MOHAMED SATHAK A J COLLEGE OF ENGINEERING

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S.No	Name of the course that include experimental learning through Project Work/Internship/Mini Project 2018-2019
1	EE6404-Measurements and Instrumentation
2	EE6801-Electric Energy Generation,Utilization and Conservation
3	EE6006-Applied Soft Computing
4	EC6002-Advanced Digital Signal Processing
5	EE6002-Power System Transients
6	EE6009-Power Electronics for Renewable Energy Systems
7	EE6402-Transmission and Distribution
8	EE6007-Micro Electro Mechanical Systems
9	EE6004-Flexible AC Transmission Systems
10	EE6011-Power System Dynamics
11	EE6003-Optimisation Techniques
12	EE6010-High Voltage Direct Current Transmission
13	EE6001-Visual Language and Application
14	EI6704-Biomedical Instrumentation

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S.No	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
1	EE6404	Measurements and Instrumentation	Wattmeter and energy meters Elements of data acquisition System

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EE6404 **MEASUREMENTS AND INSTRUMENTATION** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the basic functional elements of instrumentation
- To introduce the fundamentals of electrical and electronic instruments
- To educate on the comparison between various measurement techniques
- To introduce various storage and display devices
- To introduce various transducers and the data acquisition systems

UNIT I INTRODUCTION **9**

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration.

UNIT II ELECTRICAL AND ELECTRONICS INSTRUMENTS **9**

Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III COMPARISON METHODS OF MEASUREMENTS **9**

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic interference – Grounding techniques.

UNIT IV STORAGE AND DISPLAY DEVICES **9**

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & dot matrix display – Data Loggers.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS **9**

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

TOTAL :45 PERIODS

OUTCOMES:

- Ability to model and analyze electrical apparatus and their application to power system

TEXT BOOKS:

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2003.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

REFERENCES:

1. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2004.
2. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
3. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
2	EE6801	Electric Energy Generation, Utilization and Conservation	Estimation of average solar radiation energy balance equation and collector efficiency

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EE6801 ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION **LT P C 3 0 0 3**

OBJECTIVES:

- To analyze the various concepts behind renewable energy resources.
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To introduce knowledge on Solar Radiation and Solar Energy Collectors
- To introduce concepts of Wind Energy and its utilization

UNIT I ELECTRIC DRIVES AND TRACTION **9**

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION **9**

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps – design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.

UNIT III HEATING AND WELDING **9**

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.

UNIT IV SOLAR RADIATION AND SOLAR ENERGY COLLECTORS **9**

Introduction - solar constant - solar radiation at the Earth's surface - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency - concentrating collector - advantages and disadvantages of concentrating collectors - performance analysis of a cylindrical - parabolic concentrating collector – Feedin Invertors.

UNIT V WIND ENERGY **9**

Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind Turbines - analysis of aerodynamic forces acting on the blade - performances of wind.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.

TEXT BOOKS:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age International Limited,1993.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. G.D.Rai, "Non-Conventional Energy Sources", Khanna Publications Ltd., New Delhi, 1997.

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REFERENCES:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited.,2007.
2. H.Partab, Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi, 2004.
1. C.L.Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age International Pvt.Ltd., 2003.
2. S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha,' Generation and Utilization of Electrical Energy', Pearson Education, 2010.
3. Donals L. Steeby,' Alternative Energy Sources and Systems', Cengage Learning, 2012

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
3	EE6006	Applied Soft Computing	Applications of artificial Neural network Fuzzification – Defuzzification

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EE6006 **APPLIED SOFT COMPUTING** **L T P C**
3 0 0 3

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks
- To provide adequate knowledge about fuzzy and neuro-fuuzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.

UNIT I ARCHITECTURES – ANN **9**

Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm-Back propagation network.

UNIT II NEURAL NETWORKS FOR CONTROL **9**

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.

UNIT III FUZZY SYSTEMS **9**

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system.

UNIT IV APPLICATION OF FUZZY LOGIC SYSTEMS **9**

Fuzzy logic control: Home heating system - liquid level control - aircraft landing- inverted pendulum – fuzzy PID control, Fuzzy based motor control.

UNIT V GENETIC ALGORITHMS **9**

Introduction-Gradient Search – Non-gradient search – Genetic Algorithms: binary and real representation schemes, selection methods, crossover and mutation operators for binary and real coding - constraint handling methods – applications to economic dispatch and unit commitment problems.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.
- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.

