SRI SATYA SAI UNIVERSITY OF TECHNOLOGY AND MEDICAL SCIENCES
SCHOOL OF ENGINEERING
Outcome based Curriculum for
Undergraduate Degree Courses in Engineering & Technology
Department of Electrical and Electronics Engineering

EXA-601	**Power Systems – II**	**2L:1T:0P**	**3 credits**	**3Hrs/Week**

Preamble:

• To introduce the students to the general structure of the network for transferring power from generating stations to the consumers.

• To expose the students to the different electrical & mechanical aspects of trhe power network along with its environmental and safety constraints.

• To familiarize the students with the price structure of Indian power market

Course Outcomes:

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

- Use numerical methods to analyse a power system in steady state.
- Understand stability constraints in a synchronous grid.
- Understand methods to control the voltage, frequency and power flow.
- Understand the monitoring and control of a power system.
- Understand the basics of power system economics.

Unit 1: Power Flow Analysis (7 hours)

Review of the structure of a Power System and its components. Analysis of Power Flows: Formation of Bus Admittance Matrix. Real and reactive power balance equations at a node. Load and Generator Specifications. Application of numerical methods for solution of non-linear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations. Computational Issues in Large-scale Power Systems.

Unit 2: Stability Constraints in synchronous grids (8 hours)

Swing Equations of a synchronous machine connected to an infinite bus. Power angle curve. Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three--phase fault. Analysis using numerical integration of swing equations (using methods like Forward Euler, Runge-Kutta 4^{th} order methods), as well as the Equal Area Criterion. Impact of stability constraints on Power System Operation. Effect of generation rescheduling and series compensation of transmission lines on stability.

Unit 3: Control of Frequency and Voltage (9 hours)

Turbines and Speed-Governors, Frequency dependence of loads, Droop Control and Power Sharing. Automatic Generation Control. Generation and absorption of reactive power by various components of a Power System. Excitation System Control in synchronous generators, Automatic Voltage Regulators. Shunt Compensators, Static VAR compensators and STATCOMs. Tap Changing Transformers.Power flow control using embedded dc links, phase shifters and

Unit 4: Monitoring and Control (8 hours)

Overview of Energy Control Centre Functions: SCADA systems. Phasor Measurement Units and Wide-Area Measurement Systems. State-estimation. System Security Assessment. Normal, Alert, Emergency, Extremis states of a Power System. Contingency Analysis. Preventive Control and Emergency Control.

Unit 5: Power System Economics and Management (10 hours)

Basic Pricing Principles: Generator Cost Curves, Utility Functions, Power Exchanges, Spot Pricing. Electricity Market Models (Vertically Integrated, Purchasing Agency, Whole-sale competition, Retail Competition), Demand Side-management, Transmission and Distributions charges, Ancillary Services. Regulatory framework.

References Book**:**

1. J. Grainger and W. D. Stevenson, "Power System Analysis", McGraw Hill Education, 1994.
2. O. I. Elgerd, "Electric Energy Systems Theory", McGraw Hill Education, 1995.
3. A. R. Bergen and V. Vittal, "Power System Analysis", Pearson Education Inc., 1999.
4. D. P. Kothari and I. J. Nagrath, "Modern Power System Analysis", McGraw Hill Education, 2003.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac, "Electric Power Systems", Wiley, 2012.

EXA-601	**Power Systems-II Laboratory**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of experiments (Extendable):

1. To develop a program in Matlab for information of Y-bus matrix for N bus system.
2. Load flow solution for 3-bus system using Gauss- Seidel, Newton Raphson and FDLF methods up to 3 iteration.
3. Load flow solution for IEEE 6-bus and 30-bus system in Matlab using Newton Raphson method.
4. Assessment of transient stability of a single machine system.
5. Effect of compensation on voltage profile of IEEE 6-bus system.
6. Study of any software tools (PSCAD,EDSA, Mi POWER, ETAP etc)

EXA-602	Measurements and Instrumentation	2L:1T:0P	3 credits	3Hrs/Week

Preamble:

The objective of the course is to provide a brief knowledge of measurements and measuring instruments related to engineering. To give the sufficient information of measurements and error related to instruments and their minimization in any kind of industry viz. electrical, electronics, mechanical etc.and basic knowledge of AC bridges.

Course Outcomes:

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

- Design and validate DC and AC bridges.
- Analyze the dynamic response and the calibration of few instruments.
- Learn about various measurement devices, their characteristics, their operation and their limitations.
- Understand statistical data analysis.
- Understand computerized data acquisition.

