Dr. Babasaheb Ambedkar Technological University Lonere.

ELECTRICAL ENGINEERING DEPARTMENT

Structure and syllabus

Of

Third Year B. Tech.

(Electrical & Instrumentation Engineering)

With effect from June 2019

Teaching & Evaluation scheme of Third year B. Tech. Electrical Instrumentation engineering

V Semester

Course Code	Course Name	Teaching Scheme			Evaluation Scheme				
		L	P	T	Int	MSE	ESE	Total	Credits
BTINC501	Process loop components	3	0	1	20	20	60	100	4
BTINC502	Microprocessor and Micro Controller	3	0	0	20	20	60	100	3
BTINC503	Digital Signal Processing	3	0	1	20	20	60	100	4
BTHM501	Value Education, Human Rights and Legislative Procedures[MOOC/ Swayam/ NPTEL]	2	0	0	-	-	-	Audit course	0
BTEINE504	Elective-II-A. Fundamentals of Signals and Systems Elective-II-B Clinical Engineering	3	0	0	20	20	60	100	**3**
BTEINE505	Elective-III-A Control System Components and analysis Elective-III-B Software Techniques	3	0	0	20	20	60	100	**3**
BTINL506	Computational Technics Lab	0	2	0	**30**	-	**20**	50	**1**
BTINL507	Process loop components Lab	0	4	0	**60**	-	**40**	100	**2**
BTINL508	Microprocessor and micro Controller Lab	0	2	0	**30**	-	**20**	50	**1**
BTINF509	Industrial Training	-	-	-	**50**	-	-	50	**1**
	Total	17	08	02	**270**	**100**	**380**	750	**22**

VI semester

Course Code	Course Name	Teaching Scheme			Evaluation Scheme				
		L	P	T	Int	MSE	ESE	Total	Credits
BTINC601	Digital System	3	0	1	20	20	60	100	4
BTINC602	Industrial automation and Control	3	0	1	20	20	60	100	4
BTINC603	Power Electronics and Drives	3	0	0	20	20	60	100	3
BTINOE604	Elective-VI [MOOC/Swayam/NPTEL] Elective-VI-A Project engineering and management Elective-VI-B Design of Experiments.	3	0	0	20	20	60	100	3
BTEINE605	Elective-V-A. Analytical Instruments Elective-V-B Measurement and Data Analysis	3	0	0	20	20	60	100	3
BTEINE606	Elective-IV-A Communication Systems. Elective-IV-B Virtual Instrumentation	3	0	0	20	20	60	100	**3**
BTINL607	Digital system Lab	0	2	0	30	-	20	50	**1**
BTINL608	Industrial automation and Control Lab	0	2	0	30	-	20	50	**1**
BTINL609	Power Electronics and Drives Lab	0	4	0	60	-	40	100	**2**
	Industrial Training*								
	Total	18	08	02	**240**	**120**	**440**	800	**24**

*Industrial Training of 30 days to be assessed in 7 semester

SEMESTER V

BTINC501 Process loop components

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basics of Feedback Control System	
Course Objective		
Course Outcome		
Unit		Contact Hrs
1	Fundamentals of process control and Transmitters Elements of process control loop, Concept of Process variables, set point, controlled variable, manipulated variable, load variable. Representation of Process loop components using standard symbols (basics with reference to control loop), and Examples of process loops like temperature, flow, level, pressure etc. Need of transmitter (concept of field area & control room area), Need for standardization of signals, Current, voltage, and pneumatic signal standards, Concept of live & dead zero. Signal conditioning(Analog and digital) for RTD , T/C, magnetic flow meter, DPT , Span & zero adjustment, Types of transmitters: Two and four wire transmitters, Electronic and Pneumatic transmitters Electronic Capacitive Differential Pressure Transmitter: Types, Mounting (Installation), Manifold, Calibration setup, Application of DPT for Level measurement, Zero elevation, suppression, Square root extractor. SMART: Comparison with conventional transmitter, Block schematic, Converters: Difference between converter & Transmitter, Pneumatic to current converter, Current to pneumatic converter.	8
2	Types of Control Actions Discontinuous: Proportional (offset), Integral (Reset windup), Derivative, Proportional- Integral, Proportional- Derivative, Proportional- Integral-derivative, Antireset windup, Rate before Reset, Concept of Bump less transfers in PID controller, Effect of process characteristics on PID combination, Selection & application of controller actions.	6
3	Tuning of controller: Different Criteria like Quarter Amplitude Decay Ratio, Loop disturbance, Optimum Control, Measure of Quality, Stability Criteria. Tuning Methods: Process Reaction Curve (open loop), Ziegler Nichols (closed loop), &Frequency Response Method. Digital PID controllers: Velocity & Position algorithm, Block Schematic, Faceplate of Digital controller, Introduction to Direct Digital Control. Current to pneumatic converter & Pressure to Current converter	7
4	Programmable Logic Controller (PLC) Continuous versus Discrete Process Control, Relay based ladder diagram using standard symbols, Limitations of relay based system. Architecture of PLC, Types of Input & Output modules (AI, DI, DO, AO), Wiring diagram, Interfacing pneumatic & Hydraulic systems to PLC, Fixed & Modular PLC (Rack, slot, grouping), PLC specifications, PLC manufacturers, PLC Basic instructions, Timers (ON delay, OFF delay & Retentive) & Counters with timing diagrams, PLC ladder diagram, PLC programming for process applications, Introduction to analog programming.	8
5	Control valve Necessity, comparison with other final control elements, Control valve Characteristics: (Inherent & Installed) Control valve terminology: Rangeability, Turndown, valve capacity, viscosity index, AO, AC (Fail Safe Action) etc. Classification of control valve based on: valve body. Construction, type of actuation, application etc. Construction, Advantages, Disadvantages & applications of Globe: Single, double, 3way, angle, Gate,	8

