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 Engineering

Syllabus Vth Semester

EEA-501 Control Systems

EEA-501	**Control Systems**	**2L:1T:0P**	**3 credits**	**3 Hrs/Week**

Preamble

To make students understand the concept of state –space analysis, stability and to design the compensator in time and frequency domain.

Outcomes:

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

- Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
- Understand the concept of stability and its assessment for linear-time invariant systems.
- Design simple feedback controllers.

Unit 1: Introduction to control problem (5 hours)

Industrial Control examples, Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

Unit 2: Time Response Analysis (9 hours)

Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

Unit 3: Frequency-response analysis (8 hours)

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

Unit 4: Introduction to Controller Design (10 hours)

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.

Root-loci method of feedback controller design.

Design specifications in frequency-domain. Frequency-domain methods of design.

Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

Unit 5: State variable Analysis (10 hours)

Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback.

Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems, Introduction to Optimal Control and NonlinearControl Performance Indices. Regulator problem, Tracking Problem. Nonlinear system–Basic concepts and analysis.

References:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.
3. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
4. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009

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 Engineering

Control Systems Lab

EEA-501	Control Systems	0L:0T:1P	1 Credits	2 Hrs/week

List of Experiments:

1. To determine speed torque characteristics of armature controlled D.C. servomotor.
2. To determine the speed torque characteristics and relationship between torque speed and control windings voltage by AC servomotor.
3. To obtain the step response transient characteristics of first order electric system and to measure system parameters.
4. To plot the nyquist plot of a given transformer function using matlab.
5. To plot the bode plot of a given transformer function using matlab.

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 Engineering

EEA-502 Microprocessors

EEA-502	**Microprocessors**	**2L:1T:0P**	**3 Credits**	**3 Hrs/Week**

Preamble:

To introduce students with the architecture and operation of typical microprocessors, programming and interfacing of microprocessors and to provide strong foundation for designing real world applications using microprocessors and microcontrollers.

Outcomes:

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

- Do assembly language programming.
- Do interfacing design of peripherals like I/O, A/D, D/A, timer etc.
- Develop systems using different microcontrollers.

Unit I: Fundamentals of Microprocessors: (10 Hours)

Fundamentals of Microprocessor Architecture. 8-bitMicroprocessor and Microcontroller architecture, Comparison of 8-bit microcontrollers, 16-bit and 32-bit microcontrollers. Definition of embedded system and its characteristics, Role of microcontrollers in embedded Systems. Overview of the 8051 family.

Unit II: The 8051 Architecture (10 Hours)

Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

Unit III: Instruction Set and Programming (10 Hours)

Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing. 8051 Instruction set, Instruction timings. Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction. Assembly language programs, C language programs. Assemblers and compilers. Programming and debugging tools.

Unit IV: Memory and I/O Interfacing (6 Hours):

Memory and I/O expansion buses, control signals, memory wait states. Interfacing of peripheral devices such as General Purpose I/O, ADC, DAC, timers, counters, memory devices.

Unit V: External Communication Interface (6Hours)

Synchronous and Asynchronous Communication. RS232, SPI, I2C. Introduction and interfacing to protocols like Blue-tooth and Zig-bee. LED, LCD and keyboard interfacing. Stepper motor interfacing, DC Motor interfacing, sensor interfacing.

References:

1. M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, “The8051Microcontroller and Embedded Systems: Using Assembly and C”,Pearson Education, 2007.
2. K. J. Ayala, “8051 Microcontroller”, Delmar Cengage Learning,2004.
3. R. Kamal, “Embedded System”, McGraw Hill Education,2009.
4. R. S. Gaonkar, “, Microprocessor Architecture: Programming and Applications with the 8085”, Penram International Publishing, 1996
5. D.A. Patterson and J.H. Hennessy, "Computer Organization and Design: The Hardware/Software interface”, Morgan Kaufman Publishers, 2013.
6. D. V. Hall, “Microprocessors & Interfacing”, McGraw Hill Higher Education, 1991.