Unit I-Philosophy of Measurement(10Hrs): Methods of measurement, measurement system, classification of instrument systems, characteristics of instruments & measurement systems, Accuracy and precision, sensitivity resolution, errors in measurement & its analysis, standards, operating force, types of supports, damping, controlling.

Analog Measurement of Electrical Quantities(10Hrs):: PMMC, MI, electrodynamic, thermocouple, electrostatic & rectifier type ammeters & voltmeters, electrodynamic type wattmeter, three phase wattmeter, power in three phase systems, low power factor & UPF wattmeter, errors & remedies in wattmeter, energy meter, D'arsonal galvanometer.

Unit II- Instrument Transformers(6Hrs):: CT and PT; their errors, applications of CT and PT in the extension of instrument range, measurement of speed, frequency and power factor.

Unit III- Measurement of Parameters(6Hrs):: Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q meter, Megger.

Unit IV- AC Potentiometers(10Hrs): Polar type & Co-ordinate type AC potentiometers, application of AC Potentiometers in electrical measurement.
Magnetic Measurement- Ballistic galvanometer, flux meter, determination of hysteresis loop, measurement of iron losses, Lloyd Fischer square for measurement of power loss.

Unit V- Digital Measurement of Electrical Quantities(10Hrs):: Concept of digital measurement, block diagram, analog & digital instruments, digital voltmeter, frequency meter, spectrum analyzer, electronic multimeter.
Cathode Ray Oscilloscope: CRO block diagram, Cathode Ray Tube & its components, applications of CRO, lissajous pattern, dual trace & dual beam oscilloscopes.

References Book:

1. E. W. Golding & F. C. Widdis, "Electrical Measurement &Measuring Instrument", A. W. Wheeler & Co. Pvt. Ltd. India
2. A. K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India
3. Purkait, "Electrical & Electronics Measurement & Instrumentation", TMH
4. Forest K. Harris, "Electrical Measurement", Willey Eastern Pvt. Ltd. India
5. M. B. Stout , "Basic Electrical Measurement", Prentice Hall of India
6. W. D. Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International
7. J. B. Gupta, "Electrical Measurement & Measuring Instrument", S. K. Kataria & Sons

EXA-602	**Measurements and Instrumentation**	**0L:0T:1P**	**1 credits**	**2Hrs/Week**

List of Experiments:

1. Measurement of low resistance using Kelvin's Double Bridge.
2. Measurement of medium resistance using Wheatstone's bridge.
3. Measurement of high resistance by loss of charge method.
4. Measurement of Insulation resistance using Megger.
5. Measurement of power in a single phase ac circuit by 3 voltmeter/ 3 Ammeter method
6. Calibration of a induction type single phase energy meter
7. Calibration of a dynamometer type of wattmeter by Phantom Loading method.
8. Measurements using Instrument Transformers.
9. Study of various types of Indicating Instruments.
10. Measurement of Power in three phase circuit by one, two & three wattmeters.
11. Measurement of a batch of resistors and estimating statistical parameters.
12. Measurement of L using a bridge technique as well as LCR meter.
13. Measurement of C using a bridge technique as well as LCR meter.

Program Elective - II

EXA-603 (A)	Computer Architecture	3L:1T:0P	4 Credits	4Hrs/Week

Preamble:

To study the basic organization and architecture of digital computers (CPU, memory, I/O, software). Discussions will include digital logic and microprogramming. Such knowledge leads to better understanding and utilization of digital computers, and can be used in the design and application of computer systems or as foundation for more advanced computer-related studies

Course Outcomes:

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

- Understand the concepts of microprocessors, their principles and practices.
- Write efficient programs in assembly language of the 8086 family of microprocessors.
- Organize a modern computer system and be able to relate it to real examples.
- Develop the programs in assembly language for 80286, 80386 and MIPS processors in real and protected modes.
- Implement embedded applications using ATOM processor

Unit 1: Introduction to computer organization (10 hours)

Architecture and function of general computer system, CISC Vs RISC, Data types, Integer Arithmetic - Multiplication, Division, Fixed and Floating point representation and arithmetic, Control unit operation, Hardware implementation of CPU with Micro instruction, microprogramming, System buses, Multi-bus organization.

Unit 2: Memory organization (6 hours)

System memory, Cache memory - types and organization, Virtual memory and its implementation, Memory management unit, Magnetic Hard disks, Optical Disks.

Unit 3: Input – output Organization (6 hours)

Accessing I/O devices, Direct Memory Access and DMA controller, Interrupts and Interrupt Controllers, Arbitration, Multilevel Bus Architecture, Interface circuits - Parallel and serial port. Features of PCI and PCI Express bus.