REFERENCES:

1. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
2. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence,Control & Information', Pearson Education, New Delhi, 2003.
3. M.Gen and R,Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. William S.Levine, "Control System Advanced Methods," The Control Handbook CRC Press, 2011.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
4	EC6002	Advanced Digital Signal Processing	Filtering random processes, ARMA, AR and MA processes Forward and Backward linear prediction

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EC6002 **ADVANCED DIGITAL SIGNAL PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:

- To bring out the concepts related to stationary and non-stationary random signals
- To emphasize the importance of true estimation of power spectral density
- To introduce the design of linear and adaptive systems for filtering and linear prediction
- To introduce the concept of wavelet transforms in the context of image processing

UNIT I DISCRETE-TIME RANDOM SIGNALS **9**

Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, Power Spectral Density, Spectral Factorization, Innovations Representation and Process, Filtering random processes, ARMA, AR and MA processes.

UNIT II SPECTRUM ESTIMATION **9**

Bias and Consistency, Periodogram, Modified periodogram, Blackman-Tukey method, Welch method, Parametric methods of spectral estimation, Levinson-Durbin recursion.

UNIT III LINEAR ESTIMATION AND PREDICTION **9**

Forward and Backward linear prediction, Filtering - FIR Wiener filter- Filtering and linear prediction, non-causal and causal IIR Wiener filters, Discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS **9**

Principles of adaptive filter – FIR adaptive filter – Newton's Steepest descent algorithm – LMS algorithm – Adaptive noise cancellation, Adaptive equalizer, Adaptive echo cancellers.

UNIT V WAVELET TRANSFORM **9**

Multiresolution analysis, Continuous and discrete wavelet transform, Short Time Fourier Transform, Application of wavelet transform, Cepstrum and Homomorphic filtering.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students will be able to:

- Explain the parametric methods for power spectrum estimation.
- Discuss adaptive filtering techniques using LMS algorithm and the applications of adaptive filtering.
- Analyze the wavelet transforms.

TEXT BOOKS:

1. Monson H, Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Indian Reprint, 2007.
2. John G.Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson, Fourth, 2007.
3. Dwight F. Mix, "Random Signal Processing", Prentice Hall, 1995.

REFERENCE:

1. Sophocles J. Orfanidis, "Optimum Signal Processing, An Introduction", McGraw Hill, 1990.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
5	EE6002	Power System Transients	Effect of transients on Power Systems protection using ground wires

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EE6002 **POWER SYSTEM TRANSIENTS** **LT P C**
3 0 0 3

OBJECTIVES:

- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lighting strokes and the production of lighting surges.
- To study the propagation, reflection and refraction of travelling waves.
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I INTRODUCTION AND SURVEY **9**

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS **9**

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT III LIGHTNING TRANSIENTS **9**

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS **9**

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM **9**

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCES:

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
6	EE6009	Power Electronics for Renewable Energy Systems	Boost and buck-boost converters Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

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EE6009 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS

LT P C

3 0 0 3

OBJECTIVES:

- To Provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

UNIT I INTRODUCTION **9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

UNIT III POWER CONVERTERS **9**

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS **9**

Stand alone operation of fixed and variable speed wind energy conversion systems and solar system- Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS **9**

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.

TEXT BOOK:

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi,2009.

REFERENCES:

1. Rashid .M. H "power electronics Hand book", Academic press, 2001.
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.
5. Andrzej M. Trzynnadlowski, 'Introduction to Modern Power Electronics', Second edition, wiley India Pvt. Ltd, 2012.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
7	EE6402	Transmission and Distribution	Interference with neighboring communication circuits methods of voltage control

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EE6402 **TRANSMISSION AND DISTRIBUTION** **LT P C**
3 0 0 3

OBJECTIVES:

- To develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and operating
- voltage for determining voltage regulation and efficiency. Also to improve the voltage profile of the transmission system.
- To analyses the voltage distribution in insulator strings and cables and methods to improve the same.
- To understand the operation of the different distribution schemes.

UNIT I STRUCTURE OF POWER SYSTEM **9**

Structure of electric power system: generation, transmission and distribution; Types of AC and DC distributors – distributed and concentrated loads – interconnection – EHVAC and HVDC transmission - Introduction to FACTS.

UNIT II TRANSMISSION LINE PARAMETERS **9**

Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD; skin and proximity effects - interference with neighboring communication circuits - Typical configurations, conductor types and electrical parameters of EHV lines, corona discharges.

UNIT III MODELLING AND PERFORMANCE OF TRANSMISSION LINES **9**

Classification of lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance; transmission efficiency and voltage regulation, real and reactive power flow in lines, Power - circle diagrams, surge impedance loading, methods of voltage control; Ferranti effect.

UNIT IV INSULATORS AND CABLES **9**

Insulators - Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators. Underground cables - Types of cables, Capacitance of Single-core cable, Grading of cables, Power factor and heating of cables, Capacitance of 3- core belted cable, D.C cables.

