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

SCHEME OF TEACHING & EXAMINATION

DEPARTMENT OF ELECTRICAL ENGIENERING

M.Tech in Industrial Drives and Control

(Second Semester)

S. N.	Board of Study	Subject Code	Subject Name	Period per week			Scheme of Exam Practical / Theory			Total marks	Credit L+(T+P)/2
				L	T	P	ESE	CT	TA		
1	Electrical Engg.	585211(24)	Analysis of DC and AC Converters	3	1	-	100	20	20	140	4
2	Electrical Engg.	585212(24)	Microcontrollers And Embedded System Design	3	1	-	100	20	20	140	4
3	Electrical Engg.	585213(24)	Programmable Logic controllers and their applications	3	1		100	20	20	140	4
4	Electrical Engg.	585214(24)	Optimal Control Systems	3	1		100	20	20	140	4
5	Refer Table - II		Elective – II	3	1		100	20	20	140	4
6	Electrical Engg.	585221(24)	Programmable Logic controllers Lab			3	75	-	75	150	2
7	Electrical Engg.	585222(24)	Microcontrollers and Embedded System Design Lab			3	75	-	75	150	2
Total				15	5	6	650	100	250	1000	24

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

Table – II		
Elective – II		
Board of Study	**Subject Code**	**Subject Name**
Electrical Engg.	585231(24)	Electrical Energy Systems
Electrical Engg.	585232(24)	HV AC and DC Transmission
Electrical Engg.	585233{24}	DSP Processors and Architectures
Electrical Engg.	585234(24)	Power Quality

Chhattisgarh Swami Vivekanand Technical Univesity, 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

Current source Inverters: Operation of six-step thyristor inverter – inverter operation modes – load – commutated inverters – Auto sequential current source inverter (ASCI) – current pulsations –comparison of current source inverter and voltage source inverters.

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:-

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004.
2. Jai P.Agrawal, "Power Electronics Systems", Pearson Education, Second Edition, 2002.
3. Bimal K.Bose "Modern Power Electronics and AC Drives", Pearson Education, Second Edition, 2003.
4. Ned Mohan,Undeland and Robbin, "Power Electronics: converters, Application and design" John Wiley and sons.,1995.
5. Philip T. Krein, "Elements of Power Electronics" Oxford University Press -1998

Reference Books:

1.Sen.P.C, "Modern Power Electronics", Wheeler Publishing Co, First Edition, New Delhi, 1998.
2.Bimbra.P.S, "Power Electronics", Khanna Publishers, Eleventh Edition, 2003.

Chhattisgarh Swami Vivekanand Technical Univesity, 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

Embedded System, Categories of Embedded System, Requirements of Embedded Systems, Challenges and Issues in Embedded Software Development, Applications of Embedded Systems in Consumer Electronics, Control System, Biomedical Systems, Handheld computers, Communication devices.

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:

1. The 8051 Microcontroller – K.J.Ayala – Thomson
2. The 8051 Microcontrollers , M A Mazidi& Mazidi, Pearson Education
3. Design with PIC micro-controllers: John B Peatman, Pearson Education
4. Embedded Systems - Architecture Programming and Design – Raj Kamal, 2nd ed., 2008,TMH.
5. Programming for Embedded Systems- Dreamtech Software Team, Wiley Dreamtech

Reference books:

1. Fundamentals of Embedded Software where C and Assembly Meet Daniel W Lewis.
2. DS101374: National Semiconductor reference manual.
3. Embedded / Real Time systems: Concepts, Design and programming, Dreamtech Software Team, John Wiley & Sons.

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

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

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

Total Theory Periods : **40** Code: **585213(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 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

Programming On-Off inputs to produce on – off outputs: Timers, Counters: Auxiliary Commands & functions. Arithmetic functions, Number Comparison functions, The skip & master control relay functions, Data move systems.

UNIT – IV : Advanced PLC Functions: Sequences functions, Matrix functions. Advanced Functions - Controlling a robot with a PC; Analog PLC Operation, PID Control of Continuous Process, Networking PLCs.

UNIT – V : PLC Deployment:

PLC; Installation & testing, Troubleshooting and Maintenance, Selecting a PLC, Operation Simulation and Monitoring, Commonly Used Circuit Symbols.

Text / Reference Books:

1. Webb: Programmable Controllers: Principles & Applications, Merryl Publishing Co.
2. Simpson: Programmable Logic Controllers, Prentice Hall.
3. T.A. Hughes, Programmable Controllers, 3rd Edition, ISA Press.
4. Gary Danning, Introduction to Programmable Logic Controllers, Delmar Thomson Learning
5. Bela. G. Liptak, Instrument Engineer's Handbook, Vol:II-Process Control, 3rd Edition, ISA Press.

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

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

Subject: **Optimal Control System** Branch : **Electrical Engg.**

Total Theory Periods : **40** Code: **585214(24)**

Total marks in End semester Exam.: **100** Total Tutorial Periods: **12**

Minimum number of class test to be conducted:**02**

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, continous 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 continous 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.

