GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN ELECTRICAL ENGINEERING

TEACHING SCHEME (w. e. f. Jan' 12)

SEMESTER- VI

SR. NO.	SUB. CODE	SUBJECT	TEACHING SCHEME (HOURS)			CREDITS
			THEORY	TUTORIAL	PRACTICAL	
1	2360901	PROJECT-II	0	0	12	12
2	2360902	POWER STATION ENGINEERING	4	0	2	6
3	2360903	SWITCHGEAR AND PROTECTION	4	0	2	6
4		ELECTIVE	4	0	2	6
		TOTAL	12	0	18	30

Select **ANY ONE from the following subjects**

SR. NO.	Subject Code	NAME OF ELECTIVE SUBJECT
1	2360904	MICROPROCESSOR AND CONTROL SYSTEM COMPONENT
2	2360905	ELECTRIC TRACTION AND CONTROL
3	2360906	POWER ELECTRONICS
4	2360907	ELECTRIFICATION OF BUILDING AND COMPLEXES
5	2360908	POWER SYSTEM OPERATION AND CONTROL

GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN ELECTRICAL ENGINEERING

SEMESTER- VI

Subject Name: Power Station Engineering
Subject Code: 2360902

Sr. No.	Subject Content	Total Hrs.
1	**POWER STATION EQUIPMENT AND THEIR LAYOUT.** 1.1 Electrical and mechanical equipment and their auxiliaries of (i) Thermal (ii) Hydro and (iii) Nuclear Power Station (Specification, performance and applications) 1.2 Layout of above Power stations and control room. 1.3 Performance of alternator with infinite bus bar. 1.4 Performance and applications of synchronous motor. 1.5 Vector group of power transformer. 1.6 Unit transformer and station transformer. 1.7 Bus bar arrangement	13
2	**POWER AND CONTROL CABLE.** 2.1 Ratings and Testing of power cable. 2.2 Advance methods of fault location. 2.3 Types of cable joints, connections and terminations. 2.4 Comparison of power and control cable. 2.5 cable fault detection	5
3	**INTERCONNECTED SYSTEMS.** 3.1 Inter connections of power stations. 3.2 Inter connections of substations. 3.3 Load sharing. 3.4 Power limit of inter connector. 3.5 Functions of load dispatch centre (LDC) 3.6 power line carrier communication	7
4	**FIEXIBLE A.C.TRANSMISSION (FACTS)** 4.1 Introduction 4.2 Requirements of FACTS devices	7

	4.3 Types of FACTS Devices 4.4 Basic Know how of the FACTS Devices	
5	**POWER PLANT OPERATION ECONOMY.** 5.1 Components for total cost of generation per unit. 5.2 Methods for depreciation calculation. 5.3 Interpretation of load curves. 5.4 Effect of load curves on cost per KWH.	**5**
6	**POLLUTION AND ITS CONTROL IN POWER STATIONS.** 6.1 Types of pollution in different Power stations. 6.2 Control of pollution. 6.3 Effect of pollution on environment. 6.4 Standardization for environment protection. 6.5 Methods for reducing pollution.	**6**
7	**SAFETY MEASURES IN MODERN POWER STATION.** 7.1 Possible hazards in power station 7.2 Indian Electricity (I.E) rules for general safety. 7.3 Preventive measures for safety. 7.4 Safety devices applied to different equipment. 7.5 Safety tools and equipment used in power station	**7**
8	**POWER STATION MANAGEMENT.** 8.1 Organization structure of modern power station 8.2 Responsibilities and duties of personal. 8.3 Delegation of power. 8.4 Record keeping in power station 8.5 GEC Code for materials.	**6**
	TOTAL	**56**

NOTE: - Following are the minimum experiences required, but the college can do more experiences if possible.