UNIT V MECHANICAL DESIGN OF LINES AND GROUNDING **9**

Mechanical design of transmission line – sag and tension calculations for different weather conditions, Tower spotting, Types of towers, Substation Layout (AIS, GIS), Methods of grounding.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. D.P.Kothari , I.J. Nagarath, 'Power System Engineering', Tata McGraw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.
2. C.L.Wadhwa, 'Electrical Power Systems', New Academic Science Ltd, 2009.
3. S.N. Singh, 'Electric Power Generation, Transmission and Distribution', Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

REFERENCES:

1. B.R.Gupta, , S.Chand, 'Power System Analysis and Design'New Delhi, Fifth Edition, 2008.
2. Luces M.Fualken berry ,Walter Coffer, 'Electrical Power Distribution and Transmission', Pearson Education, 2007.
3. Hadi Saadat, 'Power System Analysis,' PSA Publishing; Third Edition, 2010.
4. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; Fourth Edition, 2012.
5. G.Ramamurthy, "Handbook of Electrical power Distribution," Universities Press, 2013.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
8	EE6007	Micro Electro Mechanical Systems	Magnetic Actuators sensors and actuators

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EE6007 **MICRO ELECTRO MECHANICAL SYSTEMS** **LT P C**
3 0 0 3

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION **9**

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I **9**

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.

UNIT III SENSORS AND ACTUATORS-II **9**

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING **9**

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS **9**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand the operation of micro devices, micro systems and their applications.
- Ability to design the micro devices, micro systems using the MEMS fabrication process.

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
9	EE6004	Flexible AC Transmission Systems	Design of SVC voltage regulator Modelling for Power Flow and stability studies

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EE6004 **FLEXIBLE AC TRANSMISSION SYSTEMS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the reactive power control techniques
- To educate on static VAR compensators and their applications
- To provide knowledge on Thyristor controlled series capacitors
- To educate on STATCOM devices
- To provide knowledge on FACTS controllers

UNIT I INTRODUCTION **9**

Reactive power control in electrical power transmission lines -Uncompensated transmission line - series compensation – Basic concepts of Static Var Compensator (SVC) – Thyristor Controlled Series capacitor (TCSC) – Unified power flow controller (UPFC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS **9**

Voltage control by SVC – Advantages of slope in dynamic characteristics – Influence of SVC on system voltage – Design of SVC voltage regulator –Modelling of SVC for power flow and fast transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS **9**

Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS **9**

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability - prevention of voltage instability. SSSC-operation of SSSC and the control of power flow –modelling of SSSC in load flow and transient stability studies.

UNIT V CO-ORDINATION OF FACTS CONTROLLERS **9**

Controller interactions – SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques – Control coordination using genetic algorithms.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc, 2002.
2. Narain G. Hingorani, "Understanding FACTS -Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi- 110 006, 2011.
3. K.R.Padiyar," FACTS Controllers in Power Transmission and Distribution", New Age International(P) Limited, Publishers, New Delhi, 2008.

REFERENCES:

1. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers, 2004.
3. Xiao – Ping Zang, Christian Rehtanz and Bikash Pal, "Flexible AC Transmission System: Modelling and Control" Springer, 2012.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
10	EE6011	Power System Dynamics	Types of excitation systems one axis machine model including excitation system power system stabilizer

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EE6011 **POWER SYSTEM DYNAMICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To introduce the basics of dynamics and stability problems
- To educate on modeling of synchronous machines
- To educate on the excitation system and speed-governing controllers.
- To study small signal stability of a single-machine infinite bus system with excitation system and power system stabilizer.
- To educate on the transient stability simulation of multi machine power system.

UNIT I INTRODUCTION **9**

Basics of system dynamics – numerical techniques – introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design - distinction between transient and dynamic stability - complexity of stability problem in large system – necessity for reduced models - stability of interconnected systems.

UNIT II SYNCHRONOUS MACHINE MODELLING **9**

Synchronous machine - flux linkage equations - Park's transformation - per unit conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants. Simplified models (one axis and constant flux linkage) - steady state equations and phasor diagrams.

UNIT III MACHINE CONTROLLERS **9**

Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit. Function of speed governing systems - block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines.

UNIT IV TRANSIENT STABILITY **9**

State equation for multi machine system with one axis model and simulation – modelling of multi machine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer. For all simulations, the algorithm and flow chart have to be discussed.

UNIT V DYNAMIC STABILITY **9**

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact - linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation - supplementary stabilizing signals - dynamic performance measure - small signal performance measures.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. P.M. Anderson and A.A.Fouad, 'Power System Control and Stability', Galgotia Publications, New Delhi, 2003.
2. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc., USA, 1994.
3. R.Ramanujam, "Power System Dynamics – Analysis and Simulation", PHI, 2009.

