| | | 3 | Control System –II |
| | | 4 | Electric Traction Engineering |

- # Lab for Elective – I (LAB)
- Interdisciplinary Elective shall be offered by the department to the students of other departments. Students from one department can not register for Interdisciplinary Elective of the same department.
- At least 15 students should register for offering any elective.

**North Maharashtra University, Jalgaon**

**Syllabus Structure For Final Year Electrical Engineering w.e.f year 2015-16**

**Semester –VIII**

| Course Code | Name of the Course | Group | Teaching Scheme | | | | Evaluation Scheme | | | | Total | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Theory | | Practical | | | |
| | | | Theory Hrs /week | Tutorial Hrs /week | Practical Hrs /week | Total | ISE | ESE | ICA | ESE | | |
| | Power System Stability (TH) | D | 3 | _ | _ | 3 | 20 | 80 | _ | _ | 100 | 3 |
| | Switchgear & Protection (TH) | D | 3 | _ | _ | 3 | 20 | 80 | _ | _ | 100 | 3 |
| | Elective – II (TH) | E | 3 | _ | _ | 3 | 20 | 80 | _ | _ | 100 | 3 |
| | Elective – III (TH) | E | 3 | _ | _ | 3 | 20 | 80 | _ | _ | 100 | 3 |
| | Power System Stability (LAB) | D | _ | _ | 2 | 2 | _ | _ | 25 | 25 (OR) | 50 | 1 |
| | Switchgear & Protection (LAB) | D | _ | _ | 2 | 2 | _ | _ | 25 | 25 (PR) | 50 | 1 |
| | Elective – II (LAB)# | E | _ | _ | 2 | 2 | _ | _ | 25 | 25 (OR) | 50 | 1 |
| | Industrial Lecture* | C | _ | _ | 1* | 1 | _ | _ | 50 | _ | 50 | 2 |
| | Project – II | D | _ | _ | 4 | 4 | _ | _ | 75 | 75(OR) | 150 | 6 |
| | **Total** | | **12** | **0** | **11** | **23** | **80** | **320** | **200** | **150** | **750** | **23** |

**ISE: Internal Sessional Examination** **ESE: End Semester Examination** **ICA : Internal Continuous Assessment**

| | Elective-II | | Elective – III |
|---|---|---|---|
| 1 | Computer Aided Power System Analysis | 1 | Flexible AC Transmission System and Power Quality |
| 2 | Industrial Automation | 2 | Generation Planning and Load Dispatch |
| 3 | Advance Microprocessor | 3 | High Voltage Transmission |
| 4 | Power System Design Practice | 4 | Electromechanical Energy Conversion. |

- # Lab for Elective – II (LAB)
- * Lectures to be delivered by experts from the industry in alternate weeks. Next week group discussion on the lecture delivered.
- At least 15 students should register for offering any elective.

## Industrial Drives and Control

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Electric Drives** | Lecture required | References |
|---|---|---|---|
| A | Concept, classification, advantages, | 01 | 1-6 |
| B | parts of drives, choice of electric drives, | 01 | 1-6 |
| C | fundamental torque equation, | 01 | 1-6 |
| D | types of practical mechanical loads, | 01 | 1-6 |
| E | dynamics of electrical drive- stability of an electrical drive, | 01 | 1-6 |
| F | constant**,** torque drive, constant power drive, | 01 | 1-6 |
| G | selection of a D.C and A.C drive, modes of operation | 01 | 1-6 |
| H | Selection of Motor Power Rating: Classes of motor duty | 01 | |
| I | determination of motor rating | 01 | |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus .<br>Numerical may be asked on topics H | | | |

**Unit-II**

| Sr.No. | **Unit- II: Converters and control** | Lecture required | References |
|---|---|---|---|
| A | Phase controlled converters: Single phase fully controlled converter, Single phase half controlled converter. | 02 | 1-6 |
| B | Three phase fully controlled converter, Three phase half controlled converter. | 01 | 1-6 |
| C | selection of converter circuits, Four quadrant operation | 01 | 1-6 |
| D | Choppers: Classes of choppers | 02 | 1-6 |
| E | Basic principles of Speed control; closed loop control, current & speed sensing | 01 | 1-6 |
| F | Phase locked loop, closed loop position control. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus .<br>Numerical may be asked on each topics | | | |

**Unit - III**

| Sr.No. | **Unit-III: DC motor drives** | Lecture required | References |
|---|---|---|---|
| A | Speed-torque characteristics of DC shunt, PMDC motor | 01 | 1-6 |
| B | Speed-torque characteristics of DC series motor, single phase controlled rectifier fed dc drives | 01 | 1-6 |

| | | | |
|---|---|---|---|
| C | three phase controlled rectifier fed dc drives | 01 | 1-6 |
| D | multi quadrant operation of dc separately excited motor fed from fully controlled rectifier | 02 | 1-6 |
| E | chopper controlled dc drives | 01 | 1-6 |
| F | source current harmonics in choppers, converter ratings and closed loop control. | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus<br>Numerical should be asked on topics c, d and e | | | |

**Unit – IV**

| Sr.No. | **Unit – IV: - Inverters and PWM techniques** | Lecture required | References |
|---|---|---|---|
| a | Voltage source inverters | 01 | 1-6 |
| b | current source inverters | 01 | 1-6 |
| c | PWM inverters | 01 | 1-6 |
| d | sine-triangle comparison | 01 | 1-6 |
| E | harmonic elimination, hysteresis current controllers | 02 | 1-6 |
| F | space vector pwm | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Numerical may be asked from topic E | | | |

**Unit – V**

| Sr.No | **Unit – V:- AC motor drives** | Lecture required | References |
|---|---|---|---|
| A | Speed control of single phase induction motors | 01 | 1-6 |
| B | Speed control of three phase induction motors | 01 | 1-6 |
| C | d-q model of induction motor | 01 | 1-6 |
| D | VSI control, CSI control, | 01 | 1-6 |
| E | Constant flux speed control structure, vector control model | 01 | 1-6 |
| F | vector control structure. | 01 | 1-6 |
| G | Energy Conservation in Electric Drives**:** Losses in Electric drive systems, measures of Energy conservation in Electric drives. | 01 | 1-6 |
| H | Use of efficient converters, energy efficient operation of drives, | 01 | 1-6 |
| I | Improvement of p.f., improvement of quality of supply, maintenance of motors | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus. | | | |

**Reference Books :**


1. V. Subramanyam , “Thyristerised Control of Electric Drives”, Tata McGraw Hill, New Dehli.
2. Dubey, Joshi, Sinha, “Thyristor Power Control”, Willey Eastern Publication.
3. M. Rashid, “Power Electronics Circuit Devices & Applications”, Prentice Hall of India.
4. G. K. Dubey , “Fundamentals of Electrical Drives”, Narosa Publishing House.
5. Mohammad A. El-Sarkawi, “Fundamentals of Electrical Drives” , vikas Publishing House.
6. Ned Mohan, “ Electric Machines and Drives”, Wiley India Pvt. Ltd.
7. http://nptel.iitm.ac.in

## High Voltage Engineering

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **Unit-I: Breakdown In Gases, Liquids & Solids** | Lecture required | References |
|---|---|---|---|
| a | Review and classification of insulating material, | 01 | 1-6 |
| b | Breakdown in gases, Townsend's law. | 01 | 1-6 |
| c | Breakdown in electronegative gases, | 01 | 1-6 |
| d | Streamer mechanism of spark, Paschen's law, | 01 | 1-6 |
| e | Corona discharge, electronegative gases. | 01 | 1-6 |
| f | Breakdown in pure and commercial liquids, | 01 | 1-6 |
| g | Breakdown in solid dielectric and composite dielectric, | 01 | 1-6 |
| h | Breakdown in vacuum . | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr. No | **Unit-II Lightning and Switching Over Voltage Protection** | Lecture required | References |
|---|---|---|---|
| a | Lighting strokes to lines and towers | 01 | 1-6 |
| b | Lighting strokes mechanism & characteristics. | 01 | 1-6 |
| c | Over voltage due to switching surge, system fault. | 02 | 1-6 |
| d | Protection of transmission lines from lightning, | 01 | 1-6 |
| e | Lightning arrestors, | 01 | 1-6 |
| f | Insulation co-ordination of HV and EHV power system . | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

Unit-III

| Sr. No | **Unit-III: Generation of High Voltage & Currents** | Lecture required | References |
|---|---|---|---|
| a | Generations of high direct current voltage, | 01 | 1-6 |
| b | Generation of high alternating voltage, | 01 | 1-6 |
| c | Generation of Impulse voltage and current , | 01 | 1-6 |
| d | Generation of lightning surges. | 01 | 1-6 |
| e | Classification of High voltage laboratories, | 01 | 1-6 |
| f | Testing facilities provided in High voltage laboratories, | 02 | 1-6 |
| g | Grounding of impulse testing laboratories. | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-IV**

| Sr. No | **Unit-IV: Measurement Of High Voltage And Currents** | Lecture required | References |
|---|---|---|---|
| a | Methods of measurement of peak voltage, | 02 | 1-6 |
| b | Methods of measurement of impulse voltage and high direct current, | 02 | 1-6 |
| c | Non destructive measurement and testing, | 02 | 1-6 |
| d | High voltage dielectric loss and capacitance measurements | 01 | 1-6 |
| e | Ratio frequency & partial discharge measurements. | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-V**

| Sr. No | **Unit-V: Testing and EHV Line Insulation** | Lecture required | References |
|---|---|---|---|
| a | Basic technology of line insulator | 01 | 1-6 |
| b | Testing of insulators bushing , | 01 | 1-6 |
| c | Testing of cables , transformer, | 02 | 1-6 |
| d | Testing of surge diverters | 01 | 1-6 |
| e | Threshold current , capacitance of long objects, | 01 | 1-6 |
| F | Electromagnetic interference, | 01 | 1-6 |
| g | E.H.V line insulation design based upon transient over voltages. | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:-**


1. M.S. Naidu & V.Kamaraju , "High Voltage Engg", Tata McGraw Hill.
2. E.Kuffel and W.S Zaenglo, "High Voltage Engg" , PERgamon Press
3. ,Rakash Das Begamudre, "Extra High Voltage Transmission", New Age International Publication.
4. C.L. Wadhawa , "High Voltage Engineering" Wley Eastern
5. R.S.Jha , "High Voltage Engineering"
6. http://nptel.iitm.ac.in

**Interdisciplinary Elective**

**Energy Audit and Conservation**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **Unit-I: Energy Audit** | Lecture required | References |
|---|---|---|---|
| a | Need and concept of energy audit, pre-requisite of energy conservation, | 01 | 1-6 |
| b | Principles of energy audit, type and methodology of energy audit: | 02 | 1-6 |
| c | Preliminary energy audit and detailed energy audit, procedures of carrying out energy audit. | 02 | 1-6 |
| d | Identification of energy conservation opportunities and priority, | 01 | 1-6 |
| e | Energy audit report writing, | 01 | 1-6 |
| f | Instruments used for energy audit. | 01 | 1-6 |
| g | Energy Conservation Act, Progress made in energy conservation in India. | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Question should not be asked from introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **Unit -II: Economics of Energy Conservation** | Lecture required | References |
|---|---|---|---|
| a | Simple payback period analysis, | 01 | 1-6 |
| b | Advantages &limitations of payback period, | 01 | 1-6 |
| c | Time value of money, net present value method, | 01 | 1-6 |
| d | Internal rate of return method, and profitability index | 01 | 1-6 |
| e | Risk and sensitivity analysis; | 01 | 1-6 |
| f | Financing options, Micro factors and macro factor | 02 | 1-6 |
| g | Study and selection of proper tariff for particular application, | 01 | 1-6 |
| h | Fixed & variable components in tariff, | 01 | 1-6 |
| i | Impact of tariff on energy management. | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Question should not be asked from introductory part of syllabus | | | |

