EE701C	**POWER SYSTEM PROTECTION**	**3L:0T:0P**	**3 Credits**
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the different components of a protection system.
2. Evaluate fault current due to different types of faults in a network.
3. Understand the protection schemes for different power system components.
4. Understand the basic principles of digital protection.
5. Understand system protection schemes, and the use of wide-area measurements.

UNIT–I

Protection against over voltages: Causes of over voltages-over voltages due to lightning –Rod gaps-Horn Gaps-Expulsion type and valve type lightning arresters-lightning arrester calculations-ground wires-counter poises-surge absorbers and surge diverters. Basics of Insulation coordination - Power system earthing.

UNIT-II

Fuses: Definitions, characteristics, types, HRC fuses.

Circuit breakers: Introduction - Formation of Arcs in CBs - arc interruption theories -Definitions - Current chopping - Classification of circuit breakers - Oil circuit breakers- Air blast circuit breaker - SF6 circuit breaker-Vacuum circuit breaker - Testing of circuit breakers.

UNIT–III

Protective Relaying fundamentals: Introduction – Need for protective systems in a power system – Zones of protection - Primary and backup protection – definition and functional characteristics of a protective relay – operating principles of various electromagnetic relays.

UNIT-IV

Types of Protective Relays: Overcurrent relays – Directional overcurrent relays – applications of over current relays. Distance relays: the universal torque equation – impedance, reactance and mho relays - differential relays – percentage differential relays – Static relays.

UNIT–V

Generator Protection: Protection against stator faults, against rotor faults and against abnormal conditions.

Transformer Protection: Buchholz relay, differential protection, percentage differential protection.

Busbar protection: - Frame leakage protection scheme

Text Books:

1. Badri Ram & D.N. Vishwakarma – Power system protection and switch gear., TMH publishing Company Ltd. 1995.
2. C.L. Wadhwa – Electrical power systems, Wiley Eastern Ltd.
3. B. Ravindranath & M. Chander, power system protection & switch gear., Wiley EasternLtd.

EE702C.i	**ELECTRICAL VEHICLES**	**3L:0T:0P**	**3 Credits**
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the basics of electric vehicles, technical characteristics and properties of batteries and also to design battery pack.
2. Know the ratings and requirements of electrical machines.
3. Apply the regenerative braking and sizing of motors.
4. Configure and design the components of hybrid electric vehicles.

UNIT I

Electric Vehicles: Introduction, Components, vehicle mechanics – Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion - Propulsion System Design.

UNIT II

Battery: Basics – Types, Parameters – Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries.

UNIT III

DC & AC Electrical Machines: Motor and Engine rating, Requirements, DC machines, three phase A.C machines, Induction machines, permanent magnet machines, switched reluctance machines.

UNIT IV

Electric Vehicle Drive Train: Transmission configuration, Components – gears, differential,clutch, brakes regenerative braking, motor sizing.

UNIT V

Hybrid Electric Vehicles: Types – series, parallel and series, parallel configuration – Design – Drive train, sizing of components.

Text book:

1. Iqbal Hussain, "Electric & Hybrid Vehicles – Design Fundamentals", Second Edition,CRC Press, 2011.
2. James Larminie, "Electric Vehicle Technology Explained", John Wiley & Sons, 2003.

Reference Books:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals", CRC Press, 2010.
2. Sandeep Dhameja, "Electric Vehicle BatterySystems", Newnes, 2000 http://nptel.ac.in/courses/108103009/

EE702C.ii	FLEXIBLE AC TRANSMISSION SYSTEMS	3L:0T:0P	3 Credits
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the working principles of FACTS devices and their operating characteristics.
2. Understand the working principles of static shunt and series compensation.
3. Understand the basic concepts of UPFC and IPFC
4. Understand the usage of Static voltage regulators and phase shifters

UNIT-I

Flexible Ac Transmission System: Transmission interconnections, flow of power in ac systems, loading capability, dynamic stability considerations, basic types of FACTS controllers.

UNIT-II

Static Shunt Compensators: Objectives of shunt compensation, static var compensators, STATCOM configuration, characteristics and control, comparison between STATCOM and SVC.

UNIT-III

Static Series Compensation: Objectives of series compensation, Variable Impedance type series compensators, switching converter type series compensators, external control for series reactive compensators.

UNIT-IV

UPFC: Principle of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the series compensators and phase angle regulators.