REFERENCES:

1. M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.
2. James A.Momoh, Mohamed. E. El-Hawary. " Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel, Dekker, USA, First Edition, 2000.
3. C.A.Gross, "Power System Analysis," Wiley India, 2011.
4. B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac," Electric Power Systems", Wiley India, 2013.
5. K.Umarao, "Computer Techniques and Models in Power System," I.K. International, 2007.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
11	EE6003	Optimization Techniques	Reduced gradient algorithms Karmarkar's algorithm

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EE6003	OPTIMISATION TECHNIQUES	L T P C 3 0 0 3

OBJECTIVES:

- To introduce the basic concepts of linear programming
- To educate on the advancements in Linear programming techniques
- To introduce non-linear programming techniques
- To introduce the interior point methods of solving problems
- To introduce the dynamic programming method

UNIT I LINEAR PROGRAMMING 9

Introduction - formulation of linear programming model-Graphical solution– solving LPP using simplex algorithm – Revised Simplex Method.

UNIT II ADVANCES IN LPP 9

Dualit theory- Dual simplex method - Sensitivity analysis–-Transportation problems– Assignment problems-Traveling sales man problem -Data Envelopment Analysis.

UNIT III NON LINEAR PROGRAMMING 9

Classification of Non Linear programming – Lagrange multiplier method – Karush – Kuhn Tucker conditions–Reduced gradient algorithms–Quadratic programming method – Penalty and Barrier method.

UNIT IV INTERIOR POINT METHODS 9

Karmarkar's algorithm–Projection Scaling method–Dual affine algorithm–Primal affine algorithm Barrier algorithm.

UNIT V DYNAMIC PROGRAMMING 9

Formulation of Multi stage decision problem–Characteristics–Concept of sub-optimization and the principle of optimality–Formulation of Dynamic programming–Backward and Forward recursion– Computational procedure– Conversion offinal value problem in to Initial value problem.

TOTAL: 45 PERIODS

OUTCOMES:

- To understand ethical issues, environmental impact and acquire management skills.

TEXT BOOKS:

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000.
2. R.Panneerselvam, "Operations Research", PHI, 2006
3. Hamdy ATaha, "Operations Research –An Introduction", Prentice Hall India, 2003.

REFERENCES:

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2002.
2. Ronald L.Rardin, "Optimization in Operation Research" Pearson Education Pvt. Ltd. New Delhi, 2005.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
12	EE6010	High Voltage Direct Current Transmission	Converter bridge characteristics Converter control characteristics SVC and STATCOM

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EE6010 HIGH VOLTAGE DIRECT CURRENT TRANSMISSION LT P C
3 0 0 3

OBJECTIVES:

- To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
- To analyze HVDC converters.
- To study about the HVDC system control.
- To analyze harmonics and design of filters.
- To model and analysis the DC system under study state.

UNIT I INTRODUCTION 9

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

UNIT II ANALYSIS OF HVDC CONVERTERS 9

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

UNIT III CONVERTER AND HVDC SYSTEM CONTROL 9

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

UNIT IV REACTIVE POWER AND HARMONICS CONTROL 9

Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters.

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis
– case study.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.

REFERENCES:

4. Kundur P., "Power System Stability and Control", McGraw-Hill, 1993.
5. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.
4. S. Kamakshaiah, V. Kamaraju, 'HVDC Transmission', Tata McGraw Hill Education Private Limited, 2011.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
13	EE6001	Visual Languages and Applications	Context menus. The C button class – C list box class – C static class - The font view application Types – Converting variable types – User defined data types - Lifetime of a Variable

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EE6001 VISUAL LANGUAGES AND APPLICATIONS L T P C 3 0 0 3

OBJECTIVES :

- To study about the concepts of windows programming models, MFC applications, drawing with the GDI, getting inputs from Mouse and the Keyboard.
- To study the concepts of Menu basics, menu magic and classic controls of the windows programming using VC++.
- To study the concept of Document/View Architecture with single & multiple document interface, toolbars, status bars and File I/O Serialization.
- To study about the integrated development programming event driven programming, variables, constants, procedures and basic ActiveX controls in visual basic.
- To understand the database and the database management system, visual data manager, data bound controls and ADO controls in VB.

UNIT I FUNDAMENTALS OF WINDOWS AND MFC 9

Messages - Windows programming - SDK style - Hungarian notation and windows data types - SDK programming in perspective. The benefits of C++ and MFC - MFC design philosophy – Document / View architecture - MFC class hierarchy - AFX functions. Application object - Frame window object - Message map. Drawing the lines – Curves – Ellipse – Polygons and other shapes. GDI pens – Brushes - GDI fonts - Deleting GDI objects and deselecting GDI objects. Getting input from the mouse: Client & Non-client - Area mouse messages - Mouse wheel - Cursor. Getting input from the keyboard: Input focus - Keystroke messages - Virtual key codes - Character & dead key messages.