**Unit - III**

| Sr.No. | **Unit-III: Energy Management** | Lecture required | References |
|---|---|---|---|

| | | | |
|---|---|---|---|
| a | Concept of energy management – | 01 | 1-6 |
| b | Energy inputs in industrial ,residential, commercial, agricultural and public sector | 01 | 1-6 |
| c | Management of power factor, power factor improvement | 01 | 1-6 |
| d | Power demand monitoring.<br>Concept of demand side management (DSM), | 02 | 1-6 |
| e | Scope of DSM, DSM planning and implementation , | 02 | 1-6 |
| f | Load management as DSM strategy | 01 | 1-6 |
| g | Advantages of DSM to consumers, utility and society. | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Question should not be asked from introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Energy Conservation** | Lecture required | References |
|---|---|---|---|
| a | Motive power: potential for saving electrical energy in motors | 01 | 1-6 |
| b | Over sizing or under loading, improving, efficiency of an existing motor, | 01 | 1-6 |
| c | Energy efficient motors, variable or adjustable speed drives for energy conservation , effect of rewinding on performance and consumption. | 01 | 1-6 |
| d | Lighting: level of illumination for different areas. | 01 | 1-6 |
| e | Use of right source of lamp for different applications, energy efficient lamps, | 02 | 1-6 |
| f | Different type of light fixtures | 01 | 1-6 |
| g | Heating & Cooling systems: energy saving in furnace air conditioners and refrigeration. | 01 | 1-6 |
| h | Energy conservation in air conditioners and refrigeration. | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Question should not be asked from introductory part of syllabus | | | |

**Unit - V**

| Sr.No. | **Unit-V : Scope of Conservation** | Lecture required | References |
|---|---|---|---|
| a | Energy conservation in industrial, | 02 | 1-6 |
| b | Energy conservation in agricultural, commercial, domestic and municipal sectors. | 02 | 1-6 |
| c | Energy conservation in generation, Co-generation, Waste heat recovery, | 02 | 1-6 |
| d | Energy conservation in transmission and distribution | 02 | 1-6 |

| | | | |
|---|---|---|---|
| Guidelines for the examiners and paper setters:<br>Question should not be asked from introductory part of syllabus | | | |

**Reference books**


1. Umesh Rathore, "Energy Management", S K Kataria and Sons.
2. S. C. Tripathy, "Electrical Energy Utilization and Conservation", THM Publication
3. S.Rao, "Energy Technology"' Khanna Pub.
4. . Preceding of the Seminar on " Energy Audit & Demand Side Management" held at Govt. College of Engineering, Pune-5 organized by M.S.E.B.(SEA) ON 16.09.1998.
5. B.E. Kushare, "Hand Book on Energy Efficient Motors" , International Cooper Proposition Council ,
6. Bureau of Energy Efficiency

**Interdisciplinary Elective**

**Renewable Energy Resources**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Solar Energy** | Lecture required | References |
|---|---|---|---|
| a | Introduction to energy technology and energy sciences, | 01 | 1-6 |
| b | Energy and environment | 01 | 1-6 |
| c | laws of conservation of energy. Essential subsystems in a solar energy plant, | 01 | 1-6 |
| d | Phenomena of light and energy, energy from sun, | 01 | 1-6 |
| e | Solar constant, power density for various wavelength of sun light, | 01 | 1-6 |
| f | clarity index, angle of latitude | 01 | 1-6 |
| g | Solar insolation at different geographical locations. | 01 | 1-6 |
| h | Solar thermal collectors and its types. | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Solar Photovoltaic** | Lecture required | References |
|---|---|---|---|
| a | Introduction to solar photovoltaic system, | 01 | 1-6 |
| b | Merit and limitations, economic considerations of solar PV system, | 01 | 1-6 |
| c | Principle and characteristic of solar cell, | 01 | 1-6 |
| d | Efficiency of solar cell , | 02 | 1-6 |
| e | Configuration of solar PV panel, | 01 | 1-6 |
| f | Solar PV cell technologies | 01 | 1-6 |
| g | Small solar PV system for residence | 01 | 1-6 |
| h | Small solar PV system for rural areas. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - III**

| Sr.No. | **Unit-III: Geothermal Energy** | Lecture required | References |
|---|---|---|---|
| a | Introduction to geothermal energy | 01 | 1-6 |
| b | Geothermal energy resources, origin of geothermal resources | 01 | 1-6 |
| d | Geothermal gradients, hydro geothermal resources, | 02 | 1-6 |
| e | Geo pressure geothermal resources | 01 | 1-6 |

| | | | |
|---|---|---|---|
| f | Geothermal fluid fluid for electric power plants | 01 | 1-6 |
| g | Classification and type of geothermal power plants. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Wind Energy** | Lecture required | References |
|---|---|---|---|
| a | Introduction to wind energy, | 01 | 1-6 |
| b | Nature of wind energy conversion system | 01 | 1-6 |
| c | Wind power density, | 01 | 1-6 |
| d | Forces on the blades of a propeller, | 01 | 1-6 |
| e | Wind turbine efficiency, | 01 | 1-6 |
| f | Wind velocity duration characteristic , | 01 | 1-6 |
| g | Type of wind turbine-generator unit , | 01 | 1-6 |
| h | Planning of wind farm and grid connection. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - V**

| Sr.No | **Unit-V : Biomass Energy** | Lecture required | References |
|---|---|---|---|
| a | Introduction to biomass energy resources, | 01 | 1-6 |
| b | Biomass conversion process, | 01 | 1-6 |
| c | Direct combustion of biomass, gaseous fuels from biomass, | 01 | 1-6 |
| d | Gaseous fuels from biomass, | 01 | 1-6 |
| e | Introduction to urban solid waste –to- energy by incineration process, | 01 | 1-6 |
| f | Waste –to- energy incineration process and energy plant, | 01 | 1-6 |
| g | location of plants, wood and wood waste as primary energy source and cogeneration plant. | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books**


1. S Rao & Dr. B B Parulekar, " Energy Technology", Khanna Publishers.
2. Dr. H S Mukunda, Understanding Clean Energy and fuels from Biomass", Wiley India
3. http://nptel.iitm.ac.in

## Elective-I
## Industrial Electrical Engineering

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Electric Drives** | Lecture required | References |
|---|---|---|---|
| a | Type of drives, Nature of load, | 01 | 1-6 |
| b | Section motors, electrical, mechanical , service capacity and rating | 01 | 1-6 |
| c | Types of Enclosures. | 01 | 1-6 |
| d | Electrical Characteristic: Operating and running, Starting, speed control and braking characteristics of DC motors. | 01 | 1-6 |
| e | Electrical Characteristic: Starting, Operating and running, speed control and braking characteristics of three phase induction motor and single phase Induction motor. | 01 | 1-6 |
| f | Problems on speed control, torque and braking of DC motors | 02 | 1-6 |
| g | Problems on speed control, torque and braking of DC motors | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus . Numerical should be asked on topics d and e. | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Types of Duties** | Lecture required | References |
|---|---|---|---|
| a | Type of duty :Continuous, intermittent and short time rating , | 02 | 1-6 |
| b | Temperature rise and rating | 02 | 1-6 |
| c | Calculations for these duties mechanical features , | 01 | 1-6 |
| d | Features of load diagram construction, | 01 | 1-6 |
| e | Load equalization & use of flywheel. | 01 | 1-6 |
| f | Problems on rating and temperature rise | 01 | 1-6 |
| g | Problems on load equalization and flywheel. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus .<br>Numerical should be asked on each topics | | | |

**Unit – III**

| Sr.No. | **Unit-III: Traction Systems** | Lecture required | References |
|---|---|---|---|
| a | Requirements of ideal traction system, | 01 | 1-6 |

| | | | |
|---|---|---|---|
| b | Systems of track electrification and their comparison, | 01 | 1-6 |
| c | Speed time curve, factors affecting on schedule speed, | 01 | 1-6 |
| d | Tractive effort, Factors affecting in energy consumption | 02 | 1-6 |
| e | Specific energy consumption. | 01 | 1-6 |
| f | Problem on speed time curves and tractive efforts | 01 | 1-6 |
| g | Problems on energy consumption and specific energy consumption. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus<br>Numerical should be asked on topics c, d and e | | | |

**Unit – IV**

| Sr.No. | **Unit – IV: Traction Motors** | Lecture required | References |
|---|---|---|---|
| a | General features of traction motors, | 01 | 1-6 |
| b | Control of traction motor: starting speed control and braking of DC series motor , | 02 | 1-6 |
| c | Control of traction motor: Speed control and braking of AC series motor , | 02 | 1-6 |
| d | Energy returned during regenerative braking | 01 | 1-6 |
| e | Overhead equipment control gear . | 01 | 1-6 |
| f | Calculation energy return in braking | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Numerical may be asked from topic b,c and d | | | |

**Unit – V**

| Sr.No | **Unit-V: Heat Ventilation and Air Conditioning** | Lecture required | References |
|---|---|---|---|
| a | Refrigeration cycle, | 01 | 1-6 |
| b | Type of refrigeration, | 01 | 1-6 |
| c | Air conditioning, type of air conditioning, | 01 | 1-6 |
| d | Heating of building. | 01 | 1-6 |
| e | Methods of electric heating & its advantages, | 01 | 1-6 |
| f | Resistance oven, induction heating | 01 | 1-6 |
| g | Electric welding. | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:**


1. J.B.Gupta , “A Course in Electrical Power”
2. V.V.L.Rao, “Utilization of Electrical Energy”, TMH
3. O.E.Taylor , “Utilization of Electrical Energy”, TMH
4. S.K.Pillai, “A Course in Electrical Energy”, TMH

**Elective-I**

**Digital Signal Processing**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Signal and Fourier Analysis** | Lecture required | References |
|---|---|---|---|
| a | Classification of signal, classification of system | 01 | 1-6 |
| b | Fourier Transform: | 02 | 1-6 |
| c | Properties of Fourier Transform, | 02 | 1-6 |
| d | Fourier Transform of some important signals | 02 | 1-6 |
| e | Fourier Transform of power and energy signal. | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

Unit-II

| Sr. No | **UNIT-III: Transform and Linear Time Invariant System** | Lecture required | References |
|---|---|---|---|
| a | Definition of Z- Transform, | 01 | 1-6 |
| b | Properties of Z- transform, | 01 | 1-6 |
| c | Inverse Z- transform | 02 | 1-6 |
| d | Linear Time Invariant System, | 02 | 1-6 |
| e | Property of DSP, impulse and frequency response. | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus<br>Numerical treatment on each topic. | | | |

Unit-III

| Sr. No | **UNIT-IV:Discrete and Fast Fourier Transform** | Lecture required | References |
|---|---|---|---|
| a | Discrete convolution, | 01 | 1-6 |
| b | Discrete-time Fourier Transform(DTFT), | 01 | 1-6 |
| c | Fast Fourier Transform (FFT), computing an inverse DFT , | 02 | 1-6 |
| d | Short Time Fourier Transform (STFT). (DWT). | 02 | 1-6 |
| e | Continuous wavelet transforms. Discrete Wavelet Transform | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus<br>Numerical treatment on each topic. | | | |

