**Bhavnagar University**
**B. E. Semester VII (Electrical)**
**E- 701 Power System Practice & Design**

| Teaching Scheme | | | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | | Practical marks | T/W marks | TOTAL |
| | | | Hrs. | Max Marks | | | |
| 4 | 2 | 0 | 3 | 100 | 50 | 25 | 175 |

**1. Transmission Line Design for any given rating**

Electrical design of transmission line

Design philosophy, voltage level selection and choice of conductors, spacing of conductor and corona, insulators and SIL, design problem

Mechanical design of transmission line

Considerations, loading on conductors, span, sag and tension clearance, stringing, problems

Transmission line tower design

Location of tower, earth wires, reduction of tower footing resistance, design of tower, examples

EHV transmission line design

Considerations, selection, spacing of conductors, corona and radio interference, shunt and series compensation, tuned power lines, insulation coordination and different types of EHV towers, EHV systems in India

**2. HVDC Transmission**

Merits and demerits of HVDC transmission, one line diagram, types of DC link, necessary equipments, operation and control, applications, recent advances, HVDC in India

**3. AC and DC Low Tension Distribution Design**

Types of distribution systems arrangements, selection and size of feeders using Kelvin's law, design of cables in distribution systems considering ampere capacity, voltage drop during starting and running load, primary distribution design, secondary distribution design, HV distribution design concept, load balancing

Distribution substation

Calculation of distributor size and its examples, calculation of voltage drops and size of distributor in ring system

Voltage regulation and lamp flicker

**4. Design of Power System**

Introduction, selection of sizes and location of generating stations, selection and specifications of transmission lines, sizes and locations of sub stations, interconnections

**5. Power System Improvement, Substation Design (Cathodic Protection Including GIS)**

Introduction, methods of power system improvement, power system improvement scheme, determination of voltage regulation and losses in power system, shifting of distribution transformer centre, financial aspects of the power system improvement scheme

**6. Power System Earthing – Power Station and Sub Station Earthing**

Objectives, definitions, tolerable limits of body currents, soil resistivity, measurement of soil resistivity, earth resistance, measurement of earth resistance, tolerable step and touch voltage, actual step and touch voltage, design of earthing grid, impulse behavior of earthing system

**7. Insulation Coordination and Location Of Lightning Arrestor**

Introduction, definitions, insultion-co-ordination curves, determination of line insulation, Basic Insulation level(BIL), Insulation levels of substation equipments, Lightning arrestor selection and location,Selection of arrestor voltage rating, arrestor discharge voltage and arrestor discharge current, protective margin.

**Note : T.W. will be based on the above syllabus.**

**BOOKS:**

Electrical Power System Design – M. V. Deshpande
Electrical Power System Design – B. R. Gupta
Electrical Power System Planning – A. S. Pabla
Substation Design – Satnam & Gupta
A course in Electrical Power- Soni,,Gupta and Bhatnagar.

**B. E. Semester VII (Electrical)**
**E- 702 Electrical Machines III**

| Teaching Scheme | | | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | | Practical marks | T/W marks | TOTAL |
| | | | Hrs. | Max Marks | | | |
| 4 | 2 | 0 | 3 | 100 | 50 | 25 | 175 |

1. **Alternator :** Types of alternators -construction - EMF equation of polyphase winding-effect of harmonics on EMF-Armature reaction in cylindrical and salient pole machine- two reaction theory-equivalent circuit of cylindrical & salient pole machines, voltage equation input/output equations-condition for maximum power-synchronizing of alternators and division of load-operation of alternators on infinite bus-electrical load diagram -synchronizing power and torque-regulation of alternator by synchronizing impedence,mmf, simple AT, ZPF & AIEE method. - Sudden short circuit of alternator.
2. **Synchronous motor :**
   Principles of reversibility - voltage equation - phasor diagram - electrical and mechanical power equ. - 'V' curves and 'O' curve - circle diagram - starting - synchronous condensor.
3. **Auto synchronous motor :**
   Construction - principle of operation - different connection scheme for excitation and its equivalent a.c. current - performance by circle diagram.
4. **Induction machines :**
   Unbalance operation of induction motor - induction regulators (single and three phase)
5. **Special machine :**
   Amplidyne, metadyne, balancers, boosters, welding machines.
6. **Testing of d.c. machines :**
   Losses in d.c. machines - efficiency - different method of testing – regererativ testing of series and shunt machines separation of losses by different methods.