UNIT II RESOURCES AND CONTROLS 9

Creating a menu – Loading and displaying a menu – Responding to menu commands – Command ranges - Updating the items in menu, update ranges – Keyboard accelerators. Creating menus programmatically - Modifying menus programmatically - The system menu - Owner draw menus – Cascading menus - Context menus. The C button class – C list box class – C static class - The font view application – C edit class – C combo box class – C scrollbar class. Model dialog boxes – Modeless dialog boxes.

UNIT III DOCUMENT / VIEW ARCHITECTURE 9

The in existence function revisited – Document object – View object – Frame window object – Dynamic object creation. SDI document template - Command routing. Synchronizing multiple views of a document – Mid squares application – Supporting multiple document types – Alternatives to MDI. Splitter Windows: Dynamic splitter window – Static splitter windows. Creating & initializing a toolbar - Controlling the toolbar's visibility – Creating & initializing a status bar - Creating custom status bar panes – Status bar support in appwizard. Opening, closing and creating the files - Reading & Writing – C file derivatives – Serialization basics - Writing serializable classes.

UNIT IV FUNDAMENTALS OF VISUAL BASIC 9

Menu bar – Tool bar – Project explorer – Toolbox – Properties window – Form designer – Form layout – Intermediate window. Designing the user interface: Aligning the controls – Running the application – Visual development and event driven programming.

Variables: Declaration – Types – Converting variable types – User defined data types - Lifetime of a variable. Constants - Arrays – Types of arrays. Procedures: Subroutines – Functions – Calling procedures. Text box controls – List box & Combo box controls – Scroll bar and slider controls – File controls.

UNIT V DATABASE PROGRAMMING WITH VB 9

Record sets – Data control – Data control properties, methods. Visual data manager: Specifying indices with the visual data manager – Entering data with the visual data manager. Data bound list control – Data bound combo box – Data bound grid control. Mapping databases: Database object – Table def object, Query def object. Programming the active database objects – ADO object model – Establishing a connection - Executing SQL statements – Cursor types and locking mechanism – Manipulating the record set object – Simple record editing and updating.

TOTAL = 45 PERIODS

OUTCOMES:

- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Jeff Prosise, 'Programming Windows With MFC', Second Edition, WP Publishers & Distributors (P) Ltd, Reprinted, 2002.
2. Evangelos Petroutsos, 'Mastering Visual Basic 6.0', BPB Publications, 1999.

REFERENCES:

1. Herbert Schildt, 'MFC Programming From the Ground Up', Second Edition, Tata McGraw Hill, reprinted, 2002.
2. John Paul Muller, 'Visual C++ 6 From the Ground Up Second Edition', Tata McGraw Hill, Reprinted, 2002.
3. Curtis Smith & Micheal Amundsen, 'Teach Yourself Database Programming with Visual Basic 6 in 21 days', Techmedia Pub, 1999.

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S.No.	Subject Code	Subject Name	Contents that included Experimental Learning through Project Work
14	EI6704	Biomedical Instrumentation	Biomechanics of soft tissues - Basic mechanics of spinal column and limbs Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine

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EI6704 BIOMEDICAL INSTRUMENTATION L T P C 3 0 0 3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton: CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

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A HYBRID CHB MULTILEVEL INVERTER WITH SUPER CAPACITOR NERGY STORAGE FOR GRID-CONNECTED PHOTOVOLTAIC SYSTEMS

A PROJECT REPORT

Submitted by

SHAIK UMAR (311815105028)

A. MOHAMED ASIF (311815105303)

S. MOHAMED RASITH (311815105304)

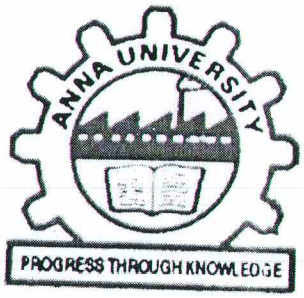
In partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

In

ELECTRICAL AND ELECTRONICS ENGINEERING



ANNA UNIVERSITY: CHENNAI 600 025

APRIL 2019



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BONAFIDE CERTIFICATE

'ertified that this project report for **"A HYBRID CHB MULTILEVEL INVERTER VITH SUPER CAPACITOR ENERGY STORAGE FOR GRID-CONNECTED 'HOTOVOLTAIC SYSTEMS"** is the bonafide work of **"SHAIK UMAR 311815105028), A. MOHAMED ASIF (311815105303), S. MOHAMED RASITH 311815105304)"** who carried out the project work under our supervision. Certified urther, that to the best of our knowledge the work reported herein does not from part of ıy other project report or dissertation on the basis of which a degree or award was ɔnferred on an earlier occasion on this or any other candidate.

GNATURE

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ABSTRACT

This paper presents a multilevel inverter configuration which is designed by pacitive voltage sources and a conventional H-bridge module. By serial connection of 'o modified H-bridge modules, it is possible to produce 9 output voltage levels cluding zero. Multicarrier phase-shifted pulse-width modulation method is used to hieve balanced power distribution among the power cells. The analysis of the output ltage harmonics is carried out. Cascaded H-bridge multilevel technology is more propriate for this particular application as the input is in the form of four separate tteries, which are used to achieve a stepped AC voltage waveform at the output. Proper arging mechanism for the batteries plays a vital part in this design.