Unit-IV

| Sr. No | **UNIT-V: Finite Impulse Response (FIR) Filter** | Lecture required | References |
|---|---|---|---|
| a | Introduction to Finite Impulse Response Filter, | 02 | 1-6 |
| b | FIR filter design FIR filter design using different windowing techniques | 02 | 1-6 |
| c | & frequency sampling method. | 02 | 1-6 |
| d | Design of linear phase FIR filter | 02 | |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus<br>Numerical treatment on each topic. | | | |

Unit-IV

| Sr. No | **UNIT-V: Finite Impulse Response (FIR) Filter** | Lecture required | References |
|---|---|---|---|
| a | Introduction to Infinite Impulse Response Filter, | 02 | 1-6 |
| b | Design Specification of IIR Low pass filter and frequency transformation, | 02 | 1-6 |
| C | Design of IIR filter using Butterworth, Chebyshev approximation. | 02 | 1-6 |
| d | Digital processor,TM320C 2000 Series processor 2812,28335 and 28027. | 02 | |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus<br>Numerical treatment on each topic. | | | |

**References:**


1. Proakis, Manolakis “Digital Signal Processing: Principles, Algorithms and Applications”, PHI.
2. Oppenheium, Schaffer ,”Digital Signal Processing”, PHI.
3. A. Nagoor Kani , “Digital Signal Processing”, Tata Mc. Graw Hill.
4. Dr. Shaila D Apte ,”Digital Signal Processing”,Second Edition , Wiley India Pvt Ltd
5. S Salivahanan, A Vallavraj and C Gnanapriya, “Digital Signal Processing” Tata Mc. Graw Hill.
6. http://nptel.iitm.ac.in

**Elective-I**

**Control System –II**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: State Space Techniques** | Lecture required | References |
|---|---|---|---|
| a | Concept of state variable. State model, | 01 | 1-12 |
| b | States variable models of SISO/MIMO linear systems, from differential equations, transfer function and block diagrams. | 02 | 1-12 |
| c | State diagram (Signal flow graphs) Decomposition of transfer functions in phase variable forms, | 02 | 1-12 |
| d | Canonical forms, Jordan canonical form, transfer function from the state model, transfer matrix. | 02 | 1-12 |
| e | Concept of Controllability and observability of linear systems. State feedback controller using pole placement , observers. | 02 | 1-12 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr. No | **UNIT-II: Sample Data Control System** | Lecture required | References |
|---|---|---|---|
| a | Representation of sample data (Discrete system) review of Z transforms, sample and hold zero order hold. | 01 | 1-12 |
| b | Sampling theorem Z-transform analysis of sampling data control system. (Open loop and closed loop), Z transfer function of systems. | 02 | 1-12 |
| c | Solutions of different equation by Z transfer methods. | 02 | 1-12 |
| d | Pulse transfer functions of open loop and closed loop system with different sample locations. | 02 | 1-12 |
| e | Stability analysis, relation between S and Z domain, stability by Jury's test and bi-linear transformation and root locus method. | 02 | 1-12 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-III**

| Sr. No | **UNIT-III: Non Linear System Analysis-I** | Lecture required | References |
|---|---|---|---|
| a | Behavior of non linear system, | 01 | 1-12 |
| b | Various general non linear ties and their characteristics. | 01 | 1-12 |
| c | Stability analysis by describing function method. | 02 | 1-12 |
| d | Existence and stability of limit cycles. | 02 | 1-12 |
| e | Limitation of describing function method. | 02 | 1-12 |

| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus |
|---|

**Unit-IV**

| Sr. No | **UNIT-IV :Non Linear System Analysis-II** | Lecture required | References |
|---|---|---|---|
| a | Liberalization in a small region operating point. | 01 | 1-12 |
| b | Singular point and their nature. | 01 | 1-12 |
| c | Phase plane method of analysis of nonlinear system, | 02 | 1-12 |
| d | Construction of phase trajectories by isoclines method. | 02 | 1-12 |
| e | Limit cycle behavior | 02 | 1-12 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-V**

| Sr. No | **UNIT-V : Stability Analysis By Liapunov Method** | Lecture required | References |
|---|---|---|---|
| a | Concept of stability, | 01 | 1-12 |
| b | Asymptotic stability in the large, instability, the sense of a Lipunov, Positive of a scale function, quadratic forms. | 01 | 1-12 |
| c | Second method of Lipnov, stability theorems, | 02 | 1-12 |
| d | Lipunov fuctions stability of linear time invariant systems, Lipunov equations. | 02 | 1-12 |
| e | Krasowakii's method for time examining the stability of non-linear time invariant system. | 02 | 1-12 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:**


1. Nagrath & Gopal, "Control System Engineering", 4th Edition, New age International.
2. K. Ogata, "Modern Control Engineering", Prentice Hall of India.
3. B.C. Kuo & Farid Golnaraghi, "Automatic Control System" Wiley India Ltd, 2008.
4. Norman s Nise, "Control System Engineering" Wiley India Pvt Ltd
5. Dr. Rajeev Gupta, "NISE's Control System Engineering" Wiley India Pvt Ltd
6. D.Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.
7. Ajit K Mandal, "Introduction to Control Engineering" New Age International,2006.
8. R.T. Stefani, B.Shahian, C.J.Savant and G.H. Hostetter, " Design of Feedback Control Systems".
9. Narendra Singh Beniwal and Beniwal,"Automatic control system with Matlab Programming "University Science Press.
10. Eugene Xavier S.P. and Joseph Cyril Babu,J.,"Principles of control systems "S.Chand
11. S.Sivangaraju,L.Devi ,"Control Systems Engineering "New Age International Publishers.
12. http://nptel.iitm.ac.in

## Electric Traction Engineering

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Traction Motors** | Lecture required | References |
|---|---|---|---|
| a | Performance of (i) d.c. motors | 02 | 1-6 |
| b | Performance of a.c. single phase series motors at low frequencies and at commercial frequency | 02 | 1-6 |
| c | Performance poly phase induction motors, under traction service conditions, specific problems and method of overcoming them, | 02 | 1-6 |
| d | Special features of construction effect of differences in driving wheel diameters | 01 | 1-6 |
| e | Speed time curves on division of load, traction motor ratings, speed factor, | 01 | 1-6 |
| f | Track and overhead equipments. | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus , numerical on a to c based on speed control, torque and braking. | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Train Movement and Performance** | Lecture required | References |
|---|---|---|---|
| a | Speed time curve | 01 | 1-6 |
| b | Speed time curve its analysis and construction, | 01 | 1-6 |
| c | Schedule speed and factors affecting it | 01 | 1-6 |
| d | Train resistance and its components. | 02 | 1-6 |
| e | Tractive effort calculations, | 01 | 1-6 |
| f | Average acceleration and speed, | 01 | 1-6 |
| g | Energy output and consumption. | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus , numerical on each topic. | | | |

**Unit – III**

| Sr.No. | **Unit-III: Power Transmission and Weight Transference** | Lecture required | References |
|---|---|---|---|
| a | Methods of transmission of power from motor to wheels | 02 | 1-6 |
| b | Idea about riding quantities of an electric loco motive, | 02 | 1-6 |
| c | Grouping of motor and weight transference, | 02 | 1-6 |
| d | Adhesive weight factors affecting slip. | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Power Supply for Traction** | Lecture required | References |
|---|---|---|---|
| a | Overhead and conductor rail system, third rail construction | 01 | 1-6 |
| b | Bonding of conductor and track rails, overhead construction for trolley, | 01 | 1-6 |
| c | Buses and railways, quaternary's construction, | 01 | 1-6 |
| d | Temperature effects, current collectors, out times of feeding | 01 | 1-6 |
| e | Distributing system for d.c low frequency, a.c and commercial frequency, | 01 | 1-6 |
| f | AC traction voltage drop control, | 01 | 1-6 |
| g | Electrolytic and inductive coordination, | 01 | 1-6 |
| h | Power loading curves, Positions of substations and load – sharing . | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – V**

| Sr.No | **Unit-V : Braking On Electrified Railways** | Lecture required | References |
|---|---|---|---|
| a | Mechanical versus electric breaking, | 01 | 1-6 |
| b | Rheostatic braking, Regenerative braking, method and energy saved in the process, Magnetic track brakes. | 01 | 1-6 |
| c | **Traction control:** Duty cycle, Methods of traction motor control, | 01 | 1-6 |
| d | Series-Parallel and other types of controllers, use of interlocks, | 01 | 1-6 |
| e | Run back prevented, multiple unit control, | 01 | 1-6 |
| f | Master controllers, Reverses, | 01 | 1-6 |
| g | Dead man's handle, use of Metadyne and Megavolt. | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:**


1. J.B.Gupta , "A Course in Electrical Power"
2. V.V.L.Rao, "Utilization of Electrical Energy", TMH
3. O.E.Taylor , "Utilization of Electrical Energy", TMH
4. S.K.Pillai, "A Course in Electrical Energy", TMH
5. H. Partab, "Art & Science of Utilization of Electrical Energy"
6. http://nptel.iitm.ac.in

## Power System Operation and Control

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Economic Load Dispatch & Optimal Operation of Power System** | Lecture required | References |
|---|---|---|---|
| a | Input Output characteristics, Heat-rate characteristics, | 01 | 1-2 |
| b | Incremental fuel rate and cost, Incremental production cost, , | 01 | 1-2 |
| c | Optimum scheduling of generation between different units. (Neglecting transmission losses), | 01 | 1-2 |
| d | Transmission loss as a function of plant generation (A simple system connection two generating plants to load) and incremental transmission loss for optimum economy, | 02 | 1-2 |
| e | Calculation of loss coefficients (Two plants system), | 01 | 1-2 |
| f | Optimum scheduling of generation between different plants considering transmission loss concept and significance of penalty factor, | 02 | 1-2 |
| g | Automatic load dispatch, function and applications | 01 | 1-2 |
| Guidelines for the examiners and paper setters:<br>Numerical may be asked from points c to f. | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Generator Voltage Control** | Lecture required | References |
|---|---|---|---|
| a | Automatic voltage control, | 01 | 1-7 |
| b | Generator controllers, | 01 | 1-7 |
| c | Cross coupling between P–f and Q–V control channel, | 01 | 1-7 |
| d | Automatic voltage regulator, | 02 | 1-7 |
| e | Types of exciters and excitation systems, | 01 | 1-7 |
| f | Exciter modeling, transfer function modeling for control | 01 | 1-7 |
| g | Static performance of AVR loops. | 01 | 1-7 |
| h | Dynamic response and performance of AVR loops. | 01 | 1-7 |
| Guidelines for the examiner and paper setter.<br>Question should not be asked from introductory part of syllabus. | | | |

**Unit - III**

| Sr.No. | **Unit-III: Load Frequency Control** | Lecture required | References |
|---|---|---|---|
| a | Automatic load frequency Control, | 01 | 1-7 |
| b | Speed governing system | 01 | 1-7 |
| c | Speed governing system and hydraulic valve actuator for | 01 | 1-7 |

| | | | |
|---|---|---|---|
| | individual generator, | | |
| d | Turbine modeling, | 02 | 1-7 |
| e | Generator and load modeling transfer function | 02 | 1-7 |
| f | Representation of power control mechanism of generator. | 01 | 1-7 |
| g | Problems on governor action and calculation of frequency. | 01 | 1-7 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus. | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Electric Power Control** | Lecture required | References |
|---|---|---|---|
| a | Concept of control area, | 01 | 1-6 |
| b | Division of power system into control areas, | 01 | 1-6 |
| c | Load frequency of single areas | 01 | 1-6 |
| d | Load frequency two area and multi area (control) | 01 | 1-6 |
| e | Power system with and without integral controls. | 02 | 1-6 |
| f | Advantage of pool operation, | 01 | 1-6 |
| g | Tie line bias control area exchange. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus. | | | |

