Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

B.Tech. Mechatronics

Subject Code	Category	Subject Name	Teaching &Evaluation Scheme								
			Theory			Practical		L	T	P	Credits
			End Sem University E	Two Term Exam	Teachers Assessment*	End Sem University	Teachers Assessment*				
BTEC408		Signal and System	60	20	20	30	20	2	1	2	4

Legends: L - Lecture; T - Tutorial/Teacher Guided Student Activity; P – Practical; C - Credit; Q/A Quiz/Assignment/Attendance, MST Mid Sem Test.

.Course Objectives:

The objective of this course is to have an introduction to approaches of signals & systems analysis with an increased emphasis on the frequency response and Analysis of system with continuous signal and discrete time signal. To enable the students to understand the fundamentals of Signals, their Time & Frequency characteristics.

Course Outcomes: Upon completion of this course students will be able to

1. Classify both continuous and discrete time signals and systems.
2. Analyze continuous signals in complex plain.
3. Understand Laplace transform
4. Analyze Z transform
5. Understand the random signals and systems.

Syllabus

UNIT-I

Introduction to signal and systems: Continuous and discrete time signals: Classification of Signals Periodic aperiodic even odd energy and power signals Deterministic and random signals complex exponential and sinusoidal signals periodicity unit impulse unit step Transformation of independent

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Registrar
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variable of signals: time scaling, time shifting. System properties: Linearity, Causality, time invariance and stability, Dirichlet's conditions, Determination of Fourier series coefficients of signal.

UNIT-II

Signal Transformation: Fourier transformation of continuous and discrete time signals and their properties, Laplace transformation-analysis with examples and properties. Parseval's theorem; Convolution in time (both discrete and continuous) and frequency domains with magnitude and phase response of LTI systems

UNIT-III

The Laplace Transform. The Region of Convergence for Laplace Transforms. The Inverse Laplace Transform. Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot. Properties of the Laplace Transform. Analysis and Characterization of LTI Systems Using the Laplace Transform. System Function Algebra and Block Diagram Representations. The Unilateral Laplace Transform.

UNIT-IV

Z-Transforms: Basic principles of z-transform, z-transform definition, Relationship between z-transform and Fourier transform, region of convergence properties of ROC, Properties of z-transform, Poles and Zeros, inverse z-transform using Contour integration, Residue Theorem, Power Series expansion and Partial fraction expansion

UNIT-V

Random Signals & Systems: Definitions, distribution & density functions, mean values & moments, function of two random variables, concepts of correlation, random processes, spectral densities, response of LTI systems to random inputs.

Text books:

1. Signals and Systems 2/E, 1996 Alan V. Oppenheim, Alan S. Willsky, with S. Hamid Prentice Hall .
2. Digital signal processing –Principles, algorithms and applications 3rd Edition, 1996 J. G. Proakis, D. G. Manolakis PHI

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Reference books:

1. Outline of Signals and Systems 1st, 1995 Hwei Hsu,Schaum's McGraw-Hill
2. Signals & Systems 2nd Edition, 2002 Simon Haykin and Van Veen Wiley
3. Signals & Systems Analysis Using Transformation Methods & MAT Lab 2003 Robert TMH
4. Signals, Systems and Transforms 3rd Edition, 2004. C. L. Philips, J.M.Parr and Eve A.Riskin Pearson education
5. Signals & Systems 2001. I. J. Nagrath, S.N.Sharan, R.Ranjan, S.Kumar

List of Experiments:

1. Introduction to MATLAB.
2. Write a program to generate continuous time signals (i) Sine wave (ii) Cosine Wave (iii) Square wave (iv) Triangular wave
3. Write a program to generate the discrete sequences (i) unit step (ii) unit impulse (iii) ramp (iv) periodic sinusoidal sequences. Plot all the sequences.
4. Find the Fourier transform of a square pulse .Plot its amplitude and phase spectrum.
5. Write a program to convolve two discrete time sequences. Plot all the sequences. Verify the result by analytical calculation.
6. Generate a discrete time sequence by sampling a continuous time signal.
7. Write a program to find the autocorrelation and cross correlation of sequences.
8. Write a program to generate a random sinusoidal signal and plot four possible realizations of the random signal.
9. To develop program modules based on operation on sequences like signal shifting, signal folding, signal addition and signal multiplication.
10. To develop program for computing Z-transform and Inverse Z-transform.