IPFC: Principle of operation and characteristics and control aspects.

UNIT-V

Static voltage regulators and phase shifters: Introduction**,** Principles of operation-Steady state model and characteristics - power circuit configurations

Text Books :

1. Hingorani ,L.Gyugyi,‘ Concepts and Technology of flexible ac transmission system’, IEEE Press New York, 2000.
2. K.R.Padiyar, “FACTS controllers in power transmission and distribution”, New age International Publishers, Delhi, 2007.
3. R. Mohan Mathur and Rajiv K. Varma, ‘Thyristor - based FACTS controllers for Electrical transmission systems’, IEEE press, Wiley Inter science, 2002.

EE702C.iii	**RESTRUCTURED POWER SYSTEMS**	**3L:0T:0P**	**3 Credits**
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the concepts of Restructuring of Power Industry
2. Understand the basics of Transmission Congestion Management
3. Understand the concepts of Locational Marginal Prices and Financial Transmission Rights
4. Understand the basics of Ancillary Service Management
5. Understand different pricing techniques of Transmission Network

UNIT I

INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY Introduction: Deregulation of power industry, restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models

UNIT II

TRANSMISSION CONGESTION MANAGEMENT Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

UNIT III

LOCATIONAL MARGINAL PRICES AND FINANCIAL TRANSMISSION RIGHTS

Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality -Simultaneous feasibility test and revenue adequency – FTR issuance process: FTR auction, FTR allocation — Flow gate rights – FTR and market power

UNIT IV

ANCILLARY SERVICE MANAGEMENT Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service

UNIT V

PRICING OF TRANSMISSION NETWORK Transmission pricing – Principles – Classification – Rolled in transmission pricing methods – Marginal transmission pricing paradigm - Composite pricing paradigm – Merits and demerits of different paradigm.

Text Books / References:

1. Sally Hunt," Making competition work in electricity", , John Willey and Sons Inc. 2002
2. Steven Stoft," Power system economics: designing markets for electricity", John Wiley & Sons, 2002.
3. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility" Pub., 2001
4. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen," Operation of restructured power systems", Kluwer Academic Pub., 2001.

EE703C.i	**POWER SYSTEM OPERATION AND CONTROL**	**3L:0T:0P**	**3 Credits**
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand economic operation and analyze methods for unit commitment of power systems.
2. Analyze voltage control and frequency regulation methods.
3. Realize stability issues and reactive power compensation.

UNIT-I

Economic operation of power systems: Introduction – operating cost of a thermal plant – Economic dispatch neglecting losses and no generation limits –Economic dispatch including losses – derivation of loss formula - Hydroelectric power plant model – Scheduling of hydropower plant. –

UNIT-II

Unit commitment and optimal power flow constraints of unit commitment problem –Solution methods of unit commitment – priority list methods – Dynamic programming approach to solve the unit commitment problem - optimal power flow solution – Elementary treatment of optimal power flow with and without constraints

UNIT-III

Load frequency control: The load frequency control problem – Basic P-f and Q-V control loops of a synchronous generator – Governor model- prime mover model – Generator model – Load model – concept of Single & Multi area power systems – Block diagrams representation of an isolated single area power system – steady state and dynamic responses of uncontrolled and proportional plus integral control of single area power system – load frequency control of two-area power system – Tie line bias control.

UNIT-IV

Automatic voltage regulator – introduction - modeling of amplifier, exciter, Generator and sensor – A simplified AVR block diagram – Excitation system stabilizer – Rate feedback and PID controller – automatic excitation generation control with system – placement and optimal feed-back design.

UNIT-V

Voltage stability and reactive power control- voltage stability problems in a power system – over flow of reactive power control – control of reactive power flow on a line – load compensation – specification of load compensator – uncompensated and compensated transmission lines

Text Books:

1. "Power system analysis" by Hadi Saadat, Tata Mc Grawhill International.
2. "Modern power system analysis" by J. Nagarath & DP Kothari, Tata Mc Grawhill secondedition
3. "Power system analysis and design" by B.R. Gupta wheeler publishing
4. "Electrical energy system theory" by O.I. Elgerd Tata Mc Grawhill Ltd second edition.