**Unit - V**

| Sr.No | **Unit-V : Voltage Stability and Compensation** | Lecture required | References |
|---|---|---|---|
| a | Power system security, Operating stage (State transition diagram), | 01 | 1-6 |
| b | Voltage stability, Comparison of angle and voltage stability, | 01 | 1-6 |
| c | Reactive power flow and voltage collapse, | 01 | 1-6 |
| d | Voltage stability analysis and prevention of voltage collapse. | 01 | 1-6 |
| e | Compensation in power system: | 01 | 1-6 |
| f | Load compensation, load ability of compensated and uncompensated over head transmission line, | 01 | 1-6 |
| g | compensation of transmission line (Shunt& Series). Introduction of FACTS | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference:**


1. Olle L. Elgerd, “Electrical Energy System Theory & Introduction ‘, TMH.
2. I. J. Nagrath & D. P. Kothari, “Modern Power system Analysis “, TMH.
3. Willium D. Stevenson Jr., “Elements of Power System Analysis” , TMH.
4. Dr. K Uma Rao, “ Power System Operation & Control”, Wiley India Pvt Ltd.
5. Dr. C.S. Indulkar, “Electric Power Control”
6. L.K. Kirchmayer , “Economic Control of Power System”
7. C L Wadhwa, “Electrical Power System Analysis”, New Age International Publication.
8. http://nptel.iitm.ac.in

**Industrial Drive and Control**
**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | Determination of Speed Torque characteristic of d.c motor controlled using single phase half controlled rectifier. | 02 |
| 2 | Determination of Speed Torque characteristic of d.c motor controlled using single phase fully controlled rectifier. | 02 |
| 3 | Performance analysis of one quadrant chopper control of d.c motor. | 02 |
| 4 | Performance analysis of one quadrant chopper control of d.c motor. | 02 |
| 5 | Speed control of single phase induction motor using ac voltage regulator. | 02 |
| 6 | Study of stepper motor drive circuit. | 02 |
| 7 | Speed control of universal motor. | 02 |
| 8 | Study of Micro-computer based control of Dc drives, | 02 |
| 9 | Study of vector control method for induction motor. | 02 |
| 10 | Study of reversible drive. | 02 |

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student should be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

## High Voltage Engineering Lab

Teacher should facilitate learning following lab experiments:

| Sr. No | | Lecture required |
|---|---|---|
| 1 | Measurement of insulation resistance of 11KV/110 V.P.T by Megger. | 02 |
| 2 | Power frequency withstand test on 11KV, 10/5 amp CT. | 02 |
| 3 | Study of corona discharge. | 02 |
| 4 | Determination of insulating break-down strength of solid, liquid and gaseous dielectric media. | 02 |
| 5 | Power frequency high voltage withstand test on cable. | 02 |
| 6 | Study of impulse generator. | 02 |
| 7 | Dry & Wet power frequency withstand test for insulator. | 02 |
| 8 | Flash over test on insulator. | 02 |
| 9 | Double voltage double frequency withstand test on transformer. | 02 |
| 10 | Calibration of sphere gap. | 02 |
| 11 | Study of 100KV high voltage testing set. | 02 |

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student may be asked questions on practical. Evaluation will be based on answers given by students in oral examination.

**Elective-I**
**Industrial Electrical Engineering**
**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | Performance characteristics of DC Series motor by load test. | 02 |
| 2 | Performance characteristics of DC Series motor by Field Test. | |
| 3 | Performance characteristics of DC Shunt motor by direct load test. | 02 |
| 4 | Performance characteristics of single phase induction motor by direct load test. | 02 |
| 5 | Performance characteristics of three phase induction motor by direct load test. | 02 |
| 6 | Speed control of DC series motor. | 02 |
| 7 | Speed control of three-phase slip ring induction motor by rotor resistance method. | 02 |
| 8 | Rheostatic braking of DC shunt motor. | 02 |
| 9 | Study of Air conditioning system. | 02 |
| 10 | Study of induction heating &Welding. | 02 |
| 11 | Study of different types of enclosures | 02 |

***Note:*** *(Objectives and conclusion should be oriented on the basis of characteristic of load, selection, and application of motors.)*

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student may be asked questions on practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

**Elective-I**
**Digital Signal Processing Lab**
**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | Shifting and folding of digital signal. | 02 |
| 2 | Linear convolution. | 02 |
| 3 | Discrete Fourier transforms. | 02 |
| 4 | Fast Fourier transforms. | 02 |
| 5 | Design and implement FIR filter using windowing method. | 02 |
| 6 | Design and implement IIR filter using Butterwoth approximation. | 02 |
| 7 | Design and implement IIR filter using Chebeshev approximation. | 02 |
| 8 | Sine/square wave generation using TMS32OC67XX. | 02 |
| 9 | FIR filter implementation using TMS32OC67XX. | 02 |
| 10 | IIR filter implementation using TMS32OC67XX. | 02 |
| 11 | Filtering Using Discrete Wavelet transforms. | 02 |

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student should be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

**Elective-I**
**Control System-II**
**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | To Study of different MATLAB tools for Control System. | 02 |
| 2 | Find the Response of the Discrete Time Control System for any two standard inputs. | 02 |
| 3 | Simulation on State Transition Matrix. | 02 |
| 4 | State Space Analysis using MATLAB. | 02 |
| 5 | Pole-Zero plot using MATLAB. | 02 |
| 6 | To check the controllability and Observability for the given system. | 02 |
| 7 | Design of control system using pole placement technique. | 02 |
| 8 | Simulation on multivariable control system. | 02 |
| 9 | Design of State observer. | 02 |
| 10 | Design of Discrete Time Control System based on minimization of quadratic performance index. | 02 |
| 11 | To determine time domain response of a second order system for step input and obtain performance parameters by using MATLAB. . | 02 |
| 12 | To convert transfer function of a system into state space form and vice-versa, by using MATLAB. | 02 |

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student should be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

**Elective-I**
**Electric Traction Engineering**
**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | Performance characteristics of DC Series motor by load test. | 02 |
| 2 | Performance characteristics of DC Series motor by Field Test. | 02 |
| 3 | Performance characteristics of DC Shunt motor by direct load test. | 02 |
| 4 | Performance characteristics of single phase induction motor by direct load test. | 02 |
| 5 | Performance characteristics of three phase induction motor by direct load test. | 02 |
| 6 | Speed control of DC series motor. | 02 |
| 7 | Speed control of three-phase slip ring induction motor by rotor resistance method. | 02 |
| 8 | Rheostatic braking of DC shunt motor. | 02 |
| 9 | Study of traction transformer. | 02 |
| 10 | Study of Metadyne for electric locomotive. | 02 |
| 11 | Study of electric traction substation. | 02 |

***Note:*** *(Objectives and conclusion should be oriented on the basis of characteristic of load, selection, and application of motors.)*

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student should be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

**Project-I**

**(Lab Course Contents)**

| | |
|---|---|
| **1** | It is expected that the broad area of Project-I shall be finalized by the student in the beginning of the VII semester / extension of Minor project undertaken may be Project-I. |
| **2** | A group of Minimum 3 and Maximum 5 students shall be allotted for Project-I and same project group for Project-II. |
| **3** | Exhaustive survey of literature based on a clear definition of the scope and focus of the topic should be carried out by the students. The **Synopsis/Abstract** on the selected topic, after detail literature survey should be submitted to the Project coordinator appointed by Head of the department. |
| **4** | Project-I may involve literature survey, problem identification, work methodology preparing specification and material procurement, collection of data , conduction of experiments and analysis. The project work shall involve sufficient work so that students get acquainted with different aspects of fabrication, design or analysis. |
| **5** | Approximately more than 50% work should be completed by the end of VII semester. |
| | Each student group is required to maintain log book for documenting various activities of Project-I and submit group project report in the form of thermal bound at the end of semester –VII. Submit the progress report in following format:<br>*a. Title*<br>*b. Abstract*<br>*c. Introduction*<br>*d. Problem identification and project objectives*<br>*e. Literature survey*<br>*f. Case study/Analysis/Design Methodology*<br>*g. Work to be completed (Progress status)*<br>*h. Expected result and conclusion*<br>*i. References.* |
| | Evaluation Committee comprising of the Guide, Project Coordinator and Expert appointed by the Head of the department will award the marks based on the work completed by the end of semester and the presentation based on the project work. |

**Guide lines for ICA :** The Internal Continuous Assessment shall be based on the active participation of the students in the Project work and knowledge / skill acquired. Assessment of the project-I for award of ICA marks shall be done jointly by the guide and departmental committee as per the guidelines given in **Table-A.**

**Guide lines for ESE:** The End Semester Examination for Project shall consist of demonstration if any, presentation and oral examinations based on the project report**.**

**Assessment of Project-I**

**Name of the Project: _____**

**Name of the Guide: _____**

**Table-A**

| SN | Name of Student | Problem Identification and project objectives | Literature Survey | Project Methodology/ Design/PCB/ hardware/ simulation/ programming | Progress Status | Present ation | Total |
|---|---|---|---|---|---|---|---|
| | | 5 | 5 | 5 | 5 | 5 | 25 |
| | | | | | | | |
| | | | | | | | |

**Seminar-I**

| | |
|---|---|
| 1 | Each Student shall select a topic for seminar which is not covered in curriculum. Seminar topic should not be repeated and registration of the same shall be done on first come first serve basis. |
| 2 | Topic of Seminar shall be registered within a three weeks from commencement of VII Semester and shall be approved by the committee. |
| 3 | The three-member committee appointed by Head of the department shall be constituted for finalizing the topics of Seminar-II. Seminar shall be related state of the art topic of his choice approved by the committee.<br>a. |
| 4 | Each student should deliver a seminar in scheduled period (Specified in time table or time framed by department) and submit the seminar report (paper bound copy/Thermal bound)in following format:<br>*b. Title*<br>*c. Abstract*<br>*d. Introduction*<br>*e. Literature survey*<br>*f. Concept*<br>*g. Functional and Technical Details*<br>*h. Applications*<br>i. Comparison with similar topics / methods<br>*j. Future scope*<br>*k. References* |

**ASSESSMENT OF SEMINAR-II**

**Guide lines for ICA:** ICA shall be based on topic selection , presentation and Seminar-II report submitted by the student in the form of thermal bound. Assessment of the Seminar-II for award of ICA marks shall be done jointly by the guide and a departmental committee, as per the guidelines given in **Table- B**

**Name of Guide: _____**

**Table-B**

| SN | Name of Student | Seminar Topic | Topic Selection | Literature survey | Report writing | Depth of under-standing | Presentation | Total |
|---|---|---|---|---|---|---|---|---|
| | | | **5** | **5** | **5** | **5** | **5** | **25** |
| | | | | | | | | |

**Industrial Visit**

| | |
|---|---|
| 1 | Industry visits for minimum two industries shall be carried out by each student preferably or college shall arrange the industrial visit during the vacation period otherwise during the regular VII semester. |
| 2 | The student should obtain appropriate certificates of visit from the concerned organizations just after the visits. |
| 3 | Every Student should submit Industrial Visit report individually at the end of Semester-VII(First Term of Final Year) |
| 4 | The report(Thermal Bound) should contain information about the following points:<br>*a. The organization - activities of organization and administrative setup technical personnel and their main duties.*<br>*b. The project / industry brief description with sketches and salient technical information.*<br>*c. The work / processes observed with specification of materials, products, equipments etc. and role of engineers in that organization.*<br>*d. Suggestions (if any) for improvement in the working of those organizations.* |
| | The evaluation of the report of technical visits will be made by panel of three teachers appointed by Head of the department based on following points: |