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Indore

Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

B.Tech. Mechatronics

SUBJECT CODE	Category	SUBJECT NAME	TEACHING &EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEI401		Microprocessor and Microcontroller	60	20	20	30	20	2	1	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To gain knowledge of basics of Microprocessor & microcontroller & Learn development of assembly language programs.
2. To learn the programming skills of 8086 microprocessor & 8051 microcontroller.
3. To learn the interfacing of external devices (LED, LCD, ADC, DAC) with the microcontroller 8051.

Course Outcomes (COs):

The students will be able to

1. Apply the concept of buses, microprocessor & microcontroller architecture and interrupts.
2. Interface memory and I/O devices with 8051 microcontroller
3. Program assembly language / C programming of 8051 & 8086.
4. Design microcontroller based small system
5. Interface 8051 with LED, LCD, ADC, DAC etc.

Syllabus

UNIT I **08hr.**

Introduction to 8086 Microprocessor

Overview of 8086 microprocessor. Architecture of 8086, Signals and pins of 8086 microprocessor, Concept of Memory Segmentation in 8086. Maximum Mode , Minimum Mode, Timing diagram, Comparative study of Salient features of 8086, 80286 & 80386.

UNIT II **10hr.**

Microprocessor 8086 programming

8086 Instructions set . Addressing mode of 8086, Assembly directives. Stack , Interupts of 8086, Assembly language programs of 8086.

Input-Output interfacing: Peripherals I/O. PPI 8255 Architecture and modes of operation, Interfacing to 16-bit microprocessor and programming, DMA controller (8257) Architecture,

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Programmable interval timer 8254, USART 8251.

UNIT III **08hr.**

Introduction to 8051 Microcontroller

Introduction, Difference between Microprocessors and Microcontrollers. Overview of 8051 Microcontroller family, Architecture of 8051 Microcontroller, The program counter and ROM space in the 8051, registers, 8051 register banks

UNIT IV **10hr.**

8051 Assembly Language Programming

Introduction to 8051 assembly programming, Structure of Assembly language, Assembling and running an 8051 program, 8051 data types and directives, interrupts

8051 Addressing Modes & Instruction set

Addressing modes, Accessing memory using various Addressing modes, Bit addresses for I/O and RAM, Arithmetic instructions, Signed number concepts and arithmetic operations, Logic and compare instructions, Rotate instruction, Jump, Loop, And Call Instructions, Call instructions time delay for various 8051 chips.

UNIT V **10hr**

8051 Programming in C

Data types and time delay in 8051 C, I/O programming in 8051 C, Logic operations in8051 C, Data conversion programs in 8051 C, Accessing code ROM space in 8051 C, Interfacing with LEDs, LCDs ADCs, DACs.

Text Books:

1.A.K. Ray & K.M.Bhurchandi, Advanced Microprocessors and peripheral-Architecture, Programmingand Interfacing, Tata McGraw –Hill, 2012(Third Edition)
2.The 8051 Microcontroller and Embedded Systems Using Assembly and C, 2/e by Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin McKinlay,2008(SecondEdition,PearsonEducation)
3.The 8051 Microcontroller & Embedded Systems using Assembly and C By Kenneth J. Ayala, Dhananjay V. Gadre, 2008 (Cengage Learning , India Edition).

Reference Books:

1.Hall Douglas V.,Microprocessor and interfacing, Revised second edition 2006, Macmillan, McGraw Hill.
2.Using the MCS-51 Microcontrollers By Han Way Huang Oxford Uni Press,2000.
3. Programming and Customizing the 8051 Microcontroller by Myke Predko Tata McGraw Hill, 1999.
4. Microcontrollers Architecture, programming, interfacing and system design by Rajkamal Pearson education,2009.

List of Experiment:

1. Introduction to 8086 & 8051 kit, hardware features & modes of operationand Technique of programming & basic commands of kit.
2. Design programs for Arithmetic Operations.
3. Develop a program to find 1's complement and then 2's complement of a 16-bit numbers.
4. Develop a program to find larger of two numbers.

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5. Write a program to shift an 8-bit number left by 2-bits.
6. Write a program to generate a square wave of 2 KHz Frequency on input pin.
7. Introduction to IDE and Assembler directives.
8. Develop 8051 Assembly language programs using Arithmetic/ Logical instructions.
9. 8051 Assembly language programming for block data transfer between internal and external memory including overlapping blocks.
10. 8051 Assembly language programming for
    a. code conversions
    b. Timers in different modes.
    c. I/O port programming in embedded C.
    d. Programming of LCD in embedded C.