Laboratory Experiences:

1. Study of thermal power station equipments and its layout.
2. Study of Hydro power station equipments and its layout.
3. Study of Nuclear power station equipments and its layout.
4. Synchronize an alternator with infinite bus bar.
5. Performance of synchronous motor with respect to change in excitation.
6. Methods of fault location and testing of power cable.
7. Tutorials on inter-connection.
8. Role of load dispatch centre (LDC)
9. Study of different types of load curves.
10. Determination of depreciation cost in power station.
11. Effect of pollution and methods for reducing it.
12. Study of safety devices applied to equipment in TPS/NPS/HPS. (any one)
13. Study of FACTs devices.
14. Organization structure of modern power station

Text Books:

1. A course in Power Plant Engg. -: Arora S. Domkundwar Dhanpatrai & sons
2. A course in Electrical Power -: J. B. Gupta S. K. Kataria & sons
3. Understanding FACTS by -: N Hingorani and L gyugyi

Reference Books:

1. Power Plant Technology -: C. L. Wakil Mc. G.Hill
2. Plant Engineers Hand Book, Vol I & II -: Homy P. Seervai Multitech Publishing
3. Elements Of Electrical Power Station Design-:Deshpande, M. V.- Phi
4. Understanding FACTS by -: N Hingorani and L gyugyi

GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN ELECTRICAL ENGINEERING

SEMESTER- VI

Subject Name: Switchgear and Protection
Subject Code: 2360903

Sr. No.	Subject Content	Total Hrs.
1	**ELEMENTS OF PROTECTION** 1.1 Line diagram of a power system and its elements. 1.2 Faults and abnormalities, their causes, types and effects. 1.3 Functions of basic elements of a protective system. 1.4 Backup protection & its types.	5
2	**PROTECTIVE RELAYS** 2.1 Concept of protective relay and its selection. 2.2 Classification of relays. 2.3 Principle of working and opeation of relays and their construction. 2.4 Basic terms related to relay like pick up value, reset value- and operating current etc. 2.5 Use the static relays in modern power system. 2.6 Settings of various types of relays. 2.7 Maintenance and testing of relays. 2.8 Principle and working of microprocessor based relay.	13
3	**PROTECTIVE TRANSFORMERS** 3.1 Necessity of Protective Transformers. 3.2 Polarity marking of C.T. & P.T. and their specifications. 3.3 Connection diagram of C.T. & P.T. in a 1- phase and 3-phase Protective systems.	4
4	**NEUTRAL EARTHING** 4.1 Importance of Neutral Earthing. 4.2 Methods of Neutral Earthing & its advantages. 4.3 Applications.	4
5	**CIRCUIT INTERRUPTING DEVICES** 5. 1 Necessity & types of interruption devices like ACB, OCB,	13

	ABCB, SF6 and vacuum circuit breakers. 5.2 Line diagram of a protective system showing different circuit interrupting devices. 5.3 Sequence of operation and interlocking. 5.4 Requirement & types of isolators. 5.5 Fuse, types and their characteristics. 5.6 Testing & application of fuses. 5.7 Arc formation process. 5.8 A.C circuit, Zero current interruption. 5.9 Working principle and various types of circuit breakers.	
6	**PROTECTIVE SYSTEMS** 6.1 Abnormalities & faults in a power system & its effects. 6.2 over current protection, ,directional over current rotection, differential protection, distance protection. Harmonic constrains in differential protection 6.3 Protection schemes for alternator. 6.4 Protection against Prime mover failure and unbalance loading. 6.5 Protection of transformers. 6.6 Protection of Transmission line and feeders. 6.7 Protection of motors. 6.8 Protection of bus bars.	**13**
7	**OVER VOLTAGE PROTECTION** 7.1 Causes of over voltages. 7.2 Methods of reducing over voltages. 7.3 Operating principles, construction & applications of lightening arrestor. 7.4 Insulation co-ordination & volt- time characteristic.	**4**
	TOTAL	**56**

NOTE: - Following are the minimum experiences required, but the college can do more experiences if possible.

Laboratory Experiences:

(1) Use overload relay and obtain it's Time-Current characteristic
(2) Use Buchholz relay for transformer protection.
(3) Use thermal overload relay for protection of motor and set the relay properly.