**Guide lines for ICA :** ICA shall be based on knowledge gain by student and Industrial Visit Report submitted by the student in the form of Thermal bound. Assessment of the Industrial Visit for award of ICA marks shall be done jointly by industrial visit coordinators departmental committee based on viva -voce as per the guidelines given in **Table- C**

**Table-C**

| SN | Name of Student | Name of Industry | Report writing | Depth of Under-standing | Total |
|---|---|---|---|---|---|
| | | | **15** | **10** | **25** |
| | | | | | |

# NORTH MAHARASHTRA UNIVERSITY, JALGAON (M.S.)

# Syllabus for

# Final Year Electrical Engineering

# Faculty of Engineering and Technology

# Teachers, Paper Setters and Examiners Guidelines Manual

# SEMESTER –VIII

# W.E.F 2015 – 2016

## Power System Stability

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Concept of Stability** | Lecture required | References |
|---|---|---|---|
| a | Meaning and concept of stability,rotor, voltage and frequency stability. | 01 | 1-6 |
| b | Definition and description steady state transient & dynamic stability limits | 01 | 1-6 |
| c | Park's transformation equations, | 01 | 1-6 |
| d | Analysis of transient and subtransient state operation of salient synchronous machine. | 01 | 1-6 |
| e | Analysis of transient and subtransient state operation of non salient pole machines, | 01 | 1-6 |
| f | Phasor diagrams, voltage behind the transient and subtransient impedances, | 01 | 1-6 |
| g | Determination of parameters of Synchronous machine | 01 | 1-6 |
| h | Determination of parameters of Synchronous machine and time constant | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Steady State Stability** | Lecture required | References |
|---|---|---|---|
| a | Concept of steady state stability limit. | 01 | 1-6 |
| b | Determination SSSL of short transmission lines, | 01 | 1-6 |
| c | Determination SSSL by Analytical methods | 01 | 1-6 |
| d | Determination SSSL by graphical methods( with and without losses) | 02 | 1-6 |
| e | Effect of inertia on steady state stability | 01 | 1-6 |
| f | Conservative criterion for steady state stability | 01 | 1-6 |
| g | Synchronizing co-efficient | 01 | 1-6 |
| h | Multi machine system. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Numerical may be asked on Sr. No. c and d | | | |

**Unit - III**

| Sr.No. | **Unit-III: Factors Affecting Steady State Stability** | Lecture required | References |
|---|---|---|---|
| a | Effect of saturation | 01 | 1-6 |
| b | Saturated reactance | 01 | 1-6 |
| c | Equivalent reactance, | 01 | 1-6 |
| d | Graphical method to find equivalent | 02 | 1-6 |

| | | | |
|---|---|---|---|
| e | Effect of short circuit ration on stability and cost | 01 | 1-6 |
| f | Effect of governor action, | 01 | 1-6 |
| g | Effect of automatic voltage regulator. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Transient State Stability** | Lecture required | References |
|---|---|---|---|
| a | Review of basic concept, TTS | 01 | 1-6 |
| b | Equal area criterion | 01 | 1-6 |
| c | Equal area criterion for different disturbances | 01 | 1-6 |
| d | Assumption made for swing equation , swing equation, | 01 | 1-6 |
| e | Short coming of classical models. | 01 | 1-6 |
| f | Point by point solution of transient stability , | 01 | 1-6 |
| g | Critical cleaning angle and critical clearing time. | 01 | 1-6 |
| h | Problems on equal area criteria. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Numerical from equal area criteria | | | |

**Unit - V**

| Sr.No | **Unit-V : Factors Affecting Transient State Stability** | Lecture required | References |
|---|---|---|---|
| a | Effects of types of fault, | 01 | 1-6 |
| b | Effect of grounding, | 01 | 1-6 |
| c | Effect of high speed reclosing | 01 | 1-6 |
| d | Precalculated swing curves and their use, | 01 | 1-6 |
| e | Effects of fault clearing time, | 01 | 1-6 |
| f | Effects of excitation and governing action, | 01 | 1-6 |
| g | Methods of improving stability, multi-machine problem . | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:**


1. Aderson and Ford, “Power System Operation and Control”, IEEE
2. E .W. Kimbark , “Power Systems Stability”, Vol- I & II , Wiley India Pvt Ltd
3. S. B.Cray , “ Power System Stability” , John Wiley
4. Nagrath & Kothari , “ Modern Power System Analysi”,TMH
5. P. S Bimbhra, “Generalized Electrical Machinery”, Khanna Publishers
6. Peter W. Sauer and M A Pai, “Power System Dynamics and Stability”, Pearson Education.
7. http://nptel.iitm.ac.in

## Switchgear and Protection

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Arc Phenomena and Interruption** | Lecture required | References |
|---|---|---|---|
| a | Basic requirement of Switching and protection , | 01 | 1-7 |
| b | Arc phenomenon, maintenance of arc | 01 | 1-7 |
| c | Properties of arc, interruption theories | 01 | 1-7 |
| d | Transient recovery Voltage, | 01 | 1-7 |
| e | Transient analysis, | 01 | 1-7 |
| f | RRRV, | 01 | 1-7 |
| g | Interruption of capacitive current | 01 | 1-7 |
| h | Interruption of current chopping, | 02 | 1-7 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Circuit Breakers and Fuses** | Lecture required | References |
|---|---|---|---|
| a | Construction & Operation , class , breaking capacity, of CB | 01 | 1-9 |
| b | Construction & Operation Bulk oil circuit breaker. | 01 | 1-9 |
| c | Construction & Operation Minimum oil circuit breaker. | 01 | 1-9 |
| d | Construction & Operation , air blast circuit breaker, SF6 . | 02 | 1-9 |
| e | Construction & Operation SF6 CB | 01 | 1-9 |
| f | Construction & Operation Vacuum Circuit Breaker , | 01 | 1-9 |
| g | Construction & Operation Earth leakage & Miniature circuit breaker | 01 | 1-9 |
| h | Construction & Operation HRC fuses | 01 | 1-9 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - III**

| Sr.No. | **Unit-III: Protective Relay-I** | Lecture required | References |
|---|---|---|---|
| a | Protection system and its attributes: sensitivity, selectivity, speed, reliability and dependability, | 01 | 1-9 |
| b | Trip circuit, organization of protection, zones of protection and maloperation. | 01 | 1-9 |
| c | Construction ,working and characteristic features of | 01 | 1-9 |

| | | | |
|---|---|---|---|
| | electromagnetic relay: Over current, | | |
| d | Instantaneous over-current relay | 02 | 1-9 |
| e | Definite time over-current, inverse time over-current relay | 02 | 1-9 |
| f | Directional over current relay and Differential relay. | 01 | 1-9 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Protective Relay-II** | Lecture required | References |
|---|---|---|---|
| a | Construction ,working and characteristic features of electromagnetic relay: Impedance relay , its trip law using universal torque equation. | 01 | 1-9 |
| b | Reactance relay its trip law using universal torque equation. | 01 | 1-9 |
| c | Mho relay , its trip law using universal torque equation. | 01 | 1-9 |
| d | Static Over current relay: Single and double actuating quantity relay, | 01 | 1-9 |
| e | Basic principle of static over current relay and directional over current relay. | 02 | 1-9 |
| f | Evolution Digital protection: basic component of digital relay, Digital sub units digital relay as unit. | 01 | 1-9 |
| g | Microprocessor based relay, block diagram, relay for motor and advantages. | 01 | 1-9 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - V**

| Sr.No | **Unit-V : Protection Scheme** | Lecture required | References |
|---|---|---|---|
| a | Different type of protective scheme: Over current protection. | 01 | 1-9 |
| b | Differential protection, | 01 | 1-9 |
| c | Earth fault protection , | 01 | 1-9 |
| d | Distance protection and carrier –aided protection. | 01 | 1-9 |
| e | Protective scheme for generator, | 01 | 1-9 |
| f | Protective scheme for transformer and busbar | 02 | 1-9 |
| g | Protective scheme for transmission line and motor. | 01 | 1-9 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books :-**


1. Y G Paithankar and S R Bhide, “Fundamentals of Power System Protection” PHI
2. T.S. Madharao , “ Power System Protection ( Static Relay)”, Tata MacGraw Hill.
3. C.R.Mason , “The Art and Science of Protective Relaying”
4. B.Ram &Vishwakarma D.N , “Power System Protection & Switch Gear”,TMH
5. Sunil S.Rao , “Switchgear & Protection”, Khurana Pun
6. B.Ravindranath & M. Chandar, “Power System Protection & Switch Gear”, New age International.
7. A.G. Phadke & Thorpe, “Power System Protection their Theory & Practice “, Chapman & Hall.
8. E. W Kimbark, “ Power Systems Stability” Vol-II, Wiley India Pvt. Ltd.
9. http://nptel.iitm.ac.in

**Elective-II**

**Computer Aided Power System Analysis**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **Unit-I: Network Topology** | Lecture required | References |
|---|---|---|---|
| a | Concept and need of modeling: Modeling of Power System Components, Basic Concepts, | 01 | 1-6 |
| b | Modeling of Power System Components Single Phase, | 01 | 1-6 |
| c | Three Phase Models, Matrix, | 01 | 1-6 |
| d | Representation of Networks Topology of Electric power system | 01 | 1-6 |
| e | Network Graphs, Incidence matrices, | 01 | 1-6 |
| f | Fundamental loop and cutest matrix, | 01 | 1-6 |
| g | Primitive impedance and admittance matrix, | 01 | 1-6 |
| h | Singular transformation of network matrix. | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **Unit-II: Incidence Matrix** | Lecture required | References |
|---|---|---|---|
| a | Formation of bus impedance and admittance matrices by algorithm | 01 | 1-6 |
| b | Formation of bus impedance and admittance matrices by algorithm | 01 | 1-6 |
| c | Modification of bus impedance and admittance matrix to account for change in networks. | 01 | 1-6 |
| d | Modification of bus impedance and admittance matrix to account for change in networks. | 02 | 1-6 |
| e | Derivation of loop impedance matrix. | 01 | 1-6 |
| f | Algorithm for formulation of 3- phase bus impedance matrix. | 01 | 1-6 |
| g | Problem on above topics | 01 | 1-6 |
| h | Problem on above topics | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - III**

| Sr.No. | **Unit-III: Short Circuit Studies** | Lecture required | References |
|---|---|---|---|
| a | Need of short circuit studies: Short circuit study of three phase network, | 01 | 1-6 |
| b | Symmetrical components. | 01 | 1-6 |
| c | Thevenin's theorem and short circuit analysis of multimode power system using bus impedance matrix. | 02 | 1-6 |
| d | Short circuit calculations for balanced short circuit bus impedance and loop impedance matrices. | 02 | 1-6 |
| e | Short circuit calculations for unbalanced short circuit bus impedance and loop impedance matrices. | 02 | 1-6 |
| f | Problem on above topics | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Load Flow Studies** | Lecture required | References |
|---|---|---|---|
| a | Basic concept of load flow studies and need | 01 | 1-6 |
| b | Slack bus, loop buses, | 01 | 1-6 |
| c | Voltage control buses, Load flow equations, | 01 | 1-6 |
| d | Power flow model using bus admittance matrix, | 01 | 1-6 |
| e | Power flow solution through Gauss-Seidal and N-R methods sensitivity analysis, | 02 | 1-6 |
| f | Second order N-R method, fast decoupled load flow method, | 01 | 1-6 |
| g | Sparsity of matrix. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - V**

| Sr.No | **Unit-V : Fault Analysis** | Lecture required | References |
|---|---|---|---|
| a | Need of fault analysis in power system | 01 | 1-6 |
| b | Simultaneous of faults, | 01 | 1-6 |
| c | Simultaneous Faults by two port network | 01 | 1-6 |
| d | Theory (Z, Y and H-type Faults), | 01 | 1-6 |
| e | Simultaneous faults by matrix Transformations, | 02 | 1-6 |
| f | Analytical simplifications of series and shunt fault. | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:**