EEA-502	**Microprocessors**	**0L:0T:1P**	**1 Credits**	**2 Hrs/week**

Hands-on experiments related to the course contents

1. To study 8085 based microprocessor system.
2. To study 8086 based microprocessor system.
3. Write an Assembly Language Program to add two 16 bit numbers.
4. Write an Assembly Language Program to subtract two 16 bit numbers.
5. To perform multiplication/division of given numbers.
6. To perform computation of square root of a given number.
7. To obtain interfacing of RAM chip to 8085/8086 based system
8. To develop and run a program for finding out the largest/smallest number from a given set of numbers.

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 Engineering

EEA-503 Electrical Machine Design

EEA-503	**Electrical Machine Design**	**2L:1T:0P**	**3 Credits**	**3Hrs/Week**

Preamble
To familiarize students with the design concepts and various factors which influence the design
Outcomes:

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

- Understand the construction and performance characteristics of electrical machines.
- Understand the various factors which influence the design: electrical, magnetic and thermal loading of electrical machines
- Understand the principles of electrical machine design and carry out a basic design of an ac machine.
- Use software tools to do design calculations.

Unit I: Introduction (10 Hours)
Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

Unit II: Transformers (10 Hours)
Sizing of a transformer, main dimensions, kVA output for single- and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

Unit III: Induction Motors (10 Hours)
Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, SC current circle diagram, leakage reactance of polyphase machines, magnetizing current

Unit IV: Synchronous Machines (11 Hours)
Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of air gap length, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators, rotor design.

Unit V: Computer aided Design (CAD): (9 Hours)

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to **c**omplex structures of modern machines-PMSMs, BLDCs, SRM and claw-pole machines.

Text / References:

1. A. K. Sawhney, “A Course in Electrical Machine Design”, Dhanpat Rai and Sons, 1970.
2. M.G. Say, “Theory & Performance & Design of A.C. Machines”, ELBS London.
3. S. K. Sen, “Principles of Electrical Machine Design with computer programmes”, Oxford and IBH Publishing, 2006.
4. K. L. Narang, “A Text Book of Electrical Engineering Drawings”, SatyaPrakashan, 1969.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, “Electrical Machine Design Data Book”, New Age International, 1979.
6. K. M. V. Murthy, “Computer Aided Design of Electrical Machines”, B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft’s Maxwell 2D machine design package.

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 Engineering

EEA-503 Electrical Machine Design

EEA-503	**Electrical Machine Design**	**0L:0T:1P**	**1 Credits**	**2Hrs/Week**

List of Experiment (Extendable):
1. Computer Program in "C" in MATLAB for Complete Design of 500KW, 600v lab wound dc machine
2. Computer Program in "C" in MATLAB for Optimal Design of dc machine
3. Computer Program in "C" in MATLAB for Complete Design of core type power Transformer
4. Computer Program in "C" in MATLAB for Complete Design of salient pole Alternator
5. Computer Program in "C" in MATLAB for Complete Design of Synchronous Machines
6. Computer Program in "C" in MATLAB for Optimal Design of cage rotor
7. Computer Program in "C" in MATLAB for Complete Design Of single ph IM
8. Computer Program in "c" in MATLAB for Optimal Design of slip ring IM

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 Engineering

Program Elective-I

EEA-504 (A) Signals and Systems

EEA-504(A)	**Signals and Systems**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Preamble:

1. To explain signals and systems representations/classifications and also describe the time and frequency domain analysis of continuous time signals with Fourier series, Fourier transforms and Laplace transforms.
2. 2 To understand Sampling theorem, with time and frequency domain analysis of discrete time signals with DTFS, DTFT and Z-Transform.
3. 3 To present the concepts of convolution and correlation integrals and also understand the properties in the context of signals/systems and lay down the foundation for advanced courses.

Outcomes:

On completion of the course, student will be able to
1) Analyze the discrete time signals and system using different transform domain techniques.
2) Design and implement LTI filters for filtering different real world signals.
3) Develop different signal processing applications using DSP processor.

Unit I- Introduction to Signal & Systems: (10 Hours)

Signals, classification of signals, basic continuous time and discrete time signals, continuous LTI, discrete LTI systems , impulse and step functions, impulse response stability, linearity, stability, time invariance, eigen values, eigen functions, discrete convolution, properties of discrete and continuous LTI system, systems described by difference and differential equations.