EE703C.ii	**POWER SEMICONDUCTOR CONTROLLED DRIVES**	**3L:0T:0P**	**3 Credits**
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the fundamental concepts of electrical drives.
2. Understand the principles of speed-control of dc motors and induction motors.
3. Understand the power electronic converters used for dc motor and induction motor speed control.

UNIT-I

Electrical Drives – An introduction – Electrical Drives, Advantages of Electrical Drives, parts of electrical drives – Electrical motor, power modulators, sources, control unit, choice of electrical drives, status of dc and ac drives.

Dynamics of Electrical Drives – Fundamental Torque equations, speed torque convention and multi quadrant operation, Equivalent values of drive parameters – Loads with rotational motion, loads with translational motion, measurement of moment of inertia. Components of load torques, Nature and classification of load torques, calculation of time and energy loss in transient operation, steady state stability, load equalization.

UNIT-II

Control of electrical drives – Modes of operation, speed control and drive classifications closed loop control of drives.

D.C. Motor drives – Starting, Braking, speed control - Armature voltage control, Ward Leonard drives, controlled rectifier fed DC drives – Single phase and 3-phase fully controlled and half controlled converter fed separately excited D.C. Motor, Chopper Controlled DC drives. (separatelyexcited motor).

UNIT-III

Induction Motor Drives: Review of three phase I.M., analysis and performance. Operation with unbalanced source voltages and single phasing, analysis of I.M. fed from non-sinusoidal voltage supply. Starting, Braking, methods

UNIT-IV

Speed control methods of IM, v/f controlled induction motors, controlled current and controlled slip operation, PWM inverter drives, Multi-quadrant drives and field oriented control, slip power control, single phase I.M. Close loop control of I.M. Drives.

UNIT-V

Synchronous motor drives: cylindrical rotor wound field motor, Salient pole wound field motor, Synchronous reluctance motor, Hysteresis synchronous motor, Operation from fixed frequency supply, starting, braking, synchronous motor, variable speed drives, starting large synchronous machines.

Energy Conservation in electrical drives – Losses in electrical drive system, measures of energy conservation in electrical drives, use of efficient converters, energy efficient operation of drives, improvement of p.f., improvement of quality of supply, maintenance of motors.

Text Books:

1. G.K.Dubey – Fundamentals of Electrical drives.
2. VedamSubrahmanyam - Electrical drives – Concepts and applications.

EE703C.iii	**POWER QUALITY**	**3L:0T:0P**	**3 Credits**
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand the basic concepts of power quality.
2. Understand the basic concepts of voltage variations and transients
3. Understand different harmonics in power systems
4. Understand the working of Power quality conditioners

UNIT –I

Electric power quality phenomena- IEC and IEEE definitions - power quality disturbances- voltage fluctuations – transients – unbalance - waveform distortion - power frequency variations.

UNIT–II

Voltage variations- Voltage sags and short interruptions – flicker-longer duration variations -sources – range and impact on sensitive circuits-standards – solutions and mitigations – equipment and techniques.

UNIT–III

Transients – origin and classifications – capacitor switching transient – lightning-load switching – impact on users – protection – mitigation.

UNIT –IV

Harmonics – sources – definitions & standards – impacts - calculation and simulation – harmonic power flow - mitigation and control techniques – filtering – passive and active.

UNIT–V

Power Quality conditioners – shunt and series compensators- DStatcom- Dynamic voltagerestorer-unified power quality conditioners-case studies.

Text Books:

1. Bollen, M.H.J., ‘Understanding Power Quality Problems: Voltage sags and interruptions’, IEEE Press, New York, 1999.
2. Arrillaga, J, Watson, N.R., Chen, S., ‘Power System Quality Assessment’, Wiley, New York, 1999.
3. Heydt, G.T., ‘Electric Power Quality’, Stars in a Circle Publications, Indiana, 1991.

EE704C.i	**HVDC TRANSMISSION**	**3L:0T:0P**	**3 Credits**
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Differentiate between AC and DC transmission, their advantages and applications
2. Analyze HVDC converters and converter bridge characteristics
3. Understand the particulars of converters and HVDC system control and reactive power control
4. Identify Converter faults and protection carried.
5. Understand harmonics, filters and different multi terminal systems

UNIT-I

DC Power Transmission Technology:

Introduction, Comparison of AC DC transmission, Converter station, Description of DC Transmission systems, Components of a HVDC system. Choice of voltage level , Modern trends in DC transmission

UNIT-II

Analysis of HVDC Converters:

Pulse number, Choice of converter configuration, valve rating. Transformer, simplified analysis of graetz circuit with and without overlap (2 and 3 valve conduction mode) rectifier and inverter waveforms, converter bridge characteristics

UNIT-III

Converter and HVDC System Control:

Principle of DC Link control, Converter control characteristics, system and control hierarchy, firing angle control, converter and excitation angle control, starting and stopping of DC Link, Power control, Sources of reactive power, static var systems.