**Term work :**
Laboratory practicals will be carried out on above syllabus.

**Reference books :**

(1) Performance & Design of d.c. machine - Clayton
(2) Performance & design of a.c. machine - M.G. Say
(3) A.C. machines - Garik
(4) A.C. machines – Kostenko

**B. E. Semester VII (Electrical)**

**E-703 Industrial Instrumentation**

| Teaching Scheme | | | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | | Practical marks | T/W marks | TOTAL |
| | | | Hrs. | Max Marks | | | |
| 3 | 2 | 0 | 3 | 100 | 50 | 25 | 175 |

1 **Transducers:**
Introduction to instrumentation system, static and dynamic characteristics of an instrumentation system, Principles and classification of transducers, Electrical transducers, basic requirements of transducers

2 **Strain Gauge and Strain Measurement:**
Factors affecting strain measurements, Types of strain gauges, theory of operation of resistive strain gauge, gauge factor, types of electrical strain gauges, strain gauge materials, gauging techniques and other factors, strain gauge circuits and temperature compensation, applications of strain gauges.

3 **Displacement Measurement:**
Resistive potentiometer (Linear, circular and helical), L.V.D.T., R.V.D.T. and their characteristics, variable inductance and capacitance transducers, Piezo electrical transducers-output equations and equivalent circuit, Hall effect devices and Proximity sensors, Large displacement measurement using synchros and resolvers, Shaft encoders.

4 **Forces and Torque Measurement:**
Load cells and their applications, various methods for torque measurement. Use of torque wrenches

5 **Pressure Measurement:**
Mechanical devices like Diaphragm, Bellows, and Bourdon tube for pressure measurement, Variable inductance and capacitance transducers, Piezo electric transducers, L.V.D.T. for measurement of pressure, Low pressure and vacuum pressure measurement using Pirani gauge, McLeod gauge, Ionization gauge, Pressure gauge calibration.

6 **Flow Measurement:**
Differential pressure meter like Orifice plate, Venturi tube, flow nozzle, Pitot tube, Rotameter, Turbine flow meter, Electro magnetic flow meter, hot wire anemometer, Ultrasonic flow meter.

7 **Level Measurement:**
Resistive, inductive and capacitive techniques for level measurement, Ultrasonic and radiation methods, Air purge system (Bubbler method).

8 **Temperature Measurement:**
Resistance type temperature sensors – RTD & Thermister, Thermocouples & Thermopiles, Different types of Pyrometers. Humidity measurement and Moisture measurement techniques.

9 **Recorders:**
X - Y, strip chart and circular type graphic recorders - indicating, recording and controlling instruments, multichannel recorders. Introduction to digital recorder.

10 **Digital Data Acquisition systems & control :-**
Use of signal conditioners, scanners, signal converters, recorders, display devices, A/D & D/A circuits in digital data acquisition. Instrumentation systems. Types of Instrumentation systems. Components of an analog Instrumentation Data – Acquisition system. Multiplexing systems. Uses of Data Acquisition systems. Use of Recorders in Digital systems. Digital Recording systems. Modern Digital Data Acquisition system. Analog Multiplexed operation, operation of sample Hold circuits.

**Term work and Practicals shall be based on the above syllabus.**

**BOOKS:-**


1. Industrial Instrumentation & Control by S. K. Singh.
2. Electrical and Electronics Measurement and Instrumentation, A. K. Shawney
3. Transducers and Instrumentation , Patranabis
4. Mechanical & Industrial Measurements by R. K. Jain
5. Industrial Instrumentation by Rangan, Sharma, Mani
6. Transducers and Instrumentation , Murthy

**B. E. Semester VII (Electrical)**

**E- 704: Microprocessor Interfacing & Applications**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | | Practical marks | T/W marks | TOTAL | |
| | | | Hrs. | Max Marks | 50 | 25 | 175 | |
| 3 | 2 | 0 | 3 | 100 | | | | |