(4) Check the Polarity of C.T. & P.T. and connect it with the relay.
(5) Apply the balance current protection scheme using appropriate switch gear.
(6) Find the fusing factor of a given fusing material.
(7) Operate air break C.B in a simulated condition.
(8) Read and interpret the protection scheme for an alternator in power station (from Blue print and visit).
(9) Read and interpret various protective scheme used for transmission lines and feeders (from Blue print and visit).
(10) Draw schematic diagram of protective schemes for 66 KV/ 132 KV/220 KV Sub station. (after visit)
(11) Visit a substation and prepare its technical report emphasizing on control side

Text Book:

1) Switch gear & Protection by S. Rao

Reference Books:

(1) Protective Relaying Vol. I & II by Van Warrington
(2) Protective Relaying by Russel & Mason
(3) Electrical Power by S.L.Uppal
(4) Electrical Power System V. K. Mehta
(5) J & P Hand book of Switchgear by Lythall

GUJARAT TECHNOLOGICAL UNIVERSITY
DIPLOMA IN ELECTRICAL ENGINEERING
SEMESTER- VI

Subject Name: Microprocessor and Control System Component (Elective)
Subject Code: 2360904

Sr. No.	Subject Content	Total Hrs.
1	**CONTROL SYSTEMS IN INSTRUMENTATION** 1.1 Introduction. 1.2 Role of control system in instrumentation. 1.3 Open loop and close loop control system. 1.4 Block diagram of open loop control system 1.5 Types of open loop control system 1.6 Block diagram of close loop control system 1.7 Types of close loop control system 1.8 Comparison between open loop and close loop control system 1.9 Servomechanism and regulators with suitable examples.	6
2	**BASIC CONTROL ACTION AND CONTROLLER CHARACTERISTICS** 2.1 On-off type control 2.2 Proportional conrol 2.3 Derivative control 2.4 Integral control 2.5 Proportional-derivative control 2.6 Proportional integral control 2.7 PID control	6
3	**CONTROL SYSTEM COMPONENTS** 3.1 Importance of control components. 3.2 Construction, working principle, torque-speed characteristic, merits and demerits and applications of AC/ DC Servo motor 3.3 Construction, working principle of Synchro, Synchro as transmitter-receiver and control transformer, application in position control system 3.4 Construction, working principle AC/ DC Techo generator, Application of position control and speed control with feed back through Techo-generator	15

	3.5 Classification of Stepper motor, Construction, working principle of Stepper motor 3.6 Solenoid valve, control valve 3.7 Servo voltage stabilizer	
4	**MICROPROCESSOR- INTRODUCTIO , ARCHITECTURE** 4.1 Introduction to microprocessor. 4.2 Advantages and disadvantages of micro processor control over traditional control. 4.3 Structure of micro processor 4.4 Generalized architecture of micro processor 4.5 Functions of each block. 4.6 Lumped and distributed digital control and their block diagram. 4.7 Different types of memories (ROM, RAM, PROM, EPROM,EEPROM) 4.8 Functional block diagram of 8085 micro processor with pin diagram. 4.9 logical block diagram of 8085 microprocessor- Registers, ALU, Decoder, Serial control action, Interrupt section, timing and control section	**15**
5	**MEMORY, I/O INTERPHASING AND APPLICATIONS OF MICROPROCESSOR IN INSTRUMENTATION SYSTEM** 5.1 Schematic diagram of memory chips decoder, memory inter phasing. 5.2 Memory I/O data transfer scheme. 5.3 Peripheral devices like 8155/ 8156 8255 - mode 0 and 1. 5.4 Inter phasing of switches and L E D S. 5.5 Temp control of furnace using micro processor 5.6 Traffic light control. 5.7 SCR firing angle control. 5.8 Data acquisition system	**14**
	TOTAL	**56**

NOTE: - Following are the minimum experiences required, but the college can do more experiences if possible.

<u>Revised</u> List of Laboratory Experiences:

(1) Control of angular displacement using Synchro.
(2) Study of AC and DC servo motor.
(3) Use techogenerator for automatic speed control of D.C. motor

(4) Study of basic control action and controller.
(5) Various servo stabiliser for automatic voltage control and study/ trace its control circuit.
(6) Study of stepper motor.
(7) Use microprocessor for temperature control.
(8) Use microprocessor for S.C.R. firing control.
(9) Study of architecture of 8085.
(10) Study of data acquisition system.