1. J. J. Gringer,W.D. Stevenson, “Power System Analysis”, McGraw Hill. 1994
2. G.W.Stagg and Al Ebiad,”Computer Methods in Power System Analysis”, Mc Graw Hill,
3. I.J.Nagrath and D.P.Kothari, “Modern Power System Analysis”, Tata McGraw Hill,1980.
4. G.L.Kusic, “Computer Aided Power System Analysis”, Prentice Hall, 1986.
5. Hadi Sadat, “Power System Analysis”, Tata McGraw Hill.
6. http://nptel.iitm.ac.in

## Elective-II
## Industrial Automation

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **Unit-I: Introduction to Industrial Automation, basics of PLC and Automation strategy.** | Lecture required | References |
|---|---|---|---|
| a | Introduction to Industrial Automation, | 01 | 1-6 |
| b | Role of automation industry, | 01 | 1-6 |
| c | Programmable Logic Controller, | 01 | 1-6 |
| d | Basic operation, PLC architecture and components, | 01 | 1-6 |
| e | Programming language, | 01 | 1-6 |
| f | PLC application and Manufacturers, | 01 | 1-6 |
| g | Introduction to Automation tools like PLC, | 01 | 1-6 |
| h | Introduction to SCADA, DCS, Hybrid DCS etc. | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **Unit-II: Basics PLC Functions and configuration.** | Lecture required | References |
|---|---|---|---|
| a | PLC registers, | 01 | 1-6 |
| b | PLC modules, | 01 | 1-6 |
| c | Addressing System, | 01 | 1-6 |
| d | Field Input/ Output system, | 02 | 1-6 |
| e | PLC timers functions, | 01 | 1-6 |
| f | PLC counters, | 01 | 1-6 |
| g | Industrial process Timing application, | 01 | 1-6 |
| h | Selection of PLC and I/O modules | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - III**

| Sr.No. | **Unit-III: Instructions , Data handling functions.** | Lecture required | References |
|---|---|---|---|
| a | PLC logical instruction, | 01 | 1-6 |
| b | PLC arithmetic instruction, | 01 | 1-6 |
| c | PLC repetitive clock functions, | 02 | 1-6 |
| d | PLC numbering systems, conversion function, | 02 | 1-6 |
| e | PLC master relay control function, Jump , Data Move instructions and other data handling functions, | 02 | 1-6 |
| f | Scaling instructions. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Programming of PLC** | Lecture required | References |
|---|---|---|---|
| a | Introduction Ladder/ FBD language, | 01 | 1-6 |
| b | PLC configuration with I/O designations, | 01 | 1-6 |
| c | Addressing system in programming, | 01 | 1-6 |
| d | Process to develop ladder language in software, | 01 | 1-6 |
| e | Uploading/ Downloading the program to/ from PLC, | 02 | 1-6 |
| f | To develop ladder for ON/OFF controlling of motor, | 01 | 1-6 |
| g | Traffic signal light, etc. | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - V**

| Sr.No | **Unit-V : Fault Analysis Application of PLC/Industrial application and Introduction to SCADA system.** | Lecture required | References |
|---|---|---|---|
| a | Application development and automation for following industries:-<br>Power | 01 | 1-6 |
| b | Pharmaceuticals | 02 | 1-6 |
| c | Automobile | 02 | 1-6 |
| d | Rubber industry etc. | 02 | 1-6 |
| e | Introduction to SCADA system | 01 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:**


1. John Webb & Ronald, "PLC Principles and Application**" ,** Prentice Hall India.
2. S.K.Sigh, "Computer Aided Process Control" ,Prentice Hall India.
3. John Hackworth & Frederick D Hackworth, "PLC: Programming Methods and Applications",Pearson Education.
4. Krushnakant, "Computer Based Process Control" Prentice Hall India.
5. Prof. Rajesh Mehra and Er. Vikram Vij, "PLC and SCADA", Laxmi Publication, Delhi.
6. http://nptel.iitm.ac.in

**Elective-II**

**Advance Microprocessor**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **Unit-I: 8086 Architecture** | Lecture required | References |
|---|---|---|---|
| a | Introduction to 8086 microprocessor, | 01 | 1-5 |
| b | Register Organization, | 01 | 1-5 |
| c | Memory Segmentation. | 01 | 1-5 |
| d | Programming Model. | 01 | 1-5 |
| e | Memory addresses, Physical memory organization. | 01 | 1-5 |
| f | Architecture of 8086, | 01 | 1-5 |
| g | Signal descriptions of 8086- common function signals. | 02 | 1-5 |
| h | Interrupts of 8086. | 01 | 1-5 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **Unit-II: Instruction Set and Assembly Language Programming of 8086** | Lecture required | References |
|---|---|---|---|
| a | Instruction formats, | 01 | 1-5 |
| b | Addressing modes, | 01 | 1-5 |
| c | Instruction set, | 01 | 1-5 |
| d | Assembler directives, macros, | 02 | 1-5 |
| e | Simple programs involving logical, | 01 | 1-5 |
| f | Branch and call instructions, | 01 | 1-5 |
| g | Sorting, evaluating arithmetic expressions, | 01 | 1-5 |
| h | string manipulations. | 01 | 1-5 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - III**

| Sr.No. | **Unit-III: I/O Interface** | Lecture required | References |
|---|---|---|---|
| a | 8255 Programmable Peripheral interface, | 02 | 1-5 |
| b | Various modes of operation of 8255 PPI, | 02 | 1-5 |
| c | Interfacing of 8255 with 8086, | 02 | 1-5 |
| d | Stepper motor interfacing, | 01 | 1-5 |
| e | D/A and A/D converter. | 01 | 1-5 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Interfacing with advanced devices** | Lecture required | References |
|---|---|---|---|
| a | Memory interfacing to 8086, | 01 | 1-5 |
| b | Interrupt structure of 8086, | 01 | 1-5 |
| c | Interrupt vectortable, | 01 | 1-5 |
| d | Interrupt service routine. | 01 | 1-5 |
| e | Introduction to DOS and BIOS interrupts, | 02 | 1-5 |
| f | Interfacing Interrupt Controller | 01 | 1-5 |
| g | 8259 DMA Controller 8257 to 8086. | 01 | 1-5 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - V**

| Sr.No | **Unit-V : Introduction to Pentium microprocessor** | Lecture required | References |
|---|---|---|---|
| a | Historical evolution of 80286,386, 486 processors. | 01 | 6-7 |
| b | Pentium features and Architectures,<br>Pentium Real mode, | 02 | 6-7 |
| c | Pentium RISC features, Pentium super-scalar architecture - Pipelining, | 02 | 6-7 |
| d | Instruction paring rules, Branch prediction, Instruction and Data caches. | 02 | 6-7 |
| e | The Floating point Unitfeatures, pipeline stages & data types. | 01 | 6-7 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:**


1. D.V.Hall, "Microprocessors and Interfacing" Tata McGraw Hill Publication, New Delhi.
2. A. Ray, K. Bhurchandi, "Advanced Microprocessors and Peripherals: Architecture, Programming & Interfacing", Tata McGraw Hill, Third edition, 2004.
3. John E. Uffenbeck, "The 8086/ 8088 Family: Design, Programming and Interfacing", Pearson, 1987.
4. Barry B Bray, "The Intel Microprocessors-Architecture, Programming and Interfacing", Pearson LPE/PHI, Second edition.
5. M.T.Savaliya, "8086 Programming and Advanced Processor Architecture", Wiley India.
6. James Antonakos , "The Pentium Microprocessor" , 2004, Pearson Education ISBN – 81-7808-545-3
7. Intel 8 bit Microcontroller manual.
8. http://nptel.iitm.ac.in

## Elective-II
## Power System Design Practice

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **Unit-I: Transmission Design Fundamentals** | Lecture required | References |
|---|---|---|---|
| a | Selection of voltage for high voltage transmission line, | 01 | 1-3 |
| b | Choice of conductor, spacing of conductor, Insulators, specification of transmission line, | 01 | 1-3 |
| c | Surge impedance loading, Electrical & mechanical design of transmission line. | 01 | 1-3 |
| d | Design of EHV transmission lines | 02 | 1-3 |
| e | Transmission of electric power at extra high voltage, | 01 | 1-3 |
| f | Design consideration of EHV line, | 02 | 1-3 |
| g | insulation coordination, Radio and television interference. | 01 | 1-3 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **Unit-II: Design of Distribution Systems** | Lecture required | References |
|---|---|---|---|
| a | Type of distribution system arrangement, | 02 | 1-3 |
| b | Primary and secondary distribution design, | 02 | 1-3 |
| c | Calculation of distribution sizes: voltage drop and regulation, | 03 | 1-3 |
| d | Deign of rural and industrial distribution system | 02 | 1-3 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus<br>Problem on voltage drop and voltage regulation | | | |

**Unit - III**

| Sr.No. | **Unit-III: Circuit Breakers** | Lecture required | References |
|---|---|---|---|
| a | Circuit breakers: operating mechanism, | 01 | 1-3 |
| b | Testing of Circuit breaker | 02 | 1-3 |
| c | Rating and selection, | 02 | 1-3 |
| d | Operating under special conditions, | 02 | 1-3 |
| e | Specification and technical details for deranged tender preparations. | 02 | 1-3 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Lighting Arrestors** | Lecture required | References |
|---|---|---|---|
| a | Rating characteristics, testing technical defects, | 02 | 1-3 |
| b | Standards followed for details insulation co ordination. | 02 | 1-3 |
| c | Power transformers, different types, | 01 | 1-3 |
| d | Tapping , fittings, cooling, , cost comparison, | 01 | 1-3 |
| e | Testing technical details for ordering and tender preparations. | 02 | 1-3 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - V**

| Sr.No | **Unit-V : Shunt Capacitors** | Lecture required | References |
|---|---|---|---|
| a | Need of shunt capacitor | 02 | 1-3 |
| b | Shunt Capacitor construction, location, | 02 | 1-3 |
| c | Connections, protection, analysis, special types, testing, technical details of shunt capacitor. | 02 | 1-3 |
| d | Earthing: Earthing systems, step potential, touch potential and transfer potential. | 02 | 1-3 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

## Reference Books:


1. Pratapsingh Satnam & P.V. Gupta, "Substation Designed Equipments", Dhanpat Rai & Sons.
2. M. V. Deshpande, "Electrical Power System Design" TMH
3. B.R.Gupta, "Power System Analysis and Design," Wheeler Publishing co.

