

**BHAVNAGAR UNIVERSITY,  
BHAVNAGAR  
B.E.SEMESTER – V ELECTRICAL**

WEF JUNE 2007

**E.501 Electrical Power SYSTEM- II**

Theory	Prac.	Total	Exam Marks	Sessional	Term work	Prac.	Total Marks
4	2	6	100	NIL	25	50	175

- (1) Line constants: Inductance of 1-phase, two-wire line and composite Conductor lines, inductance of 3-phase spacing with and Without transposition, double circuit line bundled conductors. Resistance and skin effect. Capacitance of 1-phase and 3-phase transmission line. Effect of earth, on Transmission line capacitance.
- (2) Representation of power systems components:- One line diagram and Impedance/reactance diagram per unit system Representation.
- (3) Performance of transmission lines: Performance calculation of short line medium line by nominal T and TT method. Evaluation of A, B, C, D constants long transmission lines- Rigorous solution interpretation of the long line Equation Ferranti effect equivalent circuit.
- (4) Power Circle Diagram :Receiving end and sending end power circle Diagram. Universal circle diagram.
- (5) Symmetrical Fault Analysis: Transients on a transmission line, short circuit of an unloaded and loaded synchronous machine, Reactance's of a synchronous machine, Bus impedance Matrix. Algorithm for short circuit studies.
- (6) Symmetrical Components Symmetrical component transformation phase shifting in star-delta transformers sequence impedances of power system components/sequence networks of a power system.
- (7) Unsymmetrical Fault Analysis :Symmetrical component analysis of Unsymmetrical faults like L-G, L-L, L-L-G faults. Bus Impedance matrix method.
- (8) Energy conservation - energy audit approaches at unit level, industrial Engineering approaches for conservation such as p.f. Improvement. Power factor controller, selection of electrical drives and their rating high Efficiency motors, voltage regulation maintenance and lubrication of drives vibration reduction in transmission and distribution losses, Lightning system with good design illumination systems, efficient Electrical drives for fans, pumps, compressors and refrigeration system;  
Domestic and industrial load shedding.
- (9) Use of computers in energy audit: A Case study. - Calculation and costing project cost Evaluation by ROI, payback terms - Energy balance an organization for Energy management. Conservation measures and diagnostic review.

References

- (1) Elements of power system analysis-- Stevenson
- (2) Modern power system analysis- Nagrath & Kothari.

## E 502 ENGINEERING ELECTROMAGNETICS

Theory	Prac.	Total	Exam Marks	Sessional	Term work	Prac.	Total Marks
4	0	4	100	NIL	00	00	100

Vector Analysis                      Vector algebra-Cartesian c-ordinate system, vector Components-unit vectors. Dot & cross Product, circular,Cylindrical & spherical Co-ordinate system-transformation of systems.

Coulomb's law .                      • Coulomb's law-electric field intensity field of n-point charges-field due to line charge, continuous volume charge and sheet charge.

Gauss's law and . •                      Electric flux density - Gauss law-application  
Divergence                      Divergence - Maxwell's first equation.  
Vector                      operator and Divergence theorem.

Energy & Potential:                      Energy in moving a point charge in electric field-Potential & potential difference - potential gradient- the Dipole.

Conductors, Dielectrics : Current & current density -continuity of & capacitance    current    -  
conductors and semiconductors-

dielectric - capacitance. Poisson's & Lap . •    Poisson's & Lap lace's equations.  
lace's Equations

Magnetic Field                      . •    Biot savert's law-Ampere's law-curl-strokes theorem-magnetic flux and flux density -magnetic potential - derivation of magnetic field's laws.

Magnetic forces, . •                      Force on moving charge and Differential  
Materials &                      current element-Nature of magnetic  
materials- Inductance                      Permeability-boundary condition-  
magnetic                      circuit and Inductance.

Faraday's Laws                      . •    Faraday's laws, Maxwell's equations in point form and integral form.

Uniform plane wave: Wave motion in free space and dielectrics The pointing sector - Propagation in conductors - skin effect -Reflection of uniform plan waves.Transmission lines of audio, radio and UHF frequencies.