Text Books:

(1) Mechanical and Industrial measurement - By - R.K. Jain.
(2) Microprocessor Architecture, Programming and Applications with the 8085-Ramesh Gaonkar
(3) Control System Components B. Chattergee

Reference Books:

1. Automatic Control System by S.Hasan Saeed-Katson
2. Microprocessor & its application by B.Ram
3. Control System Components Gibson & Tutor.
4. Control System Engineering H. M. Rai.
5. Servomechanism Practice Ahrendt & Savant

GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN ELECTRICAL ENGINEERING

SEMESTER- VI

Subject Name: Electric Traction and Control (Elective)
Subject Code: 2360905

Sr. No.	Subject Content	Total Hrs.
1	**TRACTION SYSTEMS** 1.1 Merits of electric traction. 1.2 Different electric traction systems. 1.3 General arrangement of above systems.	4
2	**SPEED TIME CURVES.** 2.1 Analysis of speed time curves. 2.2 Simplified speed time curves. 2.3 Relationship between principal quantities in speed time curves. 2.4 Numerical examples.	6
3	**TRACTION MOTORS.** 3.1 D. C. Traction motors. 3.2 A. C. Traction motors. 3.3 Linear Induction Motor in traction 3.4 Comparison between different traction motors.	6
4	**AUXILIARY EQUIPMENT.** 4.1 Current collecting equipment. 4.2 Coach wiring and lighting devices. 4.3 Protective devices. 4.4 Power supply accessories for auxiliary equipment.	6
5	**ELECTRIC LOCOMOTIVES.** 5.1 Classification. 5.2 Power conversion and transmission systems. 5.3 Control and auxiliary equipment. 5.4 Important features of electric locomotives. 5.5 D. C. locomotives (in detail.)	6

	5.6 A. C. locomotives (in detail.) 5.7 Diesel electric locomotives.	
6	**SPECIFIC ENERGY CONSUMPTION CALCULATION.** 6.1 Calculation of train resistance and Derivation of general equation. 6.2 General equation applied to level track, track with gradient and curves. 6.3 Numerical problems.	**7**
7	**FEEDING AND DISTRIBUTION SYSTEM.** 7.1 Distribution systems pertaining to traction (distributions and feeders) 7.2 Traction sub-station requirements and selection. 7.3 Method of feeding the traction sub- station.	**6**
8	**CONTROL OF TRACTION MOTORS.** 8.1 Controls of D. C. motors. 8.2 Control systems for motor coach trains. 8.3 Various methods of mechanical breaking systems. 8.4 Control systems for electric locomotives. 8.5 Calculations for starting rheostates and numerical problems. 8.6 Controls of single phase a.c. motors along with details of control apparatus. 8.7 Electric breaking.	**10**
9	**FUTURE TRENDS IN TRACTION.** 9.1 Energy conservation in Electric traction. 9.2 Indian scenario in electric traction. 9.3 Magnetic levitation. 9.4 High speed traction.	**5**
	TOTAL	**56**

NOTE: - Following are the minimum experiences required, but the college can do more experiences if possible.

Laboratory Experiences:

1. Study of various traction systems.
2. Tutorials on speed time curves.
3. Study energy saving in series parallel control of D. C. Motor.
4. Tutorials on specific energy consumption.
5. Study of current collecting equipments.
6. Study of power diagram of A.C. locomotive and its equipment.
7. Study of layout of D. C. locomotive and diesel locomotive.
8. Study of specific features of D. C. Series motor as traction motor.
9. Study of Arno converter.
10 Study of train lighting system.
11. Study of multiple unit control.
12. Study of energy recovered in regenerative breaking.