Unit 4: 16 and 32 microprocessors (10hours)

80x86 Architecture, IA – 32 and IA – 64, Programming model, Concurrent operation of EU and BIU, Real mode addressing, Segmentation, Addressing modes of 80x86, Instruction set of 80x86, I/O addressing in 80x86

Unit 5: Pipelining (10 hours)

Introduction to pipelining, Instruction level pipelining (ILP), compiler techniques for ILP, Data hazards, Dynamic scheduling, Dependability, Branch cost, Branch Prediction, Influence on instruction set. VLIW Architecture, DSP Architecture, SoC architecture, MIPS Processor and programming

Text/Refence Books

1. V. Carl, G. Zvonko and S. G. Zaky, **"**Computer organization**"**, McGraw Hill, 1978.
2. B. Brey and C. R. Sarma, **"**The Intel microprocessors**"**, Pearson Education, 2000.
3. J. L. Hennessy and D. A. Patterson, **"**Computer Architecture A Quantitative Approach**"**, Morgan Kauffman, 2011.
4. W. Stallings, **"**Computer organization**"**, PHI, 1987.
5. P. Barry and P. Crowley, **"**Modern Embedded Computing**"**, Morgan Kaufmann, 2012.
6. N. Mathivanan, **"**Microprocessors, PC Hardware and Interfacing**"**, Prentice Hall, 2004.
7. Y. C. Lieu and G. A. Gibson, **"**Microcomputer Systems: The 8086/8088 Family**"**, Prentice Hall India, 1986.

8. J. Uffenbeck, **"**The 8086/8088 Design, Programming, Interfacing**"**, Prentice Hall, 1987.
9. B. Govindarajalu, **"**IBM PC and Clones**"**, Tata McGraw Hill, 1991.
10. P. Able, **"**8086 Assembly Language Programming**"**, Prentice Hall IndiA

EXA-603 (B)	Digital Signal Processing	3L:1T:0P	4 Credits	4Hrs/Week

Preamble:
To make students familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors. To make students aware about the meaning and implications of the properties of systems and signals.

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

1. Represent signals mathematically in continuous and discrete time and frequency domain
2. Get the response of an LSI system to different signals
3. Design of different types of digital filters for various application

Unit -1 Discrete time signals (10Hrs):
Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals; Discrete systems attributes, Z-Transform,

Unit -2 Analysis of LSI systems (6Hrs):
Analysis of LSI systems, frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT),Fast Fourier Transform Algorithm, Implementation of Discrete Time Systems

Unit -3 Design of FIR Digital filters(10Hrs):
: Window method, Park-McClellan's method. Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low pass, Band pass, Band stop and High pass filters.

Unit -4(10Hrs) Analysis of FIR:
Effect of finite register length in FIR filter design.Parametric and non-parametric spectral estimation.

Unit -4 Signal Processing (6Hrs):
Introduction to multirate signalprocessing. Application of DSP.

Reference Books:

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall,1992.
6. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

Program Elective - III

EXA-604 (B)	Industrial Electrical Systems	3L:0T:0P	3 credits	3Hrs/Week

Preamble:

To equip learners with the skills and knowledge necessary to successfully carry out basic service and maintenance of Industrial Electrical Systems in a safe and environmentally sound manner.

Course Outcomes:

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

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.
- Analyze and select the proper size of various electrical system components.

Unit 1: Electrical System Components (10 Hours)

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

Unit 2: Residential and Commercial Electrical Systems (12 Hours)

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit 3: Illumination Systems (6 Hours)

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

Unit 4: Industrial Electrical Systems I (8 Hours)

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit 5: Industrial Electrical Systems II (6 Hours)

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and

Battery Banks, Selection of UPS and Battery Banks.

Industrial Electrical System Automation Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Reference Books

2. S.L. Uppal and G.C. Garg, "Electrical Wiring, Estimating & Costing", Khanna publishers, 2008.
3. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
4. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co., 1997.
5. Web site for IS Standards.
6. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

EXA-605 (A)	**VLSI Circuits**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preambles:

To provide students with a sound knowledge of **VLSI** system **design** verification and testability, and system reliability. The emphasis of the **course** is on techniques for system **design**, testing, system noise and performance analysis.

Outcomes:

Wires and Vias, Scalable Design rules, Layout Design tools. Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative

UNIT –I: Review of Microelectronics and Introduction to MOS Technologies: (10Hrs)

MOS, CMOS, BiCMOS Technology. Basic Electrical Properties of MOS, CMOS & BiCMOS Circuits: Ids – Vds relationships, Threshold Voltage VT, Gm, Gds and ωo, Pass Transistor, MOS, CMOS & Bi CMOS Inverters, Zpu/Zpd, MOS Transistor circuit model, Latch-up in CMOS circuits.