Multi-level inverters have been a great concern of many researchers, for more than ee decades, fostering the growth of many successful industrial applications. Among se techniques, Cascaded H-Bridge (CHB) Multi-Level Inverter technology is rapidly ining popularity due to many of its advantages the multilevel inverter utilization has en increased since the last decade. These new types of inverters are suitable in various gh voltage & high-power application due to their ability to synthesize waveforms with ter harmonic spectrum and faithful output.

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CONCLUSION:

In this paper, the design of a thirteen-level Cascaded H-Bridge (CHB) Multi-Level Inverter is presented. Despite many of the researches related to CHB inverters being made in the high power end, here the successful implementation of this technology in a low power application is presented by incorporating the proposed inverter Multilevel inverters have become an effective and practical solution for increasing power and reducing harmonics of ac waveforms. This project deals with the design and implementation of single-phase eleven-level Cascaded H-bridge multilevel inverter for RL load with multicarrier phase-shifted PWM modulation method. The simulation of 11-level cascaded H-bridge is done. Along with it, it's harmonic analysis was done. The simulation results shows that the developed nine-level Cascaded H-bridge Multilevel inverter has many merits such as reduce number of switches, lower EMI, less harmonic distortion and the THD obtained is 13.01%.

RECOMMENDED FUTURE WORK

The new hybrid H-bridge multilevel inverter can be tried to reduce the number of switch concept. This multilevel inverter facilitates the use of single DC voltage source with capacitors. A FPGA controller has been used to implement the control algorithm to drive the motor with the real time variable output voltage and variable frequency. Additionally, the capacitor voltage is detected by a voltage sensor and fed into the FPGA controller to realize the capacitor voltage regulation. The new hybrid H-bridge multilevel inverter is used with the help of renewable energy utility interface, such as solar panel, wind energy, the lead acid battery banks. Direct torque control can be used with the new hybrid H-bridge multilevel inverter to reduce the torque ripples and improve the performance of the induction motor drive.

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HIERARCHY BASED POWER MANAGEMENT SYSTEM

A PROJECT REPORT

Submitted by

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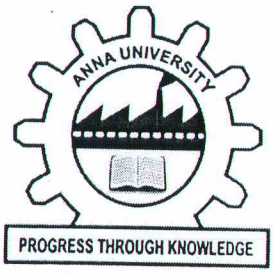
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BONAFIDE CERTIFICATE

Certification that this project report "**HIERARCHY BASED POWER MANAGEMENT SYSTEM**" is the bonafide work of **S.SHAIK FATHHULLAH(311815105027), M.GANESH(311815105301), S.MANO BALAN(311815105009)** and **M.HANEEN AHAMED(311815105302)** who carried out the project work under my supervision.

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INTERNAL EXAMINER

EXTERNAL EXAMINER

ABSTRACT

The objective of the projects is maximum demand value is the average from the instantaneous power (in KW or KVA) during a defined time interval, usually every 15 minutes (this time interval will depend on each country). As we have been advancing, the goal to control the maximum demand is to not exceed the limit of the contracted power. To archive this goal, we advise to install a system able to disconnect non critical loads, on different time periods, and also avoid connecting loads simultaneously to reduce the instantaneous power. To avoid penalties for maximum demand we must ensure that this value will never exceed contracted power. Usually in electricity bills, the highest maximum demand value recorded by the meter is compared to the contracted power. Whenever this value is higher than the contracted power, there will be an economic penalty. The objective of proposed system is efficient use of available power and prevents the device from damage and providing information to consumers about power shutdown and maximum demand hierarchy based ON\OFF .Flexibility to user to decide what load to be used at the peak load time when the power availability is low. Saved power can be utilized for other purpose. Shut down information to the specific consumer through alarm or any comm. As we like. Maximum power demand indic ation. This project present the Hierarchy based power management system for large power consumption area .Whenever the load consumption is near the demand value the relay worked on hierarchy based and it switch off the unnecessary load. This will continue unlit the normal condition occurs .So that we can reduce the penalty to the owner.

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CHAPTER 10

CONCLUSION

The power management systems detect the maximum power and it cannot make a decision on which devices to operate because of which power saving is difficult. There is no indication of shutdown and maximum power demand. The objective of proposed system is efficient use of available power and prevents the device from damage and providing information to consumers about power shutdown and maximum demand hierarchy based ON\OFF. Flexibility to user to decide what load to be used at the peak load time when the power availability is low. Saved power can be utilized for other purpose. Shut down information to the specific consumer through alarm or any common indication. This project present the Hierarchy based power management system for large power consumption area .Whenever the load consumption is near the demand value the relay worked on hierarchy based and it switch off the unnecessary load. This will continue unlit the normal condition occurs .So that consumer can reduce the penalty. In future the IOT (Internet of Things) can be implemented to this system .So that consumer can monitor the value of load from anywhere in the world. This introduction will very much help the owner to track the power value from anywhere.