2. Optimal Control:Linear quadratic methods, Brian D.O. Anderson, John B. Mure, Prentice Hall

Reference Books :

1. F.L. Lewis and V.L. Syrmos, optimal control, john wiley and sons, NY 1955.

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

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

Subject: **Electrical Energy Systems** Branch : **Electrical Engg.**

Total Theory Periods : **40** Code: **585231(24)**

Total marks in End semester Exam.: **100** Total Tutorial Periods: **12**

Minimum number of class test to be conducted:**02**

Unit – I

World energy Scenario: Energy sources and their availability, Conventional and renewable sources, Prospects of renewable energy, Trends in energy consumption, Centralized Generation: Main features, Economics, Consideration of Reliability and Economics, Need to develop new energy technology.

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

Energy Audit: Types and recommended practices, Energy Management – Problems & Prospects: Energy management strategies both at generation and demand ends. Energy demand patterns and strategies for energy conversion, energy management in industrial sector and its effect on environment.

Text Books:

1. Rai, G.D. "Non-conventional energy sources", Khanna Publishers, 1993.
2. Rai, G.D., "Solar energy utilization", Khanna Publishers, 1991.
3. Gray L. Johnson, "Wind energy Systems", Prentice Hall Inc., 1985.

Reference Books :

1. Rau JG and Wooten D.C.,"Environmental Impact Assessment", McGraw Hill, new Delhi.
2. R.E. Munn, "Environmental Impact Assessment", John Wiley and Sons, New York, USA.
3. J.M. Smith, H.C., Van Ness, "Introduction to Chemical Engineering Thermodynamics", McGraw Hill, New York, USA.
4. John F. Walker and Jenkins, N. "Wind energy Technology,", John Wiley and sons, chichester, U.K.1997.
5. Freries LL, "Wind Energy Conversion Systems", Prentice Hall, U.K. 1990.
6. Raw J.G. Wooten D.C. " Environmental Impact Assessment" MC Graw Hill , New Delhi.

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

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

Subject: **HV AC and DC Transmission** Branch : **Electrical Engg.**

Total Theory Periods : **40** Code: **585232(24)**

Total marks in End semester Exam.: **100** Total Tutorial Periods: **12**

Minimum number of class test to be conducted:**02**

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 Converters: Pulse Number, Choice of Converter Configuration, Simplified Analysis of Graetz Circuit, Converter Bridge Characteristics. Characteristics of a Twelve Pulse Converter, Detailed Analysis of Converters

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:

1. Padiyar K.R., HVDC Power Transmission Systems, Wiley Eastern Ltd., New Delhi.
2. Kimbark E.," Direct Current Transmission", Vol-I, John-Wiley & sons, NY
3. Arrillaga J., HVDC Transmission, IEE Press, London.

Reference Books:

4. Begamudre R.D., EHV AC Transmission Engineering, Wiley Eastern Press.
5. Arrillaga J. and Smith B.C., AC-DC Power System Analysis, IEE Press, London.

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

Semester - **M. Tech. – 2nd**		Specialization	**Industrial Drives and Control**
Subject: **DSP Processors and Architectures**		Branch :	**Electrical Engg.**
Total Theory Periods : **40**		Code:	**585233{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 Digital Signal Procesing: 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:

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.
2. DSP Processor Fundamentals, Architectures & Features – Lapsley et al.S. Chand & Co, 2000.

References:

1. Digital Signal Processors, Architecture, Programming and Applications-B.Venkata Ramani and M. Bhaskar, TMH, 2004.
2. Digital Signal Processing – Jonatham Stein, John Wiley, 2005.

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

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

Subject: **Power Quality** Branch : **Electrical Engg.**

Total Theory Periods : **40** Code: **585234(24)**

Total marks in End semester Exam.: **100** Total Tutorial Periods: **12**

Minimum number of class test to be conducted:**02**

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
3. N.G.Hingorani & L.Gyugyi, *Understanding FACTS*: *Concepts and Technology of Flexible AC Transmission Systems*, IEEE Press, 1999.

References:

1. J. Arrillaga, .Power System Quality Assessment., John wiley, 2000
2. J. Arrillaga, B.C. Smith, N.R. Watson & A. R.Wood,Power system Harmonic .Analysis, Wiley, 1997
3. 'Selected Topics in Power Quality and Custom Power', Course book for STTP, 2004, Ashok S.Surya Santoso,
4. H. Wayne Beaty, Roger C. Dugan, Mark F. McGranaghan, "Electrical Power System Quality" , MC GrawHill, 2002

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

Semester - **M. Tech. – 2nd**		Specialization	**Industrial Drives and Control**
Subject: **Programmable Logic Controllers Lab**		Branch :	**Electrical Engg.**
Total Practical Periods : **40**		Code:	**585221(24)**
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

Apparatus required: Allen Bradley 1400 series with instruction manual, Siemen's S7-200 Programmable Controller with System Manual.

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

Semester - **M. Tech. – 2nd**		Specialization	**Industrial Drives and Control**
Subject: **Microcontrollers and Embedded system Lab**		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 o 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.