UNIT –II: Layout Design and Tools: (10Hrs)

Transistor structures, Wires and Vias, Scalable Design rules, Layout Design tools. Logic Gates & Layouts: Static Complementary Gates, Switch Logic, Alternative Gate circuits, Low power gates, Resistive and Inductive interconnect delays.

UNIT –III: Combinational Logic Networks: (6 Hrs)

Layouts, Simulation, Network delay, Interconnect design, Power optimization, Switch logic networks, Gate and Network testing.

UNIT –IV: Sequential Systems: (10 Hrs)

Memory cells and Arrays, Clocking disciplines, Design, Power optimization, Design validation and testing.

UNIT –V: Floor Planning: (6Hrs)

Floor planning methods, Global Interconnect, Floor Plan Design, Off-chip connections.

Reference:

1. Essentials of VLSI Circuits and Systems, K. Eshraghian Eshraghian. D, A. Pucknell, 2005, PHI.
2. Modern VLSI Design – Wayne Wolf, 3rd Ed., 1997, Pearson Education.
3. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
4. Principals of CMOS VLSI Design – N.H.E Weste, K. Eshraghian, 2nd Ed., Addison Wesley.

EXA-605 (B) Image Processing

EXA-605 (B)	**Image Processing**	**3L:0T:0P**	**3 credits**	**3Hrs/Week**

Preamble
to give an introduction to basic concepts and methodologies for digital image processing , to develop a foundation that can be used as the basis for further study and research in this field.

Course Outcomes:

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

1. Mathematically represent the various types of images and analyze them.
2. Process these images for the enhancement of certain properties or for optimized use of the resources.
3. Develop algorithms for image compression and coding

Unit 1 Digital Image Fundamentals(6 Hrs)-

Elements of visual perception, image sensing andacquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Unit 2 Image Enhancements and Filtering(6 Hrs)
-Gray level transformations, histogramequalization and specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Unit 3 Color Image Processing-Color models (10 Hrs):
RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation. Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding, global and adaptive, region-based segmentation.

Wavelets and Multi-resolution image processing- Uncertainty principles of FourierTransform, Time-frequency localization, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Unit 4 Image Compression-Redundancy (10 Hrs):

inter-pixel and psycho-visual; Losslesscompression – predictive, entropy; Lossy compression-predictive and transform coding; Discrete Cosine Transform; Still image compression standards–JPEG and JPEG-2000.

Unit 5 Fundamentals of Video Coding(10 Hrs):
-Inter-frame redundancy, motion estimationtechniques – full-search, fast search strategies, forward and backward motion prediction, frame classification – I, P and B; Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks and blocks; Elements of a video encoder and decoder; Video coding standards – MPEG and H.26X.

Video Segmentation-Temporal segmentation–shot boundary detection, hard-cutsand soft-cuts; spatial segmentation–motion-based; Video object detection and tracking.

Reference Books:

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Second Edition, Pearson Education 3rd edition 2008
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2004
3. Murat Tekalp , Digital Video Processing" Prentice Hall, 2nd edition 2015

EXA 606	**Minor Project**	**0L:0T:4P**	**2 credits**	**4Hrs/Week**

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Design and validate DC and AC bridges
2. Analyze the dynamic response and the calibration of few instruments
3. Learn about various measurement devices, their characteristics, their operation and their
4. limitations
5. understand statistical data analysis
6. Understand computerized data acquisition.

7. Conceive a problem statement either from rigorous literature survey or from the requirements
8. raised from need analysis.
9. Design, implement and test the prototype/algorithm in order to solve the conceived problem.
10. Write comprehensive report on Minor project work.

Guidelines:

1. The Minor-project is a team activity having 3-4 students in a team. This is electronic product design work with a focus on electronic circuit design.
2. The Minor project may be a complete hardware or a combination of hardware and software. The software part in Minor project should be less than 50% of the total work.
3. Minor Project should cater to a small system required in laboratory or real life.
4. It should encompass components, devices, analog or digital ICs, micro controller with which functional familiarity is introduced.
5. After interactions with course coordinator and based on comprehensive literature survey/need analysis, the student shall identify the title and define the aim and Preambles of Minor project.
6. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
7. The student is expected to exert on design, development and testing of the proposed work as per the schedule.
8. Art work and Layout should be made using CAD based PCB simulation software. Due considerations should be given for power requirement of the system, mechanical aspects for enclosure and control panel design