1. **Subroutine and stack operations:** Concept of stack, stack pointer (SP), and stack related instructions, PUSH – POP. Subroutines & it's related instructions CALL - RET instructions of Intel 8086 Microprocessor.
2. **Interrupts:** Interrupt & Interrupt service routines, IRET instruction, Interrupt sequence, Layout of interrupt pointers, Hardware & Software Interrupts, Multiple interrupts, device polling, vectored interrupts, and Interrupt controller 8259
3. **Design of delay routines** and their uses in designing counters, Reading input signals In Real time applications, Developing Projects etc., Programmable Timer/Counter 8253.
4. **Peripheral Controllers for 8086/8088 family:** Memory interfacing and mapping, the 8255 Programmable Peripheral Interface (PPI), the 8251A Universal Synchronous/Asynchronous Receiver/Transmitter (USART), The 8237/8257 DMA Controllers, Interfacing of simple LEDs, 7 segment display LEDs, keys. Key debounce techniques /Keyboard / display interfacing using 8279.
5. **Interfacing Data converters** to A converter: R - 2 R ladder network type DAC, DAC interfacing e.g. DAC 0800, Generation of waveforms using DAC. Realization of A to D converter using D to A converter. DAC and ADC specifications.
   A to D converter : Different types of A to D converter, sample and hold circuit, analog multiplexer, Interfacing of ADC 0800, multiplexer AM3705, S/H LF 398, ADC 0808/ADC 0809, ADC 0816, ADC 1210/ADC 1211 and similar.
6. **Data Communication Standards:** RS 232 Serial Interface Standard, The IEEE 488-1978 General Purpose Interface Bus Standards, Error detection & Correction.
7. **Applications: M**icroprocessor based systems for measurement of electrical quantities, protective relays; firing control of SCR, triac etc, process control systems as temperature, flow etc.

**Term work Practicals shall be based on the above syllabus.**

**BOOKS:-**


1. The 8088 & 8086 Microprocessors, Programming, Interfacing, Software, Hardware and Applications By Walter A. Tribel & Avatar Singh PHI Publication
2. Microprocessor & Interfacing- Programming & Hardware- Douglas hall, TMH Publication
3. Fundamental of microprocessors and microcomputers by - B.Ram. Dhanpat Rai & Sons.
4. Microprocessor Architecture Programming and Application with 8085
   R. S. Gaonkar, Penram Publication
5. Digital Computer Electronics Malvino

**B E Semester VII (Electrical)**

**E- 705 A (Elective Paper – 1) Advanced Power System**

| Teaching Scheme | | | Examination Scheme | | | | |
|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | | Practical marks | T/W marks | TOTAL |
| | | | Hrs. | Max Marks | | | |
| 4 | 2 | 0 | 3 | 100 | 50 | 25 | 175 |

**1. Theory of Steady State Reactive Power Control in Electric Transmission Systems / Load Compensation**

Introduction – historical back ground, Fundamental requirement in A.C. Power Transmission, Engineering factors affecting stability and Voltage Control – Uncompensated and Compensated Lines – Types of Compensation Passive / Active Compensation – Examples based on above

**2.** Objectives of Load Compensation, Power Factor Correction and Voltage Regulation, Load Compensation in terms of Symmetrical Components

**3. Introduction to FACTS and HVDC Technology**

FACTS concept, transmission interconnections, flow of power in A.C. systems – loading capability – power flow and dynamic stability – relative importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS technology

HVDC transmission – comparison between AC – DC transmission – modeling of HVDC system – AC DC load flow – harmonics and other problems

**4. Overview of Power Quality and Power Quality Standards, Power Quality, Voltage Quality, Overview of Power Quality Phenomenon, Power Quality And EMC Standards**

Long Interruptions – Introduction to Interruptions – Causes of Long Interruptions – Observation of System Performance, Standard and Regulations, Short Interruptions – Introductions – Terminology – Origin Of Short Interruptions, Monitoring, Voltage Sags – Harmonics – Introduction – Harmonic Sources – Effects Of Harmonics On Electrical Equipments – resonance – shunt capacitors – filter systems

**5. Power System Dynamics**

Dynamics of synchronous generators – analysis of single machine system – power system stabilizer

**6. Voltage Stability**

Introductions – definitions – reactive power transmission – comparison of rotor angle stability and voltage stability – surge impedance loading – voltage stability limit and analysis – graphical methods voltage collapse – prevention of voltage collapse – future trends and challenges

**7. Short Circuit Studies Using Z – Bus and Y – Bus**

Introduction – types of faults – short circuit studies of a large power system networks – algorithms for calculating system conditions after the fault occurrence – direct short circuit bolted faults – comparison between symmetrical components and phase co ordinate method of short circuit study using Y- bus