**Elective-III**

**Flexible AC Transmission System and Power Quality**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: FACTS Concept** | Lecture required | References |
|---|---|---|---|
| a | Introduction to FACTS | 01 | 1-3 |
| b | Transmission interconnection | 01 | 1-3 |
| c | Opportunity for FACTS, | 01 | 1-3 |
| d | Basic type of FACTS controller, | 01 | 1-3 |
| e | Brief description of FACTs controller: | 01 | 1-3 |
| f | Shunt, series controller | 01 | 1-3 |
| g | Combination of shunt and series. | 01 | 1-3 |
| h | Comparison of HVDC and FACTS. | 02 | 1-3 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Static Shunt Compensators: SVC and STATCOM** | Lecture required | References |
|---|---|---|---|
| a | Object of shunt compensation, | 01 | 1-3 |
| b | Midpoint voltage regulation for line segmentation | 01 | 1-3 |
| c | Midpoint voltage regulation for line segmentation | 01 | 1-3 |
| d | End of line voltage support. | 02 | 1-3 |
| e | Method of controllable VAR generation: | 01 | 1-3 |
| f | Variable impedance type and switching type VAR generators, | 01 | 1-3 |
| g | Variable impedance type and switching type VAR generators, | 01 | 1-3 |
| h | STATCOM. | 01 | 1-3 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - III**

| Sr.No. | **Unit-III: Static Series Compensators** | Lecture required | References |
|---|---|---|---|
| a | Objectives of Series Compensation: | 01 | 1-3 |
| b | Concept of series capacitive compensation, | 01 | 1-3 |
| c | Voltage stability. | 01 | 1-3 |
| d | Variable impedance type series compensators: | 01 | 1-3 |
| e | Thyristor switched series capacitor(TSSC) | 02 | 1-3 |
| f | Thyristor controlled series capacitor (TCSC). | 02 | 1-3 |

| |
|---|
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus |

**Unit – IV**

| Sr.No. | **Unit-IV: Power Quality** | Lecture required | References |
|---|---|---|---|
| a | Power quality definition, | 01 | 1-3 |
| b | Need for power quality, nonlinear loads, | 01 | 1-3 |
| c | Type of power quality problems: | 01 | 1-3 |
| d | voltage sags, voltage swells, under-voltage, interruption, | 01 | 1-3 |
| e | Transients, voltage unbalance, voltage fluctuation , | 01 | 1-3 |
| f | Harmonics and electrical noise. | 01 | 1-3 |
| g | Sources of power quality problems. | 01 | 1-3 |
| h | Sources of power quality problems. | 01 | 1-3 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - V**

| Sr.No | **Unit-V : Power Quality effects and Solutions** | Lecture required | References |
|---|---|---|---|
| a | Effect of harmonics in pure resistive, | 01 | 1-3 |
| b | Effect of harmonics in inductive | 01 | 1-3 |
| c | Effect of harmonics in capacitive circuit, | 01 | 1-3 |
| d | Effect of harmonic on induction motor , | 01 | 1-3 |
| e | Effect of harmonic on transformer | 01 | 1-3 |
| f | Effect of harmonic on power factor correction and lighting installation. | 01 | 1-3 |
| g | Power quality standard | 01 | 1-3 |
| h | Mitigation by active and passive filter | 01 | 1-4 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**References,**


1. N.G.Hingorani, "Understandig FACTS" , IEEE Press, 1999
2. Yang hue Song, "Flexible AC Transmission Systems (FACTS)", IEEE Press, 199
3. Surajit Chattopadhyay , Madhuchhanda Mitra and Samarjit Sengupta, "Electric Power Quality", Springer
4. http://nptel.iitm.ac.in

**Elective-III**

**Generation Planning and Load Dispatch**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Generation** | Lecture required | References |
|---|---|---|---|
| a | Growth of electrical energy consumption, electrical energy sources, organization of power sector, | 01 | 1-3 |
| b | Role of private sector in energy management, | 01 | 1-3 |
| c | Indian electricity grid code. Environmental issue in electric power generation. | 01 | 1-3 |
| d | Cogeneration: Scope, advantages, | 01 | 1-3 |
| e | Cogeneration technology and industries suitable for cogeneration. | 01 | 1-3 |
| f | Captive power generation: advantages, constrain, government policies, energy banking and energy wheeling. | 01 | 1-3 |
| g | Distributed power generation: advantages and function | 01 | 1-3 |
| h | Electricity deregulation : need advantages, power player ,metering and energy billing deregulation. Roll of load dispatch centers. | 02 | 1-3 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Generation Planning** | Lecture required | References |
|---|---|---|---|
| a | Objectives of generation system planning, long term and short term planning, | 01 | 1-3 |
| b | Low range& short range hydro thermal scheduling of generation the short term | 02 | 1-3 |
| c | Long term hydro thermal scheduling of generation, co ordination equation. | 02 | 1-3 |
| d | Policy studies, co-ordination of steam, hydro & nuclear power stations. | 02 | 1-3 |
| e | Optimum generation allocation- | 01 | 1-3 |
| f | Line losses neglected & including the effect of transmission losses for thermal power generations. | 01 | 1-3 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - III**

| Sr.No. | **Unit-III: Load Energy Forecasting** | Lecture required | References |
|---|---|---|---|
| a | Classification of loads, | 01 | 1-3 |
| b | Load forecasting methodology. | 01 | 1-3 |
| c | Peak demand forecasting- | 01 | 1-3 |
| d | Non whether sensitive forecast- | 01 | 1-3 |
| e | Weather sensitive forecast-total forecast- | 02 | 1-3 |
| f | Annual and monthly peak demand forecast. | 02 | 1-3 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Generation System Cost Analysis** | Lecture required | References |
|---|---|---|---|
| a | Capacity cost, generation cost, | 01 | 1-3 |
| b | Depreciation, effect of load factor on unit energy cost, | 02 | 1-3 |
| c | Analysis of fixed and operating cost of steam plant, | 01 | 1-3 |
| d | Hydro plants and nuclear plant, | 01 | 1-3 |
| e | Roll of diversity in power system economics, | 01 | 1-3 |
| f | Fuel inventories, | 01 | 1-3 |
| g | off peak energy utilization. | 01 | 1-3 |
| Guidelines for the examiners and paper setters:<br>Questions should not be asked on introductory part of syllabus | | | |

**Unit - V**

| Sr.No | **Unit-V : Generation System Reliability Analysis** | Lecture required | References |
|---|---|---|---|
| a | Probabilistic generation unit | 02 | 1-3 |
| b | Model &load model effective load | 02 | 1-3 |
| c | Reliability analysis for isolated system | 02 | 1-3 |
| d | system reliability of interconnected system. | 02 | 1-3 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:**


1. B.R. Gupta, " Generation of Electric Energy" Euresia Publishing House Pvt. Ltd.
2. R.L.Sullivan, "Power System Planning" , McGraw Hill.
3. Kirchmayers L.K., " Economic Control of Interconnected System" John Wiley & Sons, New York.
4. http://nptel.iitm.ac.in

**Elective-III**

**High Voltage Transmission**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: EHV AC Transmission** | Lecture required | References |
|---|---|---|---|
| a | Role of EHV AC Transmission, Standard of transmission voltage, | 01 | 1-3,5 |
| b | Average line parameter. | 01 | 1-5,5 |
| c | Power transmission, power-handling capacity and line loss, | 01 | 1-3,5 |
| d | Corona effect: power loss and audible noise, copper loss and corona loss, | 02 | 1-5,5 |
| e | Corona loss formula, audible noise generation and characteristic. | 01 | 1-3,5 |
| f | Electrostatic field of EHV lines. Traveling waves and standing waves, | 02 | 1-5,5 |
| g | Line energization with trapped-charge voltage | 01 | 1-3,5 |
| Guidelines for the examiners and paper setters:<br>Question should not be asked from introductory part of syllabus. | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Maximum Power Transfer and Stability Limit** | Lecture required | References |
|---|---|---|---|
| a | Power Transfer at voltage stability limit of EHV lines, | 01 | 1-3,5 |
| b | Magnitude of receiving end voltage, | 01 | 1-5,5 |
| c | Voltage Magnitude of receiving end voltage during maximum power transfer. | 01 | 1-3,5 |
| d | Magnitude of Maximum power and stability limit. | 02 | 1-5,5 |
| e | Optimal reactive power at voltage stability limit | 01 | 1-3,5 |
| f | Magnitude of Maximum power and stability limit. Optimal reactive power at voltage stability limit | 01 | 1-5,5 |
| g | Voltage collapse in EHV lines, reactive power requirement for voltage in long line. | 01 | 1-3,5 |
| h | Voltage stability | 01 | 1-3,5 |
| Guidelines for the examiner and paper setter.<br>Question should not be asked from introductory part of syllabus. | | | |

**Unit - III**

| Sr.No. | **Unit-III: Over-voltages in EHV System** | Lecture required | References |
|---|---|---|---|
| a | Origin of over voltage and their types | 01 | 1-3,5 |
| b | Over Voltage in EHV system caused by switching | 01 | 1-5,5 |

| | | | |
|---|---|---|---|
| | operation: | | |
| c | Interruption of inductive | 01 | 1-3,5 |
| d | Interruption capacitive currents, Ferro-response over voltage, | 02 | 1-5,5 |
| e | Calculation surges, Power frequency voltage control and over voltages, Power circle diagram. | 02 | 1-3,5 |
| f | Surge impedance and insulation coordination. | 01 | 1-5,5 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus. | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: HVDC Transmission** | Lecture required | References |
|---|---|---|---|
| a | Comparison of EHV and HVDC transmission system based on: Economics of power transmission | 01 | 4,5 |
| b | Comparison of EHV and HVDC transmission system based on: technical performance and reliability. | 01 | 4,5 |
| c | Description of HVDC transmission system : | 01 | 4,5 |
| d | Type of link, converting stations. | 01 | 4,5 |
| e | Principle of DC link converter, | 02 | 4,5 |
| f | characteristic, modification and control characteristic | 02 | 4,5 |
| Guidelines for the examiners and paper setters:<br>Question should not be asked from introductory part of syllabus. | | | |

**Unit - V**

| Sr.No | **Unit-V : Reactive power control and stability** | Lecture required | References |
|---|---|---|---|
| a | Reactive power requirement in steady state, | 02 | 4,5 |
| b | Conventional control strategies | 01 | 4,5 |
| c | Alternate control and forced commutation | 02 | 4,5 |
| d | Sources of reactive power, | 01 | 4,5 |
| e | Stability: synchronous and asynchronous link. | 02 | 4,5 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**References Book:**


1. A.Chakrabarti, D.P.Kothari, A.K. Mukhopdadhyay, "Performance, Operational & Control of EHV Power System", Wheeler publications.
2. Rakosh Das Begamudre "Extra high-voltage A.C. Transmission Engineering" New Age International.
3. S. Rao, "EHVAC & HVDC Transmission Engineering & Practice" , Khanna Publications.
4. K R padiyar, "HVDC Power Transmission System" New Age International Publication.
5. http://nptel.iitm.ac.in

**Elective-III**

**Electromechanical Energy Conversion**

Teachers, Paper setters and Examiners should follow the guidelines as given below.