Text Book:

1. Modern Electric Traction H. Partab

Reference Books:

1. Electric Traction A.T. Dover
2. Electric Power S.L. Uppal
3. A course in Electrical Power (in SI units) J.B. Gupta
4. Electric Traction by Uppadyay

GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN ELECTRICAL ENGINEERING

SEMESTER- VI

Subject Name: Power Electronics (Elective)
Subject Code: 2360906

Sr. No.	Subject Content	Total Hrs.
1	**POWER ELECTRONICS COMPONENTS :** 1.1 Introduction to Thyristor family. 1.2 Construction, working principle, symbol, characteristics and application of (I) SCR, (II) UJT, (III) DIAC. (IV) TIRAC, (V) PUT, (VI) LASCR, (VII) IGBT, (VIII) GTO.	7
2	**SCR PROTECTION CIRCUITS & RATINGS :** 2.1 Need of protection. 2.2 Over voltage and over current protection. 2.3 Dv/dt and di/dt ratings of SCR. 2.4 Use of Snubber circuit. 2.5 Use of free wheeling diode 2.6 Use of thermistor. 2.7 Use of heat sink. 2.8 Mounting of SCR. 2.9 Knowledge of different packages available for SCR. 2.10 Use of data book. 2.11 Knowledge of different ratings of SCR. 2.12 Different special types of SCR such as Fast switching, low gate current, high gate current etc.	7
3	**COMMUTATING CIRCUITS:** 3.1 Need to turn off SCR. 3.2 Types of commutation. 3.3 Natural commutation. 3.4 Forced commutating method. 3.5 Series Resonance/current commutation.	7

	3.6 Voltage commutations. 3.7 Auxiliary SCR for commutation. 3.8 External pulse commutation.	
4	**CHOPPERS:** 4.1 Principle of chopper. 4.2 Types of chopper circuit (A type to E-type) 4.3 Jhone's chopper circuit. 4.4 Morgans chopper circuit. 4.5 Applications of chopper.	**7**
5	**INVERTERS AND UPS:** 5.1 Working principle of inverter. 5.2 Inverter circuits using transistor and SCR- their difference. 5.3 Series inverter using SCR. 5.4 Parallel inverter-using SCR. 5.5 Use of pulse width modulation circuit. 5.6 Introduction to UPS. 5.7 Block diagram of UPS.	**8**
6	**CYCLO CONVERTER :** 6.1 Introduction to cyclo converter. 6.2 Operating principle. 6.3 Types of cyclo-converter. 6.4 Single phase to single phase cyclo converter. 6.5 Single phase to bridge cyclo converter.	**7**
7	**INDUSTRIAL APPLICATIONS:** 7.1 Speed control of D.C. Motor using armature voltage control. 7.2 Speed control of D.C. Motor using SCR chopper circuit. 7.3 Speed control of D.C. drive using PLL method. 7.4 Speed control of universal motor. 7.5 Different types of speed control methods for induction motor such as stator voltage control, frequency control. 7.6 Power factor control method. 7.7 Application in heating control, resistance welding, static circuit breaker and time delay circuits.	**8**

8	**INDUSTRIAL ROBOTICS SYSTEM.** 8.1 Introduction to Robotics. 8.2 Classification & configuration. 8.3 Degree of freedom of robotics system. 8.4 Programming robotics system. 8.5 Block diagram of robotics system.	**5**
	TOTAL	**56**

NOTE: - Following are the minimum experiences required, but the college can do more experiences if possible.

Laboratory Experiences:

1. Characteristics of SCR.
2. Frequency calculation of pulse in UJT relaxation oscillator.
3. Applications of TRIAC as AC load control.
4. Characteristics of IGBT & GTO.
5. Relaxation oscillator circuit using PUT.
6. Study of different packages of SCR and use of data book.
7. SCR commutating circuits.
8. Chopper circuit using SCR.
9. Speed control of DC motor using chopper circuits.
10. Parallel inverter using two SCRS.
11. Study of cyclo converter circuit using SCR.
12. Speed control of universal motor using SCR-UJT circuit.
13. Time delay relay circuit using UJT and SCR.

Text Books:

1. Power Electronics P.C.Sen.
2. Power Electronics Dr. P.S.Bimbhra (Khanna Pub.)

Reference Books:

1. Thyristor Engineering M.S.Berde. (Khanna pub.)
2. Industries and power Electronics H.C.Rai (Umesh Pub.)
3. Power Electronics. M. H. Rashid, Printice hall of India.