**Note: T.W.and Practicals will be based on the above syllabus.**

**BOOKS:**

Reactive Power Compensation – T. J. E. Miller
Understanding FACTS – N. G. Hingorani
HVDC – K. R. Padhiyar
Understanding Power Quality Problems – H. J. Boller (IEEE press)
Power System Dynamics – K. R. Padhiyar
Advance Power System Analysis And Design – L. P. Singh

**B E Semester VII (Electrical)**

**E- 705 B (Elective Paper– 1) Microcontroller & PLC**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | | Practical marks | T/W marks | TOTAL | |
| | | | Hrs. | Max Marks | | | | |
| 4 | 2 | 0 | 3 | 100 | 50 | 25 | 175 | |

**8051 – 8 Bit Microcontroller:**

1. Introduction to 8051 microcontrollers and overview of 8051 family, Assembly programming, Program counter and ROM space,
Data types and directives, Flag bits and PSW register, Register banks and stack.

2. Jump, loop and call instructions, Time delay generation and calculation, I/O port programming, Pin description of
8051, bit manipulation, 8051 addressing modes:

3. Arithmetic Instructions and Programs: Unsigned addition and subtraction, unsigned multiplication and division,
Signed number concepts and arithmetic operations, Logic Instructions and Programs: Logic and compare instructions Rotate and
Swap instructions, BCD and ASCII application programs, Single bit instructions and programming, single bit operation with carry,
Reading input pins vs. port latch

4. Timer/ Counter and Interrupts programming: Programming 8051 timers, counter programming; Programming timer interrupts,
External hardware interrupts and serial communication interrupt, Interrupt priority in 8051, 8051 Serial communication: Basics
of serial communication, connection to RS232, serial communication programming.

5. 8051 Interfacing: 8051 interfacing to ADC, DAC, Sensors, LCD, Keyboard, 8255, Interfacing to external memory:

**B. Programmable Logic Controller**

6. An overview of PLC, General programming procedure, Input and Output module interfacing, Programming ON/OFF
Inputs to produce ON/OFF outputs, Relation of digital gate logic to contact / coil logic, Creating ladder diagrams from process
Control descriptions, Basics of register.

7. PLC Functions: Timer function, Counter function, Arithmetic function, Number comparison functions, Numbering systems
and number conversion function, Skip and Master control relay functions, Jump functions, PLC data move systems and other
PLC data handling function, Digital bit functions and applications, Sequencer function, PLC matrix functions

8. Analog PLC operations, Applications

**Note: T.W. will be based on the above syllabus.**

**Books:**

Microcontrollers Theory and Applications by Ajay V Deshmukh, TMH Publishing Co. Ltd.
The 8051 Microcontroller & Embedded Systems By Muhammad Ali Mazidi , Janice Gillispie Mazidi , Pearson Education Inc.
The 8051 Microcontroller, Architecture, Programming & Application By Kenneth J. Ayla, Penaram Publication.
Programmable Logic Controllers by John R. Hackworth, Frederick D. Hackworth, Pearson Education Inc.
Programmable Logic Controllers, Principles & Applications by john W. Webb, Ronald A. Reis, PHI
Programmable Logic Controllers & their Engineering Applications by A. J. Crispin, McGraw Hill.
Programmable Controllers by Thomas A Hughes, I S A.

**B E Semester VII (Electrical)**

**E- 706 Project**

| Teaching Scheme | | | Examination Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|
| Theory | Practical | Tutorial | Theory | | Practical marks | T/W marks | TOTAL | |
| | | | Hrs. | Max Marks | 50 | 25 | 75 | |
| 0 | 2 | 0 | | | | | | |

**The objectives of the course are:**
To provide students with a comprehensive experience of applying the knowledge gained so far.
To develop aptitude, build confidence, communication skill and presentation abilities amongst the fraternity in which he / she belongs.
To provide an opportunity to do something creative in real life work situation.
To advance institute – industry interaction / relationship.

A student is required to carry out project work related to Electrical Engineering. Under supervision / guidance of staff members, the project may be based on either design and/or fabrication or simulation on computer or society/industry need based survey or testing etc. Project work can be carried out in the Institute or in the Industry or in any research organization. The student can undertake project singly or in a batch, of not more than five students.

At the end of the semester, student will be required to submit a report consist of aim & objective, literature survey, work done, and conclusion derived if any with further scope of studies and will defend before the examiners at the time of final evaluation.