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B.Tech. Mechatronics

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTMT402		Measurement Science and Techniques	60	20	20	30	20	3	1	2	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

1. To introduce the basic functional elements of measurement
2. To introduce different types of Ammeter & Voltmeter
3. To educate on different types of signal generator.
4. To introduce various storage and display devices
5. To introduce various Environmental Pollution Monitoring Instruments

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes
The students will be able to

1. To apply knowledge of measurement system.
2. To identify, formulate, and solve the different types of Ammeter & Voltmeter
3. Demonstrate various types of of signal generator instrument.
4. Demonstrate various types of environmental pollution monitoring instruments.

Syllabus

Unit-I — 9 Hours

Measurement and error, Accuracy and precision, sensitivity resolution, Error & Error analysis, Effect of temperature, Internal friction, Stray field, Hysterisis and Frequency variation & method of minimizing them, Loading effects, due to shunt connected and series connected instruments, calibration curve, Testing & calibration of instruments

Unit-II — 10 Hours

Different types of Ammeter & Voltmeter – PMMC, MI, Electrodynamometer, Hotwire, Electrostatic, Induction, Rectifier, Ferro dynamic & Electro-thermic, Expression for control & deflection torque, their advantages, disadvantages & error, Extension of range of instruments using shunt & multiplier. Introduction to A/D and D/A converters. Various types of Analog Digital &

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Registrar

Digital to Analog converters.

Unit-III **10 Hours**

Miscellaneous Instruments & Measurements:. Frequency meter – Vibrating reed, Resonance type & Weston type, Synchronoscope, Ohmmeter – series & stunt type, Multi-meter, Megger & Ratio meter. Signal generator: Function generator, sweep frequency generator, Pulse and square wave generator, Wave Analysers, Harmonic Distortion Analyser, Spectrum Analyser, frequency counter.

Unit-IV **10 Hours**

R, L, C Measurement: Bridges: Measurement of resistance using Wheatstone bridge, Kelvin's double bridge, Loss of charge method, ohm meter, Measurement of inductance and capacitance by A.C. bridges: Maxwell's bridge, Anderson bridge, Schering bridge, Hay's bridge, Wein's bridge, Shielding and grounding, Q meter.

Unit-V **10 Hours**

Gas Analysis: Gas chromatography, Thermal conductivity method, Heat of reaction method Zirconia-probe oxygen analyser. Paramagnetic oxygen meters, Electrochemical reaction method. Environmental Pollution Monitoring Instruments : Air pollution monitoring instruments, Water pollution monitoring instruments.

Text Books:

1. A.K. Sawhney; Electrical & Electronic Measurements & Instrument; Dhanpat Rai & Sons Pub.
2. Nakra and Chaudhry "Instrumentation measurement and analysis & Co".

References:

1. Electronic Instrumentation – Kalsi – TMH.
2. Patranabis D-Principles of Industrial Inst. TMH Publication

List of Experiments:

1. Study of CRO and perform component testinng using CRO.
2. Study of phase using Lissajous pattern with help of CRO.
3. Study of frequency using Lissajous pattern with help of CRO.
4. Measurement of high resistance by loss of charge method.
5. Study of function generator with its application.
6. To study and find out the balance condition for the Maxwell's bridge.
7. To study and find out the balance condition for the Schering bridge.
8. To study and find out the balance condition for the Hay's Bridge.
9. To study and find out the balance condition for the Wein's bridge.
10. To study and find out the balance condition for the Anderson's Bridge.

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Indore

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
BTME401	DCS	FLUID MECHANICS	60	20	20	30	20	3	0	2	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** Practical: C - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

To introduction with (A) Fluid and its properties, (B) behavior of fluid under various conditions, (C) Applications.

Course Outcomes (COs):

After the successful completion of this course students will be able to

1. Understand the fundamentals of fluid mechanics.
2. Understand basics of compressible flow.
3. Understand fundamentals of flow through pipes.
4. Understand statics, dynamics and various approaches to fluid mechanics.

Syllabus

Unit - I

Flow and Fluid Properties: Viscosity, relationship between stress and strain-rate for Newtonian fluids, incompressible and compressible flows, differences between laminar and turbulent flows. Hydrostatics forces: Buoyancy and floatation, manometer, forces on submerged and floating bodies, stability conditions.

Unit - II

Kinematics: Types of fluid flow, rate of flow or discharge continuity equation, velocity and acceleration, velocity potential function and stream function, types of motion, vortex flow.
Ideal flow: Uniform flow, source flow, sink flow, free vortex flow.

