## Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

### SCHEME OF TEACHING & EXAMINATION

#### DEPARTMENT OF ELECTRICAL ENGINEERING

**M.Tech in Industrial Drives and Control**

(Second Semester)

<table>
<thead>
<tr>
<th>S. N.</th>
<th>Board of Study</th>
<th>Subject Code</th>
<th>Subject Name</th>
<th>Period per week</th>
<th>Scheme of Exam</th>
<th>Total marks</th>
<th>Credit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td>ESE</td>
</tr>
<tr>
<td>1</td>
<td>Electrical Engg.</td>
<td>585211(24)</td>
<td>Analysis of DC and AC Converters</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>Electrical Engg.</td>
<td>585212(24)</td>
<td>Microcontrollers And Embedded System Design</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>Electrical Engg.</td>
<td>585213(24)</td>
<td>Programmable Logic controllers and their applications</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Electrical Engg.</td>
<td>585214(24)</td>
<td>Optimal Control Systems</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>5</td>
<td>Refer Table - II</td>
<td>Elective – II</td>
<td></td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>Electrical Engg.</td>
<td>585221(24)</td>
<td>Programmable Logic controllers Lab</td>
<td>3</td>
<td>75</td>
<td>-</td>
<td>75</td>
</tr>
<tr>
<td>7</td>
<td>Electrical Engg.</td>
<td>585222(24)</td>
<td>Microcontrollers and Embedded System Design Lab</td>
<td>3</td>
<td>75</td>
<td>-</td>
<td>75</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>5</td>
<td>6</td>
<td>650</td>
</tr>
</tbody>
</table>

- **L** – Lecture, **T** – Tutorial, **P** – Practical, **ESE** – End Semester Examination, **CT** – Class Test, **TA** – Teacher’s Assessment

### Table – II

**Elective – II**

<table>
<thead>
<tr>
<th>Board of Study</th>
<th>Subject Code</th>
<th>Subject Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Engg.</td>
<td>585231(24)</td>
<td>Electrical Energy Systems</td>
</tr>
<tr>
<td>Electrical Engg.</td>
<td>585232(24)</td>
<td>HV AC and DC Transmission</td>
</tr>
<tr>
<td>Electrical Engg.</td>
<td>585233(24)</td>
<td>DSP Processors and Architectures</td>
</tr>
<tr>
<td>Electrical Engg.</td>
<td>585234(24)</td>
<td>Power Quality</td>
</tr>
</tbody>
</table>
Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester - M. Tech. – 2nd  Specialization  Industrial Drives and Control

Subject: Analysis of AC and DC converters  Branch : Electrical Engg.
Total Theory Periods : 40  Code: 585211(24)
Total marks in End semester Exam.: 100  Total Tutorial Periods: 12
Minimum number of class test to be conducted: 02

Unit – I

Single Phase Inverters: Introduction to self commutated switches: MOSFET and IGBT - Principle of operation of half and full bridge inverters, Performance parameters, Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques. Effect of Blanking time on output voltage in PWM inverters.

Unit – 2

Three Phase Voltage source Inverters: 180 degree, 150 and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques, Comparison of PWM inverters.

Unit - 3


Unit - 4

Multilevel Inverters: Multilevel concept – diode clamped, Improved diode clamped, flying capacitor, cascade type multilevel inverters, Features and Comparison of multilevel inverters, application of multilevel inverters

Unit – 5

Resonant source Inverters: Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – Zero voltage switching resonant inverter, Resonant DC-link inverter.

Text Books:-

Reference Books:
Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester - M. Tech. – 2nd Specialization Industrial Drives and Control
Subject: Microcontrollers and Embedded System Design Branch: Electrical Engg.
Total Theory Periods : 40 Code: 585212(24)
Total marks in End semester Exam.: 100 Total Tutorial Periods: 12
Minimum number of class test to be conducted: 02

UNIT-I Introduction to Microcontrollers
Introduction, Microcontrollers and microprocessors, history of microcontrollers, embedded versus external memory devices, 8-bit and 16-bit microcontrollers, CISC and RISC processors, Hardware and Von Neumann architecture, commercial microcontroller devices.

UNIT-II 8051 Microcontroller
Introduction, 8051 architecture, registers in 8051, pin description, 8051 connections, 8051 parallel I/O ports, Memory organization 8051 addressing modes, 8051 instruction set, 8051 instructions and simple programs, using stack pointer.

UNIT-III 8051 Interrupts, Timer/counters and Serial Communication
Interrupts, interrupts in MCS-8051, timers and counters, serial communication. Overview of 89CXX and 89C20XX Atmel microcontrollers, pin description of 89C51 and 89C2051, using flash memory, square wave generation, rectangular wave generation, pulse generation, stair case ramp generation, sine wave generation.

UNIT – IV Overview of Embedded System

UNIT – V Embedded Hardware & Software Development Environment
Hardware Architecture, Micro-Controller Architecture, Communication Interface Standards, Embedded System Development Process, Embedded Operating systems, Types of Embedded Operating systems.