Text books :

- (1) Engineering Electromagnetic -
- (2) Elements of Engineering -

By William Hayt Jr.  
By N.Narayan

### E-503 DIGITAL ELECTRONICS

Theory	Prac.	Total	Exam Marks	Sessional	Term work	Prac.	Total Marks
4	2	6	100	NIL	25	50	175

- (1) NUMBER SYSTEMS :- Binary ,Decimal,octal and hexadecimal numbers,and their conversions representation of negative numbers, binary codes.
- (2) LOGIC GATES & BOOLEAN ALGEBRA: - Inverter, AND, OR,NAND, NOR, EXCLUSIVE OR Gates. Boolean algebra: Operations, xpressions, Basic theorems and properties of Boolean algebra , De Morgan's theorem, Boolean Functions, canonical and standard forms.
- (3) SIMPLIFICATION OF BOOLEAN FUNCTIONS :- K – map method, Two and three variable maps,four variable map,five and six variable maps, product of sums simplification, Nand and Nor implementation, other two level implementation, Don't care conditions,
- (4) COMBINATIONAL LOGIC :-Introduction, design procedure, Adders, subtractors, multilevel NAND circuits,multilevel NOR circuits, Exclusive - OR and equivalence functions,combinational logic using Universal gates.
- (5) LOGIC FUNCTIONS :- Introduction, Binary parallel Adders, Decimal adders,comparator,code converters,decoders,Encoders,multiplexers, De multiplexers. Read only memory programmable logic array.
- (6) SEQUENTIAL LOGIC CIRCUITS :- Flip –Flops, triggering of Flip – Flops,analysis of clocked sequential circuits,Clocked S-R Flip-flop , J-K Flip-flop, D type & T type Flip-flops.J-K Master slave.
- (7) SHIFT REGISTER, COUNTER AND MEMORY UNIT :- Shift Registers: Serial in-serial out,Serial in-parallel out,parallel in-serial out, parallel in-parallel out , Bi directional shift register. Shift register applications,Counters:synchronous counters, Asynchronous counters Up/Down counter,cascaded counters, counter applications. Memory concept, Read only memory, programmable ROM, Read/write Random access Memories.
- (8)DIGITAL LOGIC FAMILIES :- Introduction,RTL & DTL circuits, Transistor– Transistor logic,Emitter coupled logic,MOS & CMOS logic.
- (9) Schottky TTL.

PRACTICAL/ORAL : Practicals and termwork shall be based on syllabus.

#### LIST OF BOOKS:

- (5) Digital Logic and Computer Design by M. Morrismano, PHI.
- (6) Digital electronics by R.P.JAIN
- (7) Integrated Electronics by Millman and Halkias
- (8) Digital Principles and applications by Malvino and Leach
- (5) Digital fundamentals by THOMAS FLOYD

## E-504 ELEMENTS OF ELECTRICAL DESIGN

Theory	Prac.	Total	Exam Marks	Sessional	Term work	Prac.	Total Marks
4	4	8	100	NIL	25	50	175

Magnetic circuit : Basic principles of magnetic circuits. B-H curves Calculations of MMF for air-gap and teeth, real and Apparent flux density, effect of saturation flux-density Distribution, calculation of magnetizing current, field-Form, Carter's fringe curve, flux plotting air-gap flux distribution factor actual flux distribution factor.

Electromagnets : Types and design of magnet coils. design of flat faced, circular magnet, horse shoe and plunger type magnets, design of magnetic clutches.

Transformers & Choke coils : Design of small single-phase transformers, design of welding transformers, Design of variable gap choke coils for 1-phase and 3-phase.

Armature windings: Types of d. c. and a. c. windings simplex lap and wave d.c. armature winding dummy coils, equalizer connections.

A. C. Windings : Single layer, concentric, hemi tropic, whole coil and mush winding, double layer, integral and fractional pitch winding.

Design of starters and field regulators : Design of starters for d.c. shunt and series motors, induction motors, graphical method for calculation of resistance steps. Design of resistance for starters, Design of field regulators for d.c. shunt motor and generators. Design of loading rheostats design of heating elements automatic starting of d.c. and a.c. motors. theory and circuit diagrams of push-button starters i.e. DOL star delta, rotor-resistance starters. Use of contactors in control circuits.

Term work : Term work is based on above syllabus. At least five design problems and drawings should be done in the laboratory to enhance the knowledge, industrial visit should be arranged.

Reference Books : (i) A course in Electrical machine design - by A.K. Sawhney  
(ii) Performance and design of A.C. machine - by H.G. Say  
(iii) Performance and design of D.C. machine –by A E Clayton

## **E-505 POWER ELECTRONICS DEVICES AND CIRCUITS**

<b>Theory</b>	<b>Prac.</b>	<b>Total</b>	<b>Exam Marks</b>	<b>Sessiona</b>	<b>Term work</b>	<b>Prac.</b>	<b>Total Marks</b>
<b>4</b>	<b>2</b>	<b>6</b>	<b>100</b>	<b>NIL</b>	<b>25</b>	<b>50</b>	<b>175</b>

### **1 THYRISTOR FUNDAMENTALS:**

Introduction of SCR, Reverse Recovery effect with semi conductor material.