Unit - III

Differential Analysis: Differential equations of mass and momentum for incompressible flows, inviscid - Euler equation and viscous flows - Navier-Stokes equations, Bernoulli's equation from

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Registrar
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Euler's equation and assumptions, concept of fluid rotation, vorticity, stream function, Exact solutions of Navier-Stokes equation for Coquette Flow and Poiseuille flow, Orifices and mouthpieces: classifications of and flow through orifice, hydraulic coefficients, experimental determination of hydraulic coefficients, classification and flow through convergent and divergent mouthpiece.

Unit - IV

Dimensional Analysis: Introduction, secondary or derived quantities, methods of dimensional analysis, model analysis, similitudes-types of similarities, dimensionless numbers, models law and Concept of geometric, kinematic and dynamic similarity, some common non-dimensional parameters and their physical significance: Reynolds number, Froude number and Mach number. **Internal Flows:** Fully developed pipe flow, various losses in pipe flow, empirical relations for laminar and turbulent flows: friction factor and Darcy-Weisbach relation.

Unit-V

Prandtl Boundary Layer Equations: Concept and assumptions, qualitative idea of boundary layer and separation, streamlined and bluff bodies, drag and lift forces. Flow measurements: Basic ideas of flow measurement using venturimeter, Pitot - static tube and orifice plate.

Reference Books:

1. *"Fluid Mechanics and Fluid Power Engineering ;" by D.S. Kumar, S.K. Kataria & Sons*
2. *"Fluid Mechanics and Hydraulic Machines ;" by R.K. Bansal. Laxmi Publications*
3. *"Fluid Mechanics and Hydraulic Machines ;" by R.K. Rajput, S. Chand & Co.*
4. *"Fluid Mechanics ;" by Frank. M. White, McGraw Hill Publishing Company Ltd.*
5. *"Fundamentals of Fluid Mechanics ;" by Munson, Wiley India Pvt. Ltd*
6. *"Fluid Mechanics by A. K. Mohanty ;" PHI Learning Pvt. Ltd.*
7. *" Laboratory Manual Hydraulics and Hydraulic Machines ;" by R V Raikar*

List of Experiments

1. To understand pressure measurement procedure and related instruments/devices.
2. To study meta-centric height of floating body.
3. Verification of Bernoulli's Theorem.
4. To study the velocity of flow using Pitot tube.
5. To determine the Coefficient of discharge through different flow meters. (Any two out of Orifice meter, Venturimeter and Nozzle meter.)
6. To determine the different types of flow Patterns by Reynolds experiment.
7. To study the Friction factor for the different pipes.
8. To study the loss coefficients for different pipe fittings.

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B.Tech. Mechatronics

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEI-402		SENSOR & TRANSDUCER	60	20	20	30	20	3	1	2	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

- Student will be able to understand the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities.
- Explain the principles of operation of the sensor.
- Interpretation of the measurement results by using transducers.
- Development of measurement schemes for different non electrical quantities
- Assimilating knowledge about the implementation of sensors and transducers into a control system structure.

Course Outcomes (COs):

After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

The students will be able to

1. To apply knowledge of sensors and transducer.
2. To identify, formulate, and solve engineering problems
3. Demonstrate various types of force transducer and their analysis.
4. Demonstrate various types of pressure transducer and their analysis.

Syllabus

Unit-I **10 hours**

Motional and Dimensional measurement:

Introduction, Aim of measurement, Roll of sensors in engineering, classification of transducers, Fundamental Standards, units , Resistive Potentiometers, stain gauge, LVDT, Hall Effect sensors, magnetostricitive, magnetoresisitive, Optical displacement sensor fiber optic sensor, Ultrasonic distance Sensor,Piezoresistive, Linear encoder, Proximity sensors RVDT, DC tachometer, AC tachometer , eddy curreht , drag cup type tachometer, magnetic, gyroscope.

Unit-II **12 hours**

Force, Torque measurement:

Standards and Calibration, Strain gauge: basic principal, gauge factor, types of strain gauge, materials and their properties, bonding material compensation techniques, bridge configuration, Rosettes, Tactile sensors, Piezoelectric sensors, LVDT as secondary sensor

Torque: Flat Spiral Spring, Magenetostrictive Torsion Transducer, Dynamometers.