Text Books:
2. The 8051 Microcontrollers , M A Mazidi& Mazidi, Pearson Education
3. Design with PIC micro-controllers: John B Peatman, Pearson Education
5. Programming for Embedded Systems- Dreamtech Software Team, Wiley Dreamtech

Reference books:
Subject: Programmable Logic Controllers and Their Application
Branch: Electrical Engg.

UNIT – I : Introduction to PLC
Definition: Evolution Advantages/Disadvantages: System description; Internal operation of CPU and I/C modules,

UNIT – II : Programming with PLC
General programming procedures, registers and Addresses, Relation of Digital Gate Logic to contact logic.

UNIT – III : PLC Functions


UNIT – V : PLC Deployment:
PLC; Installation & testing, Troubleshooting and Maintenance, Selecting a PLC, Operation Simulation and Monitoring, Commonly Used Circuit Symbols.

Text / Reference Books:
4. Gary Danning, Introduction to Programmable Logic Controllers, Delmar Thomson Learning
UNIT-I Linear Spaces and Linear operators
Introduction, Fields, vectors and vector spaces, linear combination and bases, linear transformations and matrices, scalar product and norms.

UNIT-II General Mathematical Procedures
Introduction, formulation of the optimal control problem, calculus of variation, numerical solution of 2 point boundary value problem.

UNIT-III Optimal Feedback Control
Discrete time linear state regulator, continuous time linear state regulator, time invariant linear state regulator.

UNIT-IV State Regulators
Use of Linear State Regulators Results to Solve Other Linear Optimal Control Problem, sub-optimal linear regulators, minimum time control of linear time invariant systems

UNIT-V Stochastic Optimal Linear Estimation and Control
Introduction, stochastic processes and linear systems, optimal estimation for linear continuous time systems, optimal estimation linear discrete time systems, stochastic optimal linear regulator

Text Books:
1. Modern Control System Theory, M. Gopal, New Age International Pub.

Reference Books:

Unit – 2

Fundamental concept of energy: Laws of thermodynamics as applied to energy transfer and transformation, Heat transfer and insulation, fundamental equations, Conversion factors and energy calculations.

Unit - 3

Energy conversion systems: Thermal Power plants, Hydroelectric Power plants micro and mini hydros, Nuclear Power plants, Environmental aspects of conventional power generation, Liquid and gaseous Fossil fuels,

Unit - 4

Different forms of Non-conventional energy sources: Transformation of energy, Solar wind, Geothermal, Tidal, Biogas, Integrated Renewable Energy systems, Energy storage techniques. Overview of solar energy conversion methods, Solar thermal power generation, Wind power characteristics-power extraction-types of wind machines, Wind generation in India

Unit – 5


Text Books:


Reference Books :

UNIT I
Overview: Comparison of EHV AC and DC transmission, description of DC transmission systems, modern trends in AC and DC transmission.

UNIT II
EHV AC Systems: Limitations of extra long AC transmission, Voltage profile and voltage gradient of conductor, Electrostatic field of transmission line, Reactive Power planning and control, traveling and standing waves, EHV cable transmission system.

Static Var System: Reactive VAR requirements, Static VAR systems, SVC in power systems, design concepts and analysis for system dynamic performance, voltage support, damping and reactive support.

UNIT-III

HVDC System Control: Principal 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, Telecommunication Requirements

UNIT-IV
Corona and Interference: Corona and corona loss due to EHV AC and HVDC, Radio and TV interference due to EHV AC and HVDC systems, methods to reduce noise, radio and TV interference.

Harmonic Filters: Generation of harmonics, design of AC filters, DC filters, Carrier Frequency and RI Noise

UNIT- V
Power flow analysis in AC/DC systems: Component models, solution of DC load flow, per unit system for DC quantities, solution techniques of AC-DC power flow equations, Parallel operation of HVDC/AC systems, Multi terminal systems.

Text Books:
Reference Books:
Unit :I
**Introduction to Digital Signal Processing:** Introduction, Digital signal-processing system, sampling process, discrete time sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation, Analysis and Design tool for DSP Systems MATLAB, DSP using MATLAB
**Computational Accuracy in DSP Implementations:** Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors

Unit :II
**Architectures for Programmable DSP Devices:** Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.
**Execution Control and Pipelining:** Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models.

Unit :III
**Programmable Digital Signal Processors:** Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX Processors, Pipeline Operation of TMS320C54XX Processors.

Unit :IV
**Implementations of Basic DSP Algorithms:** The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing.

Unit :V
**Interfacing Memory and I/O Peripherals to Programmable DSP Devices:** Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

**Text Books:**

**References:**
Unit-1

**Introduction power quality:** voltage quality, overview of power quality phenomena, classification of power quality issues, power quality measures and standards, THD -TIF-DINC-message weights-flicker factor-transient phenomena, occurrence of power quality problems, power acceptability curves, IEEE standards and recommended practices.

Unit-2

**Harmonics:** individual and total harmonic distortion, RMS value of a harmonic waveform, triplex harmonics, important harmonic introducing devices, SMPS, Three phase powerconverters, arcing devices, saturable devices, harmonic distortion of fluorescent lamps, effectof power system harmonics on power system equipment and loads. Power quality problems created by, drives and itsimpact on drives.

