The restructuring and deregulation of electric utilities together with recent progress in Smart and Renewable Energy Technologies introduce unprecedented challenges and wide scope for power and energy systems research and open up new opportunities to young Power Engineers. The advancement in Power & Energy with the vision of redefining the Conventional Power System as an Intelligent Power Grid with a blend of the latest technologies like Smart Sensing, Cyber Physical System and ICT coupled with Renewable Energy Sources, Electric Vehicle, and Energy Storage etc. will be the key factors to a sustainable world for future generations.

M. Tech. program in Power and Energy is intended to explore the above mentioned challenges and also to initiate intense research activities. The structure of lab oriented courses will enable the students to have an insight into the real time scenarios and can build a thorough understanding of the systems as a whole. The Power and Energy courses emphasis on the various streams like Power System, Sustainable and Renewable Energy, Computational and Communication Technology Applications, Power Electronics and Control, Smart Technology and Embedded Systems. This programs aims to make students employable in various sectors of Power & Energy, Communication, Smart grid, Electric Transport, Petroleum Industry, Energy Management and Conservations etc. and to impart interest in carrying out high end research activities in these areas.
# CURRICULUM

## FIRST SEMESTER

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Type</th>
<th>Course</th>
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*Non Credit Course

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Credits: **23**

## THIRD SEMESTER

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Total Credits: **66**
ELECTIVES

Subjects include areas from power system, sustainable and renewable energy, computational and communication technology, power electronics and control, smart technology and embedded systems.

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<td>Energy Conservation and Management</td>
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<td>Control System Design</td>
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LIST OF COURSES

FOUNDATION CORE

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SUBJECT CORE

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### 18MA608 SOFTWARE BASED NUMERICAL COMPUTATION METHODS  3-0-1-4


### TEXT BOOKS/ REFERENCES:


TEXT BOOKS/ REFERENCES:


TEXT BOOKS/REFERENCES:


18PR625 POWER QUALITY AND FACTS 3-0-1-4

TEXT BOOKS/ REFERENCES:


18PR602 COMPUTATIONAL INTELLIGENCE FOR POWER APPLICATIONS

TEXT BOOKS/ REFERENCES:


18PR623 APPLIED DIGITAL SIGNAL PROCESSING 2-0-2-4


TEXT BOOKS/ REFERENCES:

3. PICmicro™ PIC16F87XA Data Sheet 28/40/44-Pin Enhanced Flash Microcontrollers, 2003 Microchip Technology Inc., DS39582B.

18PR624 RESTRUCTURED POWER SYSTEM OPTIMISATION 3-0-1-4

Review of power system operation in restructured scenario, marginal cost of generation, least-cost operation, and incremental cost of generation. Introduction to Power System Optimization: classical and evolutionary approaches of optimization, Formulation of optimal

**TEXT BOOKS / REFERENCES:**


**18PR601 POWER ELECTRONICS FOR RENEWABLE ENERGY TECHNOLOGIES 2-0-2-4**


**TEXT BOOKS/ REFERENCES:**


TEXT BOOKS / REFERENCES:
The student in consultation with the faculty advisor has to select a topic related to Power and Energy area, write a paper and present it. Lab training sessions in commonly used ICs and kits (Microcontrollers, FPGA kits etc) to prepare students for project phase.

**RESEARCH METHODOLOGY**  

**Unit I:**

**Unit II:**
Problem Formulation, Understanding Modeling & Simulation, Conducting Literature Review, Referencing, Information Sources, Information Retrieval, Role of libraries in Information Retrieval, Tools for identifying literatures, Indexing and abstracting services, Citation indexes

**Unit III:**
Experimental Research: Cause effect relationship, Development of Hypothesis, Measurement Systems Analysis, Error Propagation, Validity of experiments, Statistical Design of Experiments, Field Experiments, Data/Variable Types & Classification, Data collection, Numerical and Graphical Data Analysis: Sampling, Observation, Surveys, Inferential Statistics, and Interpretation of Results

**Unit IV:**
Preparation of Dissertation and Research Papers, Tables and illustrations, Guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript. References, Citation and listing system of documents

**Unit V:**

**TEXT BOOKS/ REFERENCES:**


TEXT BOOKS/ REFERENCES:
5. Nuclear power plant instrumentation and control, A guidebook, International atomic energy agency Vienna, 1984(online resource).