	Needle, Diaphragm, Rotary valves, Ball, Butterfly. Types of actuators: Construction, Advantages, Disadvantages & applications: Spring Diaphragm & Smart actuators. Control valve accessories: Positioners: Applications/Need, Types, Effect on performance of Control valves. Solenoid valves, Hand wheel.	
6	Explosion proof housing, Encapsulation, Sealing & Immersion, Purging systems Hazardous area classification& intrinsic safety, Concept of safety cycle, HAZOP fault tolerance and safety integrity level	7
	Reference books: 1. Process control and Instrument technology, C.D.Johnson, TMH 2. Introduction to Programmable Logic Controller, Gary Dunning 3. Process Control, Instrument Engineering Hand book, B.G. Liptak	

BTINC502 Microprocessor and Microcontroller

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Digital electronics, electronics devices and circuits	
Course outcome	To know the architecture of 8085 and 8051. To understand interfacing and interrupt features of 8085 and 8051. To develop program for basic applications.	
Unit	Contents	Contact Hrs.
1	Architecture of 8085 Microprocessor and Programming: Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals, Machine cycles and timing diagrams. Instruction formats, Addressing modes, Instruction set, Need for Assembly language, Development of Assembly language programs.	8
2	Interfacing: Memory Interfacing: Interface requirements, Address space partitioning, Buffering of Buses, timing constraints, Memory control signals, Read and write cycles, interfacing SRAM, EPROM and DRAM sections. I/O Interfacing: Memory mapped I/O Scheme, I/O mapped I/O scheme, Input and Output cycles, Simple I/O ports, Programmable peripheral interface (8255). Data transfer schemes: Programmable data transfer, DMA data transfer, Synchronous, Asynchronous and interrupt driven data transfer schemes, Interfacing, Simple keyboards and LED displays.	6
3	Interrupts and DMA: Interrupt feature, Need for interrupts, Characteristics of Interrupts, Types of Interrupts, Interrupt structure, Methods of servicing interrupts, Development of Interrupt service subroutines, Multiple interrupt request and their handling, need for direct memory access, Devices for Handling DMA, Programmable DMA controller 8237.	6
4	Applications: Interfacing of A/D converters (ADC 0800/ADC 0808/ADC 0809), Interfacing of D/A converters (DAC 0800), Waveform generators, Multiplexed seven segment LED display systems, Measurement of frequency, phase angle and power factor-Traffic light controller, Stepper motor control	6
5	Intel 8051 Microcontroller : Architecture of 8051, Memory Organization, Addressing modes, Instruction set, Boolean processing, Simple programs	6
6	8051 Peripheral Functions : 8051 interrupt structures, Timer and serial functions, parallel port features : Modes of operation, Power control, features, Interfacing of 8051, Typical applications, MCS 51 family features	7
	Ref Books: 1. Goankar, R.S., "Microprocessor Architecture Programming and Applications with the 8085/8080A", 3rd Edition, Penram International Publishing House, 1997. 2. Singh. I.P., "Microprocessor Systems", Module 9: Microcontrollers and their Applications", IMPACT Learning Material Series IIT, New Delhi, 1997. 3. Douglas, V.Hall. "Microprocessor and Interfacing Programming and Hardware", 2ndEdition, McGraw Hill Inc., 1992. 4. Kenneth, L.Short., "Microprocessors and Programmed Logic", Prentice Hall of India, 2nd Edition, 1987	