Unit II- Fourier Analysis of Continuous Time Signals and Systems: (10 Hours)

Fourier series, fourier series representation of continuous periodic signal & its properties, fourier transform and its properties, parseval's theorem, frequency response of LTI systems.

Unit III- Fourier Analysis of Discrete Time Signals & Systems: (10 Hours)
Discrete-time fourier series, discrete-time fourier transform (including DFT) and properties, frequency response of discrete time LTI systems, continuous time fourier transform for periodic and non-periodic signals, properties of CTFT.

Unit IV- Laplace & Z-Transform Transform: (8Hours)
Laplace transform and its inverse, existence conditions, region of convergence and properties, application of laplace transform for the analysis of continuous time LTI system, Z-Transform, properties of Z-transform, inversion of Z-transform, two dimensional Z- transform, convergence of Z-transform, region of convergence and properties, application of Z-transform for the analysis of discrete time LTI systems, Z transform problems.

Unit V- State Space Analysis: (12 Hours)
Concept of state, state space representation, discrete time LTI systems, state space representation of continuous time LTI systems, solutions of state equation for discrete time LTI systems, solutions of state equation for continuous time LTI systems.
Sampling: Sampling theorem, ideal & real sampling, reconstruction of signal from its samples, aliasing sampling in frequency domain, sampling of discrete-time signals.

References:

1. Alan V. Oppenheim, Alan S. Willsky and H. Nawab, Signals and Systems, Prentice Hall, 1997
2. Simon Haykin, Communication Systems, 3rd Edition, John Wiley, 1995.
3. Signals & Systems, 2nd Edition, by Alan Oppenheim, Alan Wilsky, S. Nawab. Prentice Hall, 1997.
4. Signals and Systems, by Simon Haykin and Barry Van Veen. Wiley, 1999.

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 Engineering

EEA-504 (B) Line Commutated and Active Rectifiers

EEA-504 (B)	**Line Commutated and Active Rectifiers**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Preamble:
Analyse controlled rectifier circuits. Understand the operation of line-commutated rectifiers 6 pulse and multi-pulseconfigurations. nderstand the operation of PWM rectifiers operation in rectification and regenerationmodes and lagging, leading and unity power factor mode

Outcomes:
At the end of this course, students will demonstrate the ability to
- Analyse controlled rectifier circuits.
- Understand the operation of line-commutated rectifiers – 6 pulse and multi-pulse configurations.
- Understand the operation of PWM rectifiers – operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

Unit 1: Diode rectifiers with passive filtering (6 Hours)
Half-wave diode rectifier with RL and RC loads; 1-phase full-wave diode rectifier with L, C and LC filter; 3-phase diode rectifier with L, C and LC filter; continuous and discontinuousconduction, input current waveshape, effect of source inductance; commutation overlap.

Unit 2: Thyristor rectifiers with passive filtering (6 Hours)
Half-wave thyristor rectifier with RL and RC loads; 1-phase thyristor rectifier with L and LC filter; 3- phase thyristor rectifier with L and LC filter; continuous and discontinuous conduction, input current waveshape

Unit 3: Multi-Pulse converter (6 Lectures)
Review of transformer phase shifting, generation of 6-phase ac voltage from 3-phase ac, 6- pulse converter and 12-pulse converters with inductive loads, steady state analysis, commutation overlap, notches during commutation.

Unit 4: Single-phase ac-dc single-switch boost converter (6 Hours)
Review of dc-dc boost converter, power circuit of single-switch ac-dc converter, steady state analysis, unity power factor operation, closed-loop control structure.

Unit 5: Ac-dc bidirectional boost converter (6 Hours)

Review of 1-phase inverter and 3-phase inverter, power circuits of 1-phase and 3-phase ac-dc boost converter, steady state analysis, operation at leading, lagging and unity power factors. Rectification and regenerating modes. Phasor diagrams, closed-loop control structure.

Isolated single-phase ac-dc flyback converter (10 Hours) Dc-dc flyback converter, output voltage as a function of duty ratio and transformer turns ratio. Power circuit of ac-dc flyback converter, steady state analysis, unity power factor operation, closed loop control structure.