SCR –Construction, working, Two Transistors analogy, Turn on methods, Turn off methods i.e commutation methods, SCR specifications/ratings, Thyristor characteristics, Thyristor Protections: di/dt & dv/dt protections, Design of snubber circuits, Over voltage & Over current & Gate protections, Series& Parallel operations of Thyristors, Thyristor firing circuits/Triggering circuits : Resistance Triggering , Resistance-capacitance Triggering, UJT Triggering, PUT Triggering.

UJT: Construction, working, equivalent circuit, V/I Characteristics, Relaxation Oscillators circuit and it's Design, use of Pulse Transformer, Ramp & Pedestal triggering, PUT Relaxation oscillator & it's Design, Advantages & Disadvantages.

### **2 MODERN POWER SEMICONDUCTOR DEVICES :**

Historical perspective, Members of Thyristor Family, Gate assisted Turn -off Thyristors ( GATT ),Bidirectional Triode Thyristors, ( TRIAC ) Bidirectional Diode Thyristors ( DIAC ) , silicon Bilateral switch( SBS ), Silicon Unilateral switch ( SUS ), silicon controlled switch (SCS), Light activated silicon controlled Rectifiers (LASCR), Power Transistor, Insulated Gate Bipolar Transistor( IGBTs), static Induction Transistor ( SITS), Gate Turn off Thyristor, Field controlled Thyristor (FCT), static Induction Thyristor ( SITHs), MOS- controlled Thyristor( MCT ), Power Integrated circuit( PICs), comparison of power Devices.

### **3 PHASE CONTROLLED RECTIFIER:**

Phase angle control , single phase half wave & full wave control rectifier, Single phase half control bridge rectifier, Three phase controlled converters, Three pulse converters, six pulse converters, Three phase Fully controlled Bridge converter, The External performance Measures of six pulse converter, The effect of Input source Impedance, performance of converter circuits with Battery Load, Discontinuous conduction in Two quadrant converters, Inversion operation, selection of converter circuits, Firing circuits for Line commutated converters, Triggering circuit for single phase Fully controlled converter, Microprocessor based Firing scheme for Three phase Fully controlled Bridge converter.

### **4 DUAL CONVERTERS:**

Principle of Dual converter, ( Ideal Dual converter ), practical Dual converter, Dual converter without circulating current operation, Dual converter with circulating current operation, Dual mode Dual converter, comparison between Non circulating current, Microprocessor based Firing scheme for a Dual converter.

## **5 INVERTERS:**

Thyristor Inverter classification, series inverters, self commutated In parallel Inverter, The single phase Bridge voltage source Inverter, Three phase Bridge Inverters, Three phase Bridge Inverter with Input circuit commutation, voltage control of single phase inverters, voltage control of Three phase inverters, Harmonic Filters, Harmonic Reduction, current source inverters, performance comparisons of pulse width Modulated ( PWM ) , Adjustable voltage inverters and current source inverters.

## **6 CHOPPERS :**

Principle of chopper operation, control strategies, step up chopper, step-up /Down chopper, chopper configuration, chopper commutation, Jones chopper, Morgan chopper, A.C. chopper, source filter, Multiphase chopper, chopper control of D.C. series Motor, chopper firing circuit.

## **7 CYCLOCONVERTERS :**

The Basic principle of operation, single phase to single phase cycloconverter, Three phase Half wave cycloconverters, cycloconverter circuits for Three phase output, Ring connected cycloconverters circuits, output voltage Equation, control circuit, comparison of the cycloconverters and D.C. Link converter, Load commutated cycloconverters.

## **8 CONTROL OF D.C. DRIVES:**

Basic Machine Equations, Breaking Modes, schemes for D.C. Motor speed control, single phase separately Excited Drives, Breaking operation of Rectifier controlled separately Excited Motor, single phase series D.C. Motor drives, power factor Improvement, Three phase separately Excited Drives, D.C. Chopper Drives, Closed loop control of D.C. Drives, phase locked Loop ( PLL ) control of D.C. Drives, Microprocessor control of D.C. Drives.

## **9 CONTROL OF A.C. DRIVES:**

Basic principle of operation, squirrel- cage Rotor design, speed control of Induction motor, stator voltage control, variable frequency control, Rotor Resistance control, slip power Recovery scheme, synchronous Motor drives, Microprocessor controlled A.C. drives.

### **• Books of references :**

- 1 Power electronics By P.S.Bhimbara Khanna publications Delhi
- 2 Power electronics and controls by Samir K. Datta Prentice Hall India, New Delhi
- 3 Industrial & power Electronics by - Harish C. Rai Umesh Publications, Delhi
- 4 Thyristor Engineering by M.S. Berde Khanna publications Delhi
- 5 Power electronics by M.H.Rashid, PHI Publication