BTINC 503 Digital Signal Processing

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Signals and systems network analysis and synthesis.	
Course Outcome	To study different signals, systems, design procedure for filters. To understand time domain and frequency domain of systems. To analyses system signals and digital filter structure. To design digital filter for engineering application.	
Unit	Contents	Contact Hrs
1	Introduction to signals and systems Discrete time signals and systems, Z-transforms, structures for digital filters, design procedures for FIR and IIR filters. Frequency transformations: linear phase design; DFT. Methods for computing FFT. Noise analysis of digital filters, power spectrum estimation. Signals and signal Processing: characterization & classification of signals, typical Signal Processing operations, example of typical Signals, typical Signal Processing applications.	8
2	Time Domain Representation of Signals & Systems- Discrete Time Signals, Operations on Sequences, the sampling process, Discrete-Time systems, Time-Domain characterization of LTI Discrete-Time systems, state-space representation of LTI Discrete-Time systems, random signals	6
3	Transform-Domain Representation of Signals-The Discrete-Time Fourier Transform, Discrete Fourier Transform, DFT properties, computation of the DFT of real sequences, Linear Convolution using the DFT. Z-transforms, Inverse z transform, properties of z-transform, transform domain r epresentations of random signals. Transform-Domain Representation of LTI Systems: the frequency response, the transfer function, types of transfer function, minimum-phase and maximum-Phase transfer functions, complementary transfer functions, Discrete-Time processing of random signals	6
4	Digital Processing of Continuous-Time Signals - sampling of Continuous Signals, Analog Filter Design, Anti-aliasing Filter Design, Sample-and Hold circuits, A/D & D/A converter, Reconstruction Filter Design.	6
5	Digital Filter Structure - Block Diagram representation, Signal Flow Graph Representation, Equivalent Structures, bone FIR Digital Filter Structures, IIR Filter Structures, State-space structure, all pass filters, tunable IIR Digital filters. cascaded Lattice realization of IIR and FIR filters, Parallel all pass realization of IIR transfer function, Digital Sine-Cosine generator.	6
6	Digital Filter Design: Impulse invariance method of IIR filter design, Bilinear Transform method of IIR Filter Design, Design of Digital IIR notch filters, FIR filter Design based on truncated fonner sens, FIR filter design based on Frequency Sampling approach	7
	Ref Books: 1. Proakis J.G., and Manolakis, Introduction to DSP, PHI, 2007 2. Sanjit K. Mitra, “Applications DSP a Computer based approach”, TMH, 2006	

BTHM501 Value Education, Human Rights and Legislative Procedures

Teaching scheme:
Theory: 2 hrs
Tutorial: 0 hr
Total credit: 0 Audit course

Examination Scheme:
Mid-term test: NA
Internal Assessment: NA
End semester exam: NA

Prerequisite	Human Values and engineering ethics	
Course outcome	To understand value of education and self-development To develop good values and character To know Human right and legislative procedure	
Unit	Contents	Contact Hrs.
1	Values and Self Development-Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non-moral valuation, Standards and principles, Value judgments.	8
2	Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness, Honesty, Humanity, Power of faith, National unity, Patriotism, Love for nature, Discipline.	6
3	Personality and Behavior Development- Soul and scientific attitude, God and scientific attitude, Positive thinking, Integrity and discipline, Punctuality, Love and kindness, Avoiding fault finding, Free from anger, Dignity of labor, Universal brotherhood and religious tolerance, True friendship, Happiness vs. suffering love for truth, Aware of self-destructive habits, Association and cooperation, Doing best, Saving nature.	6
4	Character and Competence- Science vs. God, Holy books vs. blind faith, Self-management and good health, Science of reincarnation, Equality, Nonviolence, Humility, Role of women, All religions and same message, Mind your mind, Self-control, Honesty, Studying effectively.	6
5	Human Rights- Jurisprudence of human rights nature and definition, Universal protection of human rights, Regional protection of human rights, National level protection of human rights, Human rights and vulnerable groups.	6
6	Legislative Procedures- Indian constitution, Philosophy, fundamental rights and duties, Legislature, Executive and Judiciary, Constitution and function of parliament, Composition of council of states and house of people, Speaker, Passing of bills, Vigilance, Lokpal and functionaries	7
	Ref Books: 1. Chakraborty, S.K., Values and Ethics for Organizations Theory and Practice, Oxford University Press, New Delhi, 2001. 2. Kapoor, S.K., Human rights under International Law and Indian Law, Prentice Hall of India, New Delhi, 2002. 3. Basu, D.D., Indian Constitution, Oxford University Press, New Delhi, 2002. 4. Frankena, W.K., Ethics, Prentice Hall of India, New Delhi, 1990. 5. Meron Theodor, Human Rights and International Law Legal Policy Issues, Vol. 1 and 2, Oxford University Press, New Delhi, 2000.	