GUJARAT TECHNOLOGICAL UNIVERSITY
DIPLOMA IN ELECTRICAL ENGINEERING
SEMESTER- VI

Subject Name: Electrification of Building and Complexes (Elective)
Subject Code: 2360907

Sr. No.	Subject Content	Total Hrs.
1	**ELEMENTS OF ELECTRIFICATION** 1.1 Electrical wiring systems for domestic and industrial installations. 1 .2 Electrification of building, a design of small residential building & drawing of wiring blue prints, interpretation of symbols and wiring information available. Estimation of material, labour and other costing, total cost of wiring project, salient features of simple residential wiring, comparison of different building electrification. 1.3 Testing of installation and supervisor report. 1.4 Rules of distribution of electrical installation circuits. 1.5 Selection of main cable, main switches, circuit breakers, etc. 1.6 Calculation of total load on electrical distribution work. 1.7 Illumination requirements in high rise buildings Commercial Building & Public Building. 1.8 Economical consideration in the illumination design.	**12**
2	**ELECTRIFICATION OF MULTISTORIED BUILDINGS (PLANNING AND DESIGNING)** 2.1 Preparing of blue print of the electrification wiring layout circuits. 2.2 Electrification wiring supply-location from nearly substation, selection of type of wiring-either concealed conduit or surface conduit. 2.3 Deciding the number of sub circuits from the total circuit requirement. 2.4 Estimation of material requirements floor wise. Specification of wiring material & accessories. - Estimation of total cost of electrification using S.O.R - Case studies – 1,2,3,4,etc. 2.5 Requirements of approval from electrical inspection for high rise building.	**13**

	2.6 Load calculation for lifts, escalators, air conditioners etc. - Problems and case studies. 2.7 Study of tenders for electrification.	
3	**ELECTRIFICATION OF COMPLEXES OR PUBLIC BUILDINGS** 3. 1 Special requirements of hotels, theaters library and cultural halls etc. from electrification points of view. 3. 2 Estimation of material requirement about cost and total cost of electrification of complexes. 3. 3 Case study of electrification of any one from above building students should be given in groups(each group any one type of buildings)	**13**
4	**DISTRIBUTION SYSTEM FOR MULTISTORIED BUILDINGS.** 4. 1 Incoming supply to substation for multistoried high rise buildings (building having height more then 15m. 4. 2 Distribution panels and bus bar system. Meter connection- bifurcation of metering-meters as per consumers demand, use of digital – meters for prevention of theft of power. 4. 3 Cable laying in building. (Special precautions to be Observed	**10**
5	**ELECTRICAL SAFETY AND I.E. RULES** 5.1 Importance of safety rules. - Safety precaution in electrical installation of multistoried buildings. 5.2 Fire alarm system. 5.3 Smoke dete ction system. 5.4 Safety for lifts and escalators. 5.5 Earthing system (IE rules regarding safety). - Lightening arrestors arrangements. 5.6 Use of ELEB and MCB in an installation. - Electronic safety locks at the entrance. - Use of national building code (electrical service) for safety. - Requirement of qualified persons for electrification. 5.7 Use of D.G. set as a standby power supply in case of emergency so that working of people is not suffered and uninterrupted supply can be maintain.	**8**
	TOTAL	**56**

NOTE: - Following are the minimum experiences required, but the college can do more experiences if possible

Laboratory Experiences:

1. Draw a complete wiring diagram, and prepare a blue print of any one of the complexes. (Cinema, hotel, library, cultural hall, hospital etc. A group of 4 students, having one different complex –per group.
2. Study a large building or complex electrification tender.
3. Estimation costing and design of any given high rise building.
4. Economical illumination system design for any complex, building.
5. Study of safety management in electrical installation in a high rise building.
6. Load calculation for lift, escalators, air conditioning in high rise building.
7. Prepare field visit report (Important observations) of any high-rise building or complex.

Reference Books:

1. National Building code of India Group 1 & Group 4 Bureau of Indian standard,-New Delhi, Book no. 1604
2. Electrical Design Estimation & Costing K.B.Raina-S.K.Bhattacharya-Willet Estern Ltd.
3. Electrical Estimation & Costing S.L. Uppal-Khanna Publisher.
4. Electrical Workshop Estimation Installation Arrora Das-Khanna Publisher.
5. India Electrical Rules 1956 Hand book R. Chudrey- Publisher: Butterwarth –London-New Delhi.
6. Building construction Hand book R. Chudley-Publisher:B.H.Newners-Butterwarth London-New Delhi.

GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN ELECTRICAL ENGINEERING

SEMESTER- VI

Subject Name: Power System Operation and Control (Elective)
Subject Code: 2360908

Sr. No.	Subject Content	Total Hrs.
1	**REPRESENTATION OF POWER SYSTEM COMPONENTS :** 1.1 Single-phase solution of Balanced Three-phase Networks. 1.2 The One-line Diagram and the Impedance or reactance Diagram. 1.3 Per Unit system and per unit representation of different components of power system. 1.4 Per Unit impedance diagram of a power system.	8
2	**LOAD FLOW STUDIES :** 2.1 Formation of Bus Admittance Matrix (YBUS) by a. Net work Model Formulation and b. Singular Transformation. 2.2 Advantages of Bus Admittance Matrix (YBUS) over Bus impedance Matrix (ZBUS). 2.3 Load Flow problem and Types of Buses. 2.4 Load Flow solution by Gauss-Siedel Method, its algorithm, flow chart and limitations. 2.5 Load Flow solution by Newton-Raphson Method, its algorithm, flow chart and limitations. 2.6 Decoupled and Fast Decoupled Methods for load flow solution. 2.7 Comparison of Load flow Methods.	10
3	**OPTIMAL SYSTEM OPERATION:** 3.1 System constraints. 3.2 Optimal operation of Generators of a Bus Bar. 3.3 Optimal Unit Commitment (UC) and Dynamic programming Method. 3.4 Reliability considerations. 3.5 Economic Dispatch Neglecting Losses. 3.6 Automatic Load Dispatching.	10

4	**AUTOMATIC GENERATION AND VOLTAGE CONTROL:** 4.1 Load Frequency Control (Single Area Case) 4.2 Turbine Speed Governing System. 4.3 Automatic Voltage Control. 4.4 Active and reactive power control	**6**
5	**SYMMETRICAL COMPONENTS:** 5.1 Symmetrical component Transformation. 5.2 Phase shift in star Delta Transformers. 5.3 Sequence Impedance of Transmission Lines. 5.4 Sequence Impedance and sequence network of power system. 5.5 Sequence Impedance and Networks of synchronous Machine. 5.6 Sequence Impedances and Networks of Transformers. 5.7 Construction of sequence Networks of a Power system.	**10**
6	**POWER SYSTEM STABILITY:** 6.1 Dynamics of a Synchronous Machine. 6.2 Power Angle Equation. 6.3 Node Elimination Technique. 6.4 Steady state stability. 6.5 Transient stability. 6.6 Equal area criterion. 6.7 Numerical solution of swing equation. 6.8 Multi machines stability. 6.9 Factors affecting transient stability with recent trends.	**12**
	TOTAL	**56**

NOTE: - Following are the minimum experiences required, but the college can do more experiences if possible.

Laboratory Experiences:

1. Computation of impedance of a different element of power system in per unit value from given base KVA and KV.
2. Load flow solution of given power system by Gauss-Seidel Method.
3. Study of Newton-Raphson method for solving load flow problem.
4. Study of Dynamic programming method to prepare unit commitment table for economic system operation.
5. Resolve unsymmetrical quantity into a set of symmetrical components.

6. Draw the positive, Negative and zero sequence impedance networks for the given power system.
7. Study of automatic voltage control of alternator.
8. Study of turbine speed governing system for load frequency control.
9. Determination of stability by equal area criterion method.
10. Solution of swing equation using point by point method.
11. Study of steady state stability and transient stability of interconnected power system.
12. Study of procedure for load dispatch in L.D.C. (visit report).

Text Books:

1. Electrical Power System C.L.Wadhwa
2. A course in Electrical Power J.B.Gupta

Reference Books:

1. Power system engineering I.J.Nagrath and D.P.Kothari
2. Modern Power System Analysis I.J.Nagrath and D.P.Kothari
3. Power System Analysis and Design B.R.Gupta
4. Power System Analysis by A Stewonson