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SMART IRRIGATION SYSTEM USING ARDUINO UNO

A PROJECT REPORT

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INTERNAL EXAMINER

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ABSTRACT

The Smart Irrigation System is the method to control the flow of water in the Agriculture land at from any places with our Smart Phones in this the project able to sense the water moister level in the field and also project can able to sense the Humidity level in the field Atmosphere. All this setup are able to monitor by our Programed Mobile Number carried by our mobile phones.

Soil moisture sensor, Humidity and temperature sensor, GSM module, LCD display and Arduino all these hardware components are interfaced with the project and the software project used Arduino IDE.

The project act to work in both manual and automatic process in the manual process user giving the commands and if project want to set the system in the automatic mode by sending the command by our programed mobile phone.

Thus project able to monitor our land moisture level and humidity level 24/7 at where ever else project start the automatic monitoring system.

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CHAPTER 10

CONCLUSION

The project was based on the agricultural lands by using Arduino UNO as the microcontroller and GSM module as interface with the users in the purpose of the flexibility of the customers to monitor their irrigation land from anywhere with their mobile phones. The results showed that the system works successfully. Future research is controlling the flow of water, meaning instead of just monitoring the water flow, usage, moisture content, controlling them will be one step further, so that the users can even control their motor and there field moisture level by themselves remotely from their mobile phones.

10.1 Future scope

- Smart irrigation can be implemented through wireless network and the wireless communications
- Software can be modified to view the moisture and water level on request
- This will help to monitor the land from anywhere just by sending a simple message (sms) or through internet.
- Theft detection



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SMART HIGHWAY ACCIDENT ALERT USING RASPBERRY PI CAMERA

A PROJECT REPORT

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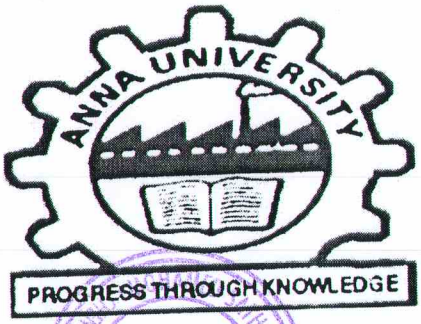
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ABSTARCT

A smart roads using Raspberry pi cam is a special idea which makes the rivers to drive safer than before. The first motive of smart road is to provide afety, use less amount of electricity and reduce traffic. This can be mplemented by using advanced technologies like Light Sensors, Ultrasonic Sensors, Camera, Motion Sensors, Interactive Lighting System, The solar roadways, Glow in the Night. In Indian road-traffic, the problems like crowded roads, unpredictable time to travel from one place to another are a serious problems which is also polluted and noisy. Now, researchers have started to introduce connected vehicle technology which is difficult to implement on roads. In this project, we present a low cost innovative technology for smart roads. The wastage of electricity from street lights can be minimized by using the motion sensors and light sensors due to which the loss of electricity can be prevented. In this project we send the videos to control room if any accident and any disturbance are acquire anyone can switch on the panic button.

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7.3 CONCLUSION

This work can be achieved by the smart highway accident alert using Raspberry pi camera. It provides safety, can use less amount of electricity and reduce traffic implemented by advanced technologies. These solar roadways are glow in night. In this work we present low cost and innovative technology for smart roads.

The IOT is used for network connectivity and computing capability extends to object sensors to generate and exchange and consume data with minimal human intervention. There is no signal, Universal definition.

7.4 FUTURE WORK

Smart roads can provide real-time information to drivers about weather conditions, traffic information and parking availability. Smart roads are particularly useful on risky or mountainous roads to make driving safer by warning about incoming traffic or landslides.

Smart roads can also generate energy to use for street lights or change electric vehicles on the move. They also improve LEDs to dynamically change lane or parking configuration as per the situation.

We also improve technology on road has been adapted to wireless charge an electric bus while it travels on its route. The lot of potential for exploring new ideas for developing smart roads. Smart roads are certainly the roads of the future.

While retrofitting is allowing us to incorporate beneficial aspects of IOT technology into current road systems, future roads are being designed from the ground up around complete interconnectivity with IOT networks.