Text / References:

1. G. De, "Principles of Thyristorised Converters", Oxford & IBH Publishing Co, 1988.
2. J.G. Kassakian, M. F. Schlecht and G. C. Verghese, "Principles of Power Electronics", Addison- Wesley, 1991.
3. L. Umanand, " Power Electronics: Essentials and Applications", Wiley India, 2009.
4. N. Mohan and T. M. Undeland, " Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007. 5. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2001

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 Engineering

Open Core Elective-I

EEA-505 (A) Electrical Materials

EEA-505 (A)	**Electrical Materials**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Preamble: To make students understands the insulating, conducting and magnetic materials used in electrical machines and their properties and application .

Outcomes: At the end of the course the students will be able to evaluate and classify insulating, conducting and magnetic materials used in electrical machines. Understand the properties of liquid, gaseous and solid insulating materials.

Unit I Conducting Material and Their Properties (10 Hrs)

Classification, properties, highresistivity alloy: constant mangann,nichrome, electrochemical, properties of copper,aluminum, steel tungsten, molybdenum, platinum, tantalum, niobium, mercurry, nickel,titanum, carbon, lead, thermal, bitmetals, thermocouple, materials, specific resistance,conductance, super conductors, variation of resistance with temperature.

Unit II Semi Conductor Materials: **(10 Hrs)**
Electrical conductivity, elements having semiconductor properties, general application, hall effect, energy levels, conduction in semiconductors, intrinsic conduction, impurity conduction, p and n type impurities, electrical change, neutrality, drift, mobility current flow in semi conductors p-n junction formation by alloying, elasing (forward and reverse) of p-n junction, reverse separation current, zener effect, junction, capacitance, hall defects and hall coeffiecient.

Unit III Magnetic Materials: (10 Hrs)
B.H. curve, soft and hard magnetic materials, di-magnetic, para magnetic and ferromagnetic materials, electrical sheet steel, cast iron, permanent magnetic materials, dynamic and static hysteresis loop, hysterisis loss, eddy current loss, magnetisation, magnetic susceptibility, coercive force, rectangular hysteresia loop, magnet rest square loop core materials, iron silicon, iron alloys.

Unit IV Insulating Materials: **(6 Hrs)**
Electrical, mechanical and chemical properties of insulating material, electrical characteristics, volume and surface resistivity, permitivity loss, and dielectric loss, polarisability**,** classification of dielectric.

Unit V Mechanical Properties: (6 Hrs)
Classification of insulating materials on the basis of temperature rise, general properties of transformer oil, varnishes, solidifying insulating materials, resins, bituminous waxes, drying oils, fibrous insulating materials, wood, paper and cardboard, insulating textiles, varnished adhesive tapes, inorganic fibrous material and other insulating materials, such as mica, ceramic, bakelite, ebonite, glass, PVC, rubber, other
plastic molded materials.

References:
1. TTTI Madras; Electrical Engineering Materials; TMH.
2. Electrical Engineering Material s & Devices; John Allison ;TMH
3. Electrical Engineering Materials: Indulkar and S. Thruvengadem;
4. Electrical Engineering Materials; S. Chand
5. Dekkor AK; Electrical Engineering Materials; PHI

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SCHOOL OF ENGINEERING
Outcome Based Curriculum for
Undergraduate Degree Courses in Engineering & Technology
Department of Electrical Engineering

EEA-505 (B) Embedded Systems

EEA-505 (B)	**Embedded Systems**	**3L:1T:0P**	**4 Credits**	**4Hrs/Week**

Preamble: Discuss the major components that constitute an embedded system.2. Implement small programs to solve well-defined problems on an embedded platform.3. Develop familiarity with tools used to develop in an embedded environment.

Outcomes: At the end of content students will be able to

1. Understand microcontroller, microcomputer,embedded system.
2. Understand different components of a micro-controller andtheir interactions.
3. Become familiar with programming environment used todevelop embedded systems
4. Understand key concepts of embedded systems like IO,timers, interrupts, interaction with peripheral devices
5. Learn debugging techniques for an embedded system

Unit1. Introduction: (10- Hours):
Different types of Micro-controllers, embedded micro-controller, external memory micro-controller, Processor architectures: Harvard vs Princeton, CISC vs. RISC, Micro-controller memory types. Development tools/environment, Intel Hex Format object files, debugging.