**Unit-I**

| Sr. No | **UNIT-I: Magnetically Coupled Circuits And Transformer:** | Lecture required | References |
|---|---|---|---|
| a | Self and mutual flux linkages and inductances. | 01 | 1-6 |
| b | Voltage Equation of coupled circuits. | 01 | 1-6 |
| c | Coefficients of coupling and leakage coefficient. | 01 | 1-6 |
| d | Two winding transformers: | 02 | 1-6 |
| e | Steady state and transient analysis using mutual and self inductances. | 01 | 1-6 |
| f | Variable frequency transformers. | 02 | 1-6 |
| g | Energy flow considerations. | 01 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Question should not be asked from introductory part of syllabus. | | | |

**Unit-II**

| Sr.No. | **UNIT-II: Electrochemical Energy Conversion Principles**: | Lecture required | References |
|---|---|---|---|
| a | Electrochemical System, | 01 | 1-6 |
| b | Energy process in electromagnetic systems. | 01 | 1-6 |
| c | Law of conversation of energy as applied to electromechanical system. | 01 | 1-6 |
| d | Linear and non-linear, singly and doubly excited magnetic systems; | 02 | 1-6 |
| e | Energy and co-energy, various expressions for forces and torques; | 01 | 1-6 |
| f | Energy, forces and torque in a system of rigid currents. | 01 | 1-6 |
| g | Application to various magnetic field transducers. | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Question should not be asked from introductory part of syllabus. | | | |

**Unit - III**

| Sr.No. | **Unit-III: Electric Field And Transducers** | Lecture required | References |
|---|---|---|---|
| a | Quasi-static electric fields as coupling medium, | 02 | 1-6 |
| b | Energy forces and torques in a system of charged conductors, | 02 | 1-6 |
| c | Application of electric field transducers. | 02 | 1-6 |
| d | Incremental motion transducers (detailed analysis of | 02 | 1-6 |

| | | | |
|---|---|---|---|
| | few cases). | | |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus. | | | |

**Unit – IV**

| Sr.No. | **Unit-IV: Basic Rotating Machines** | Lecture required | References |
|---|---|---|---|
| a | Common structural features of rotating machines. | 02 | 1-6 |
| b | Machine windings and their basic properties. | 02 | 1-6 |
| c | Distributed bindings as current sheets. | 02 | 1-6 |
| d | Equivalence between concentrated and distributed windings M.M.F. and flux distributation and various windings. Rotating magnetic field. | 02 | 1-6 |
| Guidelines for the examiners and paper setters:<br>Question should not be asked from introductory part of syllabus. | | | |

**Unit - V**

| Sr.No | **Unit-V : Types Of Rotating Machines** | Lecture required | References |
|---|---|---|---|
| a | Commutator machines | 02 | 1-6 |
| b | Synchronous machines | 02 | 1-6 |
| c | Asynchronous machines | 02 | 1-6 |
| d | Induced e.m.f.s and electromagnetic torque in non salient pole machines**.** | 02 | 1-6 |
| Guidelines for the examiner and paper setter.<br>Questions should not be asked on introductory part of syllabus | | | |

**Reference Books:**


1. Rakosh Das, Begamudre, “Electromachinical Energy Conversion” Wiley Eastern Publication.
2. Gourishankar, “Electromechnical Energy Conversion”.
3. Fitzgerald, Kingsley & Kusko, “Eletric Machinary” McGraw Hill Kogo Kusha Ltd.
4. Dr. P S Bimbhra, “Electrical Machinary”, Khanna Publication.
5. Dr. P S Bimbhra, “Generalized Electrical Machinary”, Khanna Publication.
6. R K Srivastava, “ Electrical Machines” Second Eddition, Cengage Learning.

**Power System Stability**
**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | Determination of Parameters and time constants of synchronous machines | 02 |
| 2 | Synchronous machine of infinite bus: Effect of Excitation | 02 |
| 3 | Effect of saturation and & determination of equivalent reactance's of synchronous machines. | 02 |
| 4 | Retardation test on synchronous machines to find moment of inertia of rotating part and angular momentum. | 02 |
| 5 | To obtain power angle characteristics of lossy & lossless lines. | 02 |
| 6 | To study transient stability by point by point method. | 02 |
| 7 | To determine the steady state stability limit of short transmission line. | 02 |
| 8 | To determine SSSL of long transmission line. | 02 |
| 9 | Study of clerk's diagram. | 02 |
| 10 | Study of different types of automatic voltage regulator. | 02 |

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student may be asked questions on practical. Evaluation will be based on answer given by student in the oral examination.

**Switchgear and Protection**
**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | To conduct and study of Arc extinction phenomenon : Application in air circuit breaker. | 02 |
| 2 | Study of relaying components and control circuit developments. | 02 |
| 3 | To conduct and plot the characteristic of rewirable fuses and MCB | 02 |
| 4 | To conduct plot operating characteristics of Inverse time over current relay. | 02 |
| 5 | To conduct Over current & earth fault protection scheme of alternator. | 02 |
| 6 | To conduct Protection of 3 phase transformer using differential relay (Merz- Price protection scheme) | 02 |
| 7 | To conduct and study the through fault stability of differential protection scheme for transformer. | 02 |
| 8 | To conduct Protection of transmission line. | 02 |
| 9 | Study of MHO distance relay to plot. a) R- X diagram b) Relay voltage Vs Admittance characteristic. | 02 |
| 10 | Study of Static relay | 02 |
| 11 | Demonstration of microprocessor base protection. | |

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student may be asked to perform any one practical. Evaluation will be based on paper work , practical performance and oral in the practical examination.

**Elective -II**

**Computer Aided Power System Analysis Lab**

**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | Program for determination of the parameters of the equivalent circuit. | 02 |
| 2 | Program for building of $Z_{Bus}$ by addition of branch. | 02 |
| 3 | Program for building of $Z_{Bus}$ by addition of link. | 02 |
| 4 | Program for illustration of the Ferranti Effect. | 02 |
| 5 | Program for the formation of $Y_{Bus}$ by Singular Transformation. | 02 |
| 6 | Program for load flow by Newton Raphson Method. | 02 |
| 7 | Program for Balanced Three phase short circuit. | 02 |
| 8 | Program for Unbalanced short circuits. | 02 |
| 9 | Program for Fault analysis of Power System network of an Electric Utility Company. | 02 |
| 10 | Study of IEC and ANSI standards for Short circuit analysis. | 02 |
| 11 | Introduction to PSCAD | 02 |
| 12 | Introduction to ETAP | 02 |

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student may be asked questions on practical. Evaluation will be based on answers given by students in oral examination.

**Elective -II**
**Industrial Automation**
**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | Study of programmable logic controller. | 02 |
| 2 | Study of programming languages. | 02 |
| 3 | Develop and implement any PLC program using ladder/FBD programming language. | 02 |
| 4 | Interfacing of PLC to any SCADA through modbus protocol. | 02 |
| 5 | Developing and implementing any control loop using PLC system. | 02 |
| 6 | Study of SCADA system. | 02 |
| 7 | Study of DCS system. | 02 |
| 8 | Study of interfacing devices/ protocols like modbus, Profibus etc. | 02 |
| 9 | To controller conveyer belt system from online programming system. | 02 |
| 10 | To develop total controlling panel for settlement of conveyor based automation system. | 02 |

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student may be asked questions on practical. Evaluation will be based on answers given by students in oral examination.

**Elective -II**
**Advance Microprocessor**
**(Lab Course Contents)**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | Study of architecture and instructions set of 8086 microprocessor. | 02 |
| 2 | Study of architecture of Pentium microprocessor. | 02 |
| 3 | Microprocessor 8086 assembly language programs based on data transfer instruction | 02 |
| 4 | Microprocessor 8086 assembly language programs based on arithmetic instruction | 02 |
| 5 | Microprocessor 8086 assembly language programs based on logical instruction | 02 |
| 6 | Applications of microprocessor 8086 in measurement of electrical quantity. | 02 |
| 7 | Applications of microprocessor 8086 in Electrical drives and speed control for stepper motor. | 02 |
| 8 | Program to convert the temperature in degree centigrade to ferniest by 8086 microprocessor. | 02 |
| 9 | Program to find highest and lowest marks in the examination by 8086 microprocessor | 02 |
| 10 | Program to sort the numbers in ascending order and descending order by 8086 microprocessor. | 02 |
| 11 | Program to find the number of negative numbers in the array by 8086 microprocessor. | |
| 12 | Program for conversion of BCD to Hex and Hex to BCD | |

**Note:** Lab file should consist of minimum **Eight** experiments.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal.

**Guide lines for ESE:-**

In ESE the student may be asked questions on practical. Evaluation will be based on answers given by students in oral examination.

**Elective -II**

**Power System Design Practice**

Teacher should facilitate learning following lab experiments:

| S.N. | Lab Experiment | Hours required |
|---|---|---|
| 1 | Draw the substation layout for 400KV.and design the three phase transmission line with electrical consideration. | 04 |
| 2 | Sag-Tension calculation | 04 |
| 3 | Different busbar arrangement and isolating switches. | 04 |
| 4 | Different types of circuit breaker. | 04 |
| 5 | Different types of Lightning Arresters | 04 |
| 6 | Design of Earthling system for 132/400KV substation. | 04 |

**Note:** Lab file should consist of minimum **five** drawing sheet along with report.

**Guide lines for ICA :**

ICA shall be based on continuous evaluation of student performance throughout semester and practical assignment submitted by the student in the form of journal and drawing sheet.

**Guide lines for ESE:-**

In ESE the student may be asked questions on drawing sheet. Evaluation will be based on answers given by students in oral examination.

**Industrial Lecture**
**(Course Contents)**

| | |
|---|---|
| **1** | There is a need to create avenues for a close academia and industry interaction through all the phases of technology development, starting from conceptualization down to commercialization. |
| **2** | List of renowned persons from industry shall be prepared by the committee appointed by Head of the department. After approval from the Principal, Minimum five Industrial lectures in alternate week shall be arranged, which shall be delivered by the experts/Officials from Industries/Govt. organizations/ Private Sectors/Public Sectors / R&D Labs covering the various aspects. |
| **3** | Topics of Industrial Lectures shall be Technical in nature and should not be the specific contents from the curriculum. |
| **4** | Minimum **five** Lectures to be delivered by experts from the industry in alternate weeks. |
| **5** | Students shall submit the report based on minimum five lectures giving summary of the lecture delivered. |
| **6** | The summary should contain brief resume of the expert, brief information of his organization and brief summary of the lecture in bullet point form. |

**Guide lines for ICA :** Assessment of the Industrial Lecture for award of ICA marks shall be done jointly by departmental committee as per attendance in industrial lecture, report submitted by student and overall performance in semester as per the guidelines given in **Table- D**

**Table-D**

| SN | Name of Student | Attendance (05 Marks per Lecture) | Dept of Understanding (03 Marks per Lecture) | Report Writing | Total |
|---|---|---|---|---|---|
| | | **25** | **15** | **10** | **50** |
| | | | | | |

**Project-II**

**(Lab Course Contents)**

| | |
|---|---|
| **1** | Project-I work decided in VII semester shall be continued as Project-II |
| **2** | Students should complete implementation of ideas given in synopsis/Abstract, so that project work should be completed before end of semester. |
| **3** | Project-II may involve fabrication, design , experimentation , data analysis within realistic constraints such as economic, environmental, social, ethical, health and safety, manufacturability, and sustainability. The stage also includes testing , possible results and report writing |
| **4** | Each students project group is required to maintain log book for documenting various activities of Project-II and submit group project report at the end of Semester-VIII in the form of Hard bound.<br>*a. Title*<br>*b. Abstract*<br>*c. Introduction*<br>*d. Problem identification and project objectives*<br>*e. Literature survey*<br>*f. Case study/Analysis/Design Methodology*<br>*g. Project design and implementation details*<br>*h. Result and conclusion*<br>*i. Future scope*<br>*j. references.* |

**Guide lines for ICA :** ICA shall be based on continuous evaluation of students performance throughout semester in project-II and report submitted by the students project group in the form Hard bound. Assessment of the project-II for award of ICA marks shall be done jointly by the guide and departmental committee as per the guidelines given in **Table-D.**

**Guide lines for ESE:-**

In ESE the student may be asked for demonstration and questions on Project. Evaluation will be based on answers given by students in oral examination.

**Assessment of Project-II**

**Name of the Project: _____**

**Name of the Guide: _____**

**Table-D**

| | | **Assessment by Guide (50 Marks)** | | | | **Assessment by Committee (25 Marks )** | | |
|---|---|---|---|---|---|---|---|---|
| **SN** | **Name of Student** | **Attendance , Participation and team work** | **Material procurement/ assembling/Designing/Programming** | **Case study/ Execution** | **Project Report** | **Dept of Understan-ding** | **Presentation** | **Total** |
| **Marks** | | **10** | **15** | **15** | **10** | **10** | **15** | **75** |
| | | | | | | | | |