UNIT-IV

Converter Faults:

Protection against over currents, over voltages in converter station, surge arresters, protection against over voltages

Smoothing reactor, DC Line, Transient over-voltages in DC line, protection of DC line, DC breakers.

UNIT-V

Generation of Harmonics, Design of AC Filters, Dc Filters, Carrier frequency and RI noise. **MTDC Links** Multi-Terminal and Multi-Infeed Systems. Series and Parallel MTDC systems using LCCs.MTDC systems using VSCs. Modern Trends in HVDC Technology. Introduction to Modular Multi-level Converters.

Text Books:

1. K R Padiyar, “HVDC Transmission Systems”
2. S. Rao, “EHV AC and HVDC Transmission engineering and Practice”
3. J.Arrillaga, “High Voltage Direct Current Transmission”, Peter Peregrinus Ltd.,1983.
4. E.W.Kimbark, “Direct Current Transmission”, Vol.1, Wiley-Interscience,1971.

EE704C.ii	HIGH VOLTAGE ENGINEERING	3L:0T:0P	3 Credits
Sessional Marks: **40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of the course, the student will demonstrate

1. Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
2. Knowledge of generation and measurement of D. C., A.C., & Impulse voltages. Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.
3. Knowledge of how over-voltages arise in a power system, and protection against these over-voltages.

UNIT-I

Breakdown in solid, liquid and gas insulating materials

Ionization processes and de-ionization processes, Types of Discharge, Gases as insulating materials, Breakdown in Uniform gap, non-uniform gaps, Townsend's theory, Streamer mechanism, Corona discharge Breakdown in pure and commercial liquids, Solid dielectrics and composite dielectrics, intrinsic breakdown, electromechanical breakdown and thermal breakdown, Partial discharge, applications of insulating materials.

UNIT-II

Generation of High Voltages

Generation of high voltages, generation of high D. C. and A.C. voltages - Van de Graff Generator, Cockcroft Walton Voltage multipliers, Cascade transformer circuits, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

UNIT-III

Measurements of High Voltages and Currents

Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillo graphs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

UNIT-IV

Lightning and Switching Over-voltages

Charge formation in clouds, Stepped leader, Dart leader, Lightning Surges. Switching over-voltages, Protection against over-voltages, Surge diverters, and Surge modifiers.

UNIT-V

High Voltage Testing of Electrical Apparatus and High Voltage Laboratories Various standards for HV Testing of electrical apparatus, IS, IEC standards, Testing of insulatorsand bushings, testing of isolators and circuit breakers, testing of cables, power transformers and some high voltage equipment, High voltage laboratory layout, indoor and outdoor laboratories, testing facility requirements, safety precautions in H. V. Labs.

Text/Reference Books:

1. M.S. Naidu and V. Kamaraju, “High Voltage Engineering”, Mc Graw Hill Education, 2013.
2. C. Wadhwa, “High Voltage Engineering”, New Age International Publishers, 2007.
3. D.V. Razevig (Translated by Dr. M. P. Chourasia), “High Voltage Engineering Fundamentals”, Khanna Publishers,1993.
4. E. Kuffel, W.S. Zaengl and J. Kuffel, “High Voltage Engineering Fundamentals”, NewnesPublication, 2000.

1. R.Arora and W.Mosch “High Voltage and Electrical Insulation Engineering”, John Wiley & Sons,2011.Various IS standards for HV Laboratory Techniques and Testing

EE704C.iii	SMART GRID	3L:0T:0P	3 Credits
Sessional Marks: **40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of this course, students will demonstrate the ability to

1. Understand smart grids and analyze the smart grid policies and developments in smart grids.
2. Develop concepts of smart grid technologies and their applications.
3. Analyze micro grids, distributed generation systems, the effect of power quality in smart grid and understand latest developments in ICT for smart grid.

UNIT – 1

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient &Self-Healing Grid, Present development & International policies on Smart Grid. Case study of Smart Grid.