Unit2 Architecture of 8051: (10- Hours):
Block diagram, pin Configuration, Functional descriptions of internal Units-- registers, PSW, internal RAM, ROM, Stack, Oscillator and Clock. Other features--I/O Pins, Ports and Circuits, Counters and timers, Serial data transmission /reception. Interrupts--Timer flag interrupt, serial communication interrupt, External interrupt, software generated interrupts.

Unit3. Programming of 8051: (10- Hours):
Instruction format, addressing modes, Data transfer instructions, logical instructions, arithmetic instructions, Jump and Call instructions. Interrupts and interrupt handler subroutines. Development of assembly Language programs

Unit4. Architecture Of Pic: (6- Hours):
Block diagram, pin Configuration, Functional descriptions of internal blocks—program memory considerations, register file structure. registers, oscillators and clock. Other features--I/O Pins, Counters and timers, Watchdog timer, SPI port USART. Interrupts—Interrupt structure.

Unit5. Application Design & Hardware Interfacing With 8051 & Pic: (6- Hours):

Hardware Interfacing with LED, Seven segment LED, LCD, Switches and stepper motor.

References:

1. Design with PIC Micro-controller by John B. Peatman, Pearson.
2. The 8051 microcontroller and embedded system by M.A.Mazidi, PHI
3. Programming and customizing the 8051 micro-controller- Predko, TMH.
4. Designing Embedded Hardware: John Catsoulis: Shroff Pub and Dist.
5. Programming embedded systems in C and C++: Michael Barr: Shroff Pub and distr

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SCHOOL OF ENGINEERING
Outcome Based Curriculum for
Undergraduate Degree Courses in Engineering & Technology
Department of Electrical Engineering

EEA-506 Industrial Training-I

EEA-506	**Industrial Training-I**	**0L:0T:2P**	**2 credits**	**4Hrs/Week**

Preamble

1. To expose the students to actual working environment of electrical engineering and enhance their knowledge and skill from what they have learned in the classes.
2. Another purpose of this program is to instill the good qualities of integrity, responsibility and self-confidence.
3. To persue students with the electrical field ethics and rules in terms of the society.

Outcomes:

Ability to communicate efficiently. Acquired to be a multi-skilled engineer with good technical knowledge of electrical and electronics components and their processing, management, leadership and entrepreneurship skills. Ability to identify, formulate and model problems and find engineering solution based on a systems approach.

Students must observe following points to enrich their learning in electrical engineering during industrial training:

- Industrial environment and work culture.
- Organisational structure and inter personal communication.
- Machines/ equipment/ instruments - their working and specifications.
- Product development procedures and phases.
- Project planning, monitoring and control.
- Quality control and assurance.
- Maintenance system.
- Costing system.
- Stores and purchase systems.
- Roles and responsibilities of different categories of personnel.
- Customer services.
- Problems related to various areas of Work etc.
- Layout if any

To be submitted : The students has to submit the power point presentation of minimum15 slides of the training performed(comprising of points stated above) along with the original certificate of training performed with proper seal and signature of the authorized person.

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 Engineering

Scheme of Studies:

Duration: Minimum 2 weeks in summer break after IV semester, assessment to be done in V Semester

Scheme of Examination:

For the assessment of industrial training undertaken by the students, following components are considered with their weightage.

(a) Term Work in Industry Marks Allotted

Attendance and General Discipline 20

Daily diary Maintenance 20

Initiative and participative attitude during training 30

Assessment of training by Industrial Supervisor 30

Total 100*

(b) Practical/Oral Examination (Viva-Voce) in Institution Marks Allotted

1. Training Report 50

2. Seminar and cross questioning (defense) 100

Total 150

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* - Marks of various components in industry should be awarded by the I/c of training in Industry but in special circumstances if not awarded by the industry then faculty in charge /T.P.O. will give the marks.

During training students will prepare a first draft of training report in consultation with section In charge. After training they will prepare final draft with the help of T.P.O. /Faculty of the Institute. Then they will present a seminar on their training and they will face viva-voce on training in the Institute.