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DIODE CLAMPED MULTILEVEL INVERTER BASED ON SOLAR ENERGY

A PROJECT REPORT

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ABSTRACT

Multilevel converters are increasingly being considered for high power applications because of their ability to operate at higher output voltages while producing lower levels of harmonic components in the switched output voltages. Two well known multilevel converter topologies are the Neutral Point Clamped (NPC) Inverter and Cascaded inverter. One of the major problems in electric power quality is the harmonic contents. There are several methods of indicating the quantity of harmonic contents. The most widely used measure is the total harmonic distortion (THD). Various switching techniques have been used in static converters to reduce the output harmonic content. Pulse Width Modulation techniques for multilevel inverters have been developed very intensively in recent years. Many carriers based and sinusoidal PWM (SPWM) techniques for multilevel inverters have been properly deduced from that of two-level inverter. In contrast, PD modulation of a NPC inverter is harmonically superior, because it places harmonic energy directly into the carrier harmonic for each phase leg, and relies on cancellation of this harmonic across phase legs as the line-to-line voltage is developed. Many different PWM-strategies for multi-level inverters exist. This paper proposes the various multi level circuits with SPWM strategies for Inverters. Operating principles with switching functions are analyzed for Five to fifteen (odd) levels SPWM inverter. Five-level to fifteen level (odd levels) SPWM inverter is presented to alleviate harmonic components of output voltage.

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7.3 CONCLUSION

The energy of light shifts electrons in some semiconducting materials. This photovoltaic effect is capable of large-scale electricity generation .However , the present low efficiency of solar PV cells demands very large areas to supply electricity demands. This three level DCMLI has been presented for induction motor application. The working of multilevel inverter is explained detail. The main concept of this project is to use diodes to limit the power devices voltage stress. The three level DCMLI have became on effective practical solution forlargest output levels and reduced the ripple on induction motor. More than benefit multilevel inverter compare to normal inverter because, normal inverter is produced impure AC source but my project is produced clearly pure AC Source. Main motive is reduced the ripple of induction motor.

7.4 FUTURE SCOPE

In our project we have done a "THREE LEVEL DIODE CLAMPED MULTILEVEL INVERTER" in future we have research on solar energy by using diode clamped multi level inverter in various number of level.For the purpose of to reduced harmonics in induction motor.

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A SMART PREPAID ENERGY METER WITH GSM TECHNOLOGY

A PROJECT REPORT

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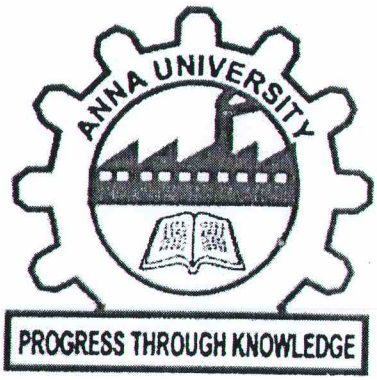
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INTERNAL EXAMINER

17/4/19
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ABSTRACT

Every month we can see a person standing in front of our house from Electricity board or water board whose duty is to read the energy meter and handover the bills (Electric) to the owner of that house. This is nothing but meter reading. According to that reading we have to pay the bills.

The main drawback of this system is that person has to go area by area and he has to read the meter of every house and handover the bills. The Electricity board authority has to give privileges for these people to do their duty monthly. The thing is, Government will not appoint any particular persons for this duty. The people working in these boards will go on a particular day and do their duty leaving all their pending works.

Due to this, their work will be delayed and this is great loss for government. To overcome this drawback we have come up with an idea and this idea will help the government and it will save the time of the employees working in these boards as system supports if we use smartcard to implement prepaid energy meter then it will be helpful to store data in a smartcard of that user.

The aim of the project is to automate the prepaid billing of energy meter. In this project the front end is User friendly and the employees can work on this software with minimum knowledge of computers. Employees can read the meter by sitting in the Office



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CHAPTER 8

CONCLUSION

This project based on energy meter prepaid system by using Arduino UNO as microcontroller and GSM module as interface with the users in the purpose of the flexibility of the customers to monitor their current bill or power consumptions usage from anywhere with their mobile phones. The results showed that the system works successfully. Future research is controlling the energy meter, meaning instead of just monitoring the meter, usage, power consumption, controlling them will be one step further, so that the users can even control their bill, usage, power consumptions by themselves remotely from their mobile phones.

8.1 LIMITATIONS

The users cannot set the 'limit' of the bill for every month using SMS but they need to modify the coding by themselves or used the current limit that had been set in the coding. So, for future work or recommendation, adding the rechargeable battery to make sure the system can be operate and standby to counting even when breakout. The rechargeable battery that can be use is lead acid battery. It will backup if the system is shutdown. Another recommendation is using the Arduino Mega as the main controller, so that there are many things can be added because Arduino UNO will not have enough RAM if we combine with many sensors or interfaces. When the RAM is not enough, it will occurs in unstable system.

8.2 FUTURE SCOPE

- Remote recharging can be implemented through wireless network the wireless communications
- Software can be modified to view the balance on request

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