UNIT – 2

Smart Grid Technologies-I: Introduction to Smart Meters, Real Time Prizing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase ShiftingTransformers.

UNIT – 3

Smart Grid Technologies-II: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System (GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

UNIT – 4

Micro grids and Distributed Energy Resources: Concept of micro grid, need & applications of microgrid, formation of microgrid, Issues of interconnection, protection & control of microgrid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, microturbines, Captive power plants, Integration of renewable energy sources.

UNIT – 5

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

Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN).

Text Books:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai "Integration of Green and Renewable Energy in Electric Power Systems", Wiley
2. Clark W. Gellings, "The Smart Grid: Enabling Energy Efficiency and DemandResponse", CRC Press

Reference Books:

1. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, AkihikoYokoyama, "SmartGrid: Technology and Applications", Wiley
2. Jean Claude Sabonnadière, NouredineHadjsaïd, "Smart Grids", Wiley Blackwell 19
3. Peter S. Fox Penner, "Smart Power: Climate Changes, the Smart Grid, and the Future of ElectricUtilities", Island Press; 1 edition 8 Jun 2010
4. S. Chowdhury, S. P. Chowdhury, P. Crossley, "Microgrids and Active Distribution Networks."Institution of Engineering and Technology, 30 Jun 2009
5. Stuart Borlase, "Smart Grids (Power Engineering)", CRC Press 6. Andres Carvallo, John Cooper, "The Advanced Smart Grid: Edge Power Driving Sustainability: 1", Artech House Publishers July 2011

EE707 L	**POWER SYSTEM SIMULATION LAB**	**0L:0T:3P**	**1.5 Credits**
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Pre-requisites: Power systems-II, Power System Analysis, Power System Operation and Control, Power System Protection

Course Outcomes: At the end of the course, the student will be able to:

1. Analyze transmission systems under steady state and transient conditions
2. Perform fault calculation and network protection
3. Understand the performance of renewable energy systems

LIST OF EXPERIMENTS

1. Determination of Receiving end quantities and the line performance of a medium/longtransmission line using simulation tool.
2. Using Computer code determine:
   i. Bus admittance matrix by inspection method for a 3-bus power system and obtain
   ii. Power flow solution by Newton-Raphson method.
3. Determination of Sequence components (Positive, Negative and Zero) of an alternatorusing simulation tool.
4. Transient analysis of a Single Machine Infinite Bus (SMIB) system using simulation tool.
5. Simulation of LG, LL, LLG and LLL faults on a simple power system.
6. Determine steady state frequency error and frequency deviation response for an
   i. Isolated power system and
   ii. Interconnected power system.
7. Plot the Swing curve for a simple 3 or 4 bus power system using Simulation Tool.
8. Study the Over current protection scheme using numerical relay.
9. Determination of ABCD parameters and performance of a transmission line
10. Determination of Positive, Negative and Zero sequence reactance for a 3-phase alternator

Additional Experiments

1. Plot V-I characteristics of Solar panel at various levels of insolation.
2. Study the performance of a Wind turbine system at different wind speeds and plot the characteristics.
3. Determination of Earth resistance in humid and dry earth conditions.

EE708 S	**IOT LAB**	**1L:0T:2P**	**2 Credits**
Sessional Marks :**40**		End Semester Examination Marks: **60**	

Course Outcomes: At the end of the course, the student will be able to:

1. Control different electrical and electronics applications using Arduino
2. Control different electrical and electronics applications using Raspberry Pi

List of Experiments

1. Interfacing LED, Push button using Arduino.
2. Interfacing DHT11- Temperature and humidity sensor using Arduino.
3. Interfacing Ultrasonic sensor using Arduino.
4. Interfacing PIR sensor using Arduino.
5. Design of Traffic Light Simulator using Arduino.
6. Interfacing RFID using Arduino/ Raspberry Pi
7. Interfacing of LED, Push button with Raspberry Pi (Python Program).
8. Design of Motion Sensor Alarm using PIR Sensor.
9. Interfacing DHT11-Temperature and Humidity Sensor with Raspberry Pi.
10. Implementation of DC Motor and Stepper Motor Control with Raspberry Pi.

Project based experiments:

1. Raspberry Pi based Smart Phone Controlled Home Automation.
2. Smart Traffic light Controller.
3. Smart Health Monitoring System.