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Unit-III **12 hours**

Pressure Measurement:

Standards and calibration Units and relations. Positive Pressure Sensors

Pressure and sound measurement: Moderate pressure Bourdon tube, Bellows &diaphragms, High pressure measurement, Piezo electric, Electric resistance, Low pressure measurement, Mcleod gauge, Knudsen gauge, Viscosity gauge, Thermal conductivity, Ionization gauge, Dead weight gauge, sound level measurement using different types of microphone

Unit-IV **12 hour**

Flow measurement: Obstruction meter: Orifice, Nozzle, venturi, Pitot tube, Annubar tubes, Target, rotameter, Turbine, Electromagnetic, Vortex, Positive displacement, Anemometers, Weirs & flumes, Laser Doppler, Anemometer, Ultrasonic flow meter, fluidic oscillator, Mass flow meter, Flow visualization, Level measurement: Visual lev el indicators, Ordinary float type, Purge method, Buoyancy method, resistance, Capacitance and inductive Probes, Ultrasonic, Laser, Optical fiber. Thermal, Radar radiation.

Unit-V **10 hours**

Temperature measurement:

Bimetallic thermometers, Liquid in glass, Pressure thermometer, thermocouples, RTD, Thermistors, Semiconductor sensors, Digital thermometers,Pyrometers, Miscellaneous Measurement: Humidity, Dew point, Viscosity, Thermal and nuclear radiation measurements.

Text Book

1. H.N. Norton "Handbook of transducers".
2. E.O. Doebelin "Measurement systems applications and design"

Reference Book

1. DVS Murthy "Transducers and instrumentation"
2. Nakra and Chaudhry "Instrumentation measurement and analysis *& Co*

List of experiments

1. Calibration of pressure gauge using dead weight pressure tester and preparation of report for the same.
2. Characterization of strain gauge indicator and weight measurement using load cell.
3. Measurement of displacement using LVDT.
4. Study of linear and rotary encoder as displacement sensor.
5. Measurement of Pressure using Bellows, Bourdon gauge, Diaphragm.
6. Calibration of vacuum gauge using vacuum gauge tester and preparation of the report.
7. Characterization of Thermocouples (J/T/K/R/S)
8. Characterization of RTD.
9. To study characteristics of thermistor.
10. Calibration of Rotameter.

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B.Tech. Mechatronics

COURSE CODE	Category	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment *	END SEM University Exam	Teachers Assessment *				
BTEI404		PLC Lab	0	0	0	0	50	0	0	4	2

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course educational objectives
To provide knowledge levels needed for PLC programming and operating.

.Course outcomes:
At the end of the course student will have ability to

1. understand different types of Devices to which PLC input and output modules are connected
2. create ladder diagrams from process control descriptions.
3. apply PLC timers and counters for the control of industrial processes
4. use different types PLC functions, Data Handling Function

Laboratory Experiment List:

1. Introduction of mechatronics and study of elements of mechatronics systems.
2. To study and analysis of Mechatronics products and systems in manufacturing.
3. To simulate the PLC Ladder logics through Siemens PLC kit and Step-7 Micro/ Win software.
4. To perform and verify given Boolean expressions using ladder logic on PLC simulation software kit.
5. To perform and verify half adder and full adder using ladder logic on PLC simulation software kit.
6. To perform and verify half subtractor and full subtractor using ladder logic on PLC simulation software kit.
7. Design ladder logic for MUX (4x1) on PLC simulation software kit.
8. Design a ladder logic for DEMUX (1x4) on PLC simulation software kit.
9. Design ladder logic for Encoder on PLC simulation software kit.
10. Design ladder logic for Decoder on PLC simulation software kit.

Text Books:

1. Process Control Instrumentation Technology, Johnson Curties, Prentice hall of India, 8th edition

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2. Andrew Parr, Industrial drives, Butterworth – Heineamann
3. G.K.Dubey.Fundamentals of electrical drives
4. Programmable Logic Controllers by W.Bolton

References:

1. Introduction to Programmable Logic Controllers by Garry Dunning, 2nd edition, Thomson, ISBN:981-240-625-5
2. Instrumentation Engineers Hand Book - Process Control, Bela G Liptak, Chilton book company, Pennsylvania
3. A.E. Fitzerald ,C.Kingsley and S.D Umans, Electric Machinery - McGraw Hill Int. Student Edition.
4. S.K.Pillai. A First course on electric drives –Wiley Eastern 1990
5. Programmable Logic Controllers by Hugh Jack.
6. Programmable Logic Controllers Principles & applications, John Webb,PHI-2001

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