Unit-3

**FACTS Concept and general system consideration:** Transmission Interconnections, Flow of Power in AC Systems, Loading capability, Power flow and Dynamic Stability Considerations of a transmission interconnection, Relative Importance of Controllable Parameters,

Unit-4

**Basic types of FACTS Controller ;** Static Shunt Compensators: Objectives of Shunt Compensation, Methods of Controllable Var Generation, Static Var Compensators: SVC and STATCOM, Comparison between STATCOM and SVC, Static Var Systems.

Unit-5

**Grounding and wiring:**Introduction, NEC grounding requirements, reasons for grounding,typical grounding and wiring problems, solutions to grounding, and wiring problems.

**Text books:-**
1. Electric power quality by G. T. Heydt
2. Understanding Power Quality Problems by Math H. Bollen

**References:**
3. ‘Selected Topics in Power Quality and Custom Power’, *Course book for STTP, 2004*, Ashok S.Surya Santoso,
Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester - M. Tech. – 2nd

Subject: **Programmable Logic Controllers Lab**

Total Practical Periods: **40**

Total marks in End semester Exam.: **75**

**List of Experiments:**

1. Study hardware and software associated with PLC to learn the configuration and various building blocks of PLC.
2. Implementation of Logic gates by developing a ladder using standard procedure and solving the problem using ladder programming.
3. Understand working of DOL starter and develop a ladder program for starting an electrical motor using DOL starter.
4. Study the timing diagram of On Delay Timer and develop an application using On-Delay timer.
5. Study the timing diagram of OFF Delay Timer and develop an application using OFF Delay Timer.
6. Study Counter timing diagram and develop an application specific ladder program using UP/DOWN counters.
7. Study computational / arithmetic instructions used in PLC ladder programming.
8. Speed control of Dc motor using PLC.
9. Speed control of Induction Motor using PLC
10. Study working of proportional, integral and derivative control actions instruction using PLC simulator and observe the effect of change in Proportional Band, Integral gain and Derivative gain values on PID performance

Chhattisgarh Swami Vivekanand Technical University, Bhilai (C.G.)

Semester - M. Tech. – 2nd  Specialization  Industrial Drives and Control

Branch :  Electrical Engg.

Total Practical Periods : 40  Code:  585222(24)
Total marks in End semester Exam.: 75

List of Experiments:

1. Write a microcontroller 8051 program to transfer the bytes into RAM locations starting at 50H, assuming that ROM space starting at 240H contains CHHATTISGARH by using –
   a) a Counter,
   b) null char for end of string.
2. Write a microcontroller 8051 program to get hex data on the range of 00-FFh from port 0 and convert it to decimal. Save the digits in R7, R6 and R5, where the least significant digit is in R7.
3. Write a microcontroller 8051 program to add two 16 Bit unsigned numbers. Operands are two RAM variables. Results to be in R1-R0 pair.
4. Write a microcontroller 8051 program to subtract an unsigned 16 Bit number from another. Operands are two RAM variables. Results to be in R1-R0 pair.
5. Write a microcontroller 8051 program to add two unsigned 32-bit numbers. Operands are two RAM variables. Results to be in R1-R0 pair.
6. Write a microcontroller 8051 program to add two 16 Bit signed numbers.
7. Write a microcontroller 8051 program to convert a binary number to equivalent BCD
8. Write a microcontroller 8051 program to convert a packed BCD number to two ASCII numbers and place them in R5 and R6.
9. Write a microcontroller 8051 program to calculate the square root of an 8-bit number using iterative method.
10. Write a microcontroller 8051 program to add two floating-point numbers.
11. Write a microcontroller 8051 program to multiply two floating-point numbers.
12. Write a microcontroller 8051 program that generates 2kHz square wave on pin P1.0, 2.5 kHz on pin P1.2 and 25 Hz on pin P1.3.
13. Write a microcontroller 8051 program for counter 1 in mode 2 to count the pulses and display the state of the TL1 count on P2. Assume that the clock pulses are fed to pin T1.
14. Write a microcontroller 8051 program to transfer letter “N” serially at 9600 baud, continuously. Assume crystal frequency to be 11.0592 MHz.
15. Write a microcontroller 8051 program to transfer word “CSVTU” serially at 4800 baud and one stop bit, continuously. Assume crystal frequency to be 11.0592 MHz.
16. Write a microcontroller 8051 program to receive bytes of data serially, and put them in P1. Set the baud rate at 2400 baud, 8-bit data, and 1 stop bit. Assume crystal frequency to be 11.0592 MHz.

List of Equipments/Machine Required:
Microcontroller kit, Interfacing kit, Keyboard, Monitor, SMPS for Microcontroller

Recommended Books:
1. 8051 Programming, Interfacing and Applications, K.J. Ayala; Penram Publ.
2. The 8051 Microcontrollers , M A Mazidi & Mazidi, Pearson Education.