Energy system modelling: background, motivations, modelling physical systems, time scales of power system dynamics, energy system architecture, energy system scripting, python language. Analysis of energy systems: power flow analysis, modelling and solution by Newton Raphson method, continuation power flow analysis, modelling and solution by homotopy methods, optimal power flow analysis, modelling and solution by gradient method. Modelling of Renewable Energy: operation of PV & Wind energy systems, frequency impact & voltage analysis, modelling of solid oxide fuel cell and battery energy storage. Modelling of HVDC transmission system and voltage source converter, modelling of STATCOM and
analysis. Dealing with uncertainty and probabilistic techniques: uncertainty power flow analysis and probabilistic optimal power flow analysis. Case studies of various analyses on standard IEEE test system.

TEXT BOOKS/ REFERENCES:


18PR703 ENERGY CONSERVATION AND MANAGEMENT 2-0-1-3


TEXT BOOKS/ REFERENCES:


18PR704 ENERGY STORAGE TECHNOLOGY


TEXT BOOKS/ REFERENCES:


18PR705 ELECTRICAL DRIVES AND CONTROL

Fundamentals of electric drives, dynamics of electric drives, multi quadrant operation, closed loop control of drives. Review of DC and AC Motor Drives: Primitive machine: unified approach to the analysis of electrical machine, basic two pole model of rotating machines, Kron’s primitive machine: voltage, power and torque equation, linear transformation from 3

TEXT BOOKS/ REFERENCES:


18PR706             LOGIC AND DISTRIBUTED CONTROL SYSTEMS       2-0-1-3


TEXT BOOKS/ REFERENCES:


18PR707                                     CONTROL SYSTEM DESIGN                               2-0-1-3
Control system design by root locus method: lag, lead, lag-lead compensators, control system design by frequency response: lag, lead, lag-lead compensators. PID controller design: Tuning algorithms for PID controllers, optimal PID tuning, anti-reset wind up, derivative kick, modifications to conventional PID controller. Design of control system in state space: Pole placement controller, selection of pole locations for good design, control law design for full state feedback, design of servo systems. Observer design: Reduced order observer, design of regulator systems with observers. Computer aided designs. Simulations and case studies of classical controller design.

TEXT BOOKS/ REFERENCES:

18PR708 MACHINE LEARNING AND MULTIAGENT SYSTEM FOR POWER ENGINEERING 2-0-1-3


TEXT BOOKS/ REFERENCES:
SMART ELECTRICAL NETWORKS AND INTELLIGENT COMMUNICATION SYSTEMS


TEXT BOOKS / REFERENCES:

SOLAR ENERGY UTILISATION

Review of solar energy systems. Solar photovoltaic applications: types of systems, system design, balance of solar PV systems, Solar PV inverter & converter design, controllers, energy storage options for solar PV systems, battery & fuel cell, site selection for SPV

TEXT BOOKS/ REFERENCES:

18PR711 WIND ENERGY CONVERSION SYSTEMS 2-0-1-3


TEXT BOOKS/ REFERENCES:

18PR712 BIO-ENERGY CONVERSION 2-0-1-3


TEXT BOOKS/REFERENCES:

18PR713 ADVANCED DIGITAL SIGNAL Processors AND APPLICATIONS 2-0-1-3

Installing Linux OS, Installing and using OpenCV image processing library and basic python using Raspberry PI.

TEXT BOOKS/ REFERENCES:

18PR714 ELECTRIC VEHICLE TECHNOLOGY 2-0-1-3


TEXT BOOKS/ REFERENCES:

18PR715 CYBER PHYSICAL SYSTEMS 2-0-1-3

Cyber-Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS, CPS HW platforms: Processors, Sensors, Actuators, CPS Network, CPS SW stack RTOS, Scheduling Real Time control tasks. Principles of Automated Control Design:

TEXT BOOKS/ REFERENCES:


18PR716 ICT ENABLED POWER SYSTEM PROTECTION 2-0-1-3


TEXT BOOKS/ REFERENCES:

5. IEEE standards, Transaction papers on power system protection.