BTEINE504. Elective II.A. Fundamentals of Signals and Systems

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic electrical engineering	
Course Objective	To familiarize the students with elements of signals and systems.	
Course Outcome	Understand standard concepts and tools that will serve as building blocks towards signal and system analysis	
Unit		Contact Hrs
1	**Classification of signals:** Continuous time signals (CT signals), discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Exponential, Classification of CT and DT signals - periodic and periodic, random signals.	5
2	**Classification of systems:** CT systems and DT systems, Basic properties of systems - Linear Time invariant Systems and properties	5
3	**Analysis of continuous time signals:** Fourier series analysis, Spectrum of C.T. signals, Fourier Transform and Laplace Transform in Signal Analysis	7
4	**Linear time invariant –continuous time systems** Differential equation, Block diagram representation, Impulse response, Convolution integral, frequency response , Fourier and Laplace transforms in analysis, State variable equations and matrix representation of syst	7
5	**Analysis of discrete time signals** Sampling of CT signals and aliasing, DTFT and properties, Z-transform and properties of Z transform.	6
6	**Linear time invariant - discrete time systems** Difference equations, Block diagram representation, Impulse response, Convolution sum, LTI systems analysis using DTFT and Z-transforms , State variable equations and matrix representation of systems.	7
	REFERENCES: 1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, Signals and Systems, Pearson Education, 2007. 2. Edward W Kamen& Bonnie's Heck, "Fundamentals of Signals and Systems", Pearson Education, 2007 3. H P Hsu, RakeshRanjan" Signals and Systems", Schaum's Outlines, Tata McGraw Hill, Indian Reprint, 2007 4. S.Salivahanan, A. Vallavaraj, C. Gnanapriya, Digital Signal Processing, McGraw Hill International/TMH, 2007. 5. Simon Haykins and Barry Van Veen, Signals and Systems John Wiley & sons , Inc, 2004. 6. Robert A. Gabel and Richard A.Roberts, Signals & Linear Systems, John Willy	

BTEINE504 Elective II.B. Clinical Engineering

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Electrical measurement and instrumentation, physics, basic electrical engineering	
Course outcome	Application of mathematics, science and engineering to biomedical instrumentation. Design aspects of clinical laboratory instruments and analysis. Select and use latest hardware tools for various biomedical systems design.	
Unit	Contents	Contact Hrs
1	Respiratory instrumentation: Natural process of breathing, O_2 and CO_2 transport, regulation of breathing, ventilator terms, spirometer, airflow measurement, oxygenators-bubble type, membrane type, gas analyzers, ventilators.	8
2	Clinical Lab instrumentation: Blood and its composition and function, electron microscope, blood cell counters, electrophoresis, pulse oximetry, hemoglobin and glucose measurement, auto analyzer.	6
3	Operation room instrumentation: Electrosurgical unit, anesthesia machine, operation table, autoclave, elements of intensive care unit, bedside monitor, drug delivery system, lithotripsy, ICU layout, introduction to telemetry and telemedicine.	6
4	Electrical safety: Significance of electrical danger, physiological effects of electrical current, ground shock hazards, methods of accident prevention, safety standards, and electrical safety analyzer.	6
5	Skeletal system, overview of biomechanics, GAIT analysis, orthotics and prosthetic devices, overview of various orthotics and prosthetic devices materials, wheelchair types, materials used in wheelchair, joysticks used in wheelchair, artificial organ- artificial kidney.	6
6	Imaging systems: X-rays, image intensifiers, CT scanner, ultrasound scanner, nuclear methods, thermography, MRI, fusion imaging, artifacts, introduction to image processing.	7
	Ref Books: 1. Carr and Brown, Englewood Cliffs, Introduction to biomedical equipment technology, Prentice Hall 2. John G. Webster, Medical instrumentation application and design, John Willey & Sons Pvt. Ltd.	

BTEINE 505 Elective III. A. Control System components and analysis

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Network analysis and synthesis, numerical methods and C programming	
Course outcome	To know different basic concepts and components of a control system. To derive transfer functions of basic control system components. To perform stability analysis using time domain and frequency domain response on a given system	
Unit	Contents	Contact Hrs.
1	Introduction: Concept of open & closed loop control system, Servomechanism, Multivariable control system, Applications in non-engineering field.	8
2	Physical Systems and Transfer Function: a) Concept of system: physical system, Physical model, Linear and nonlinear systems, Time variant and invariant system. b) Equations of physical systems (Mass-Spring-Dashpot system, R-L-C series & parallel circuit) transfer function, Procedure of obtaining transfer function.	6
3	Block diagrams and Signal flow graphs: a) Block diagram algebra, Diagram reduction, and Numerical examples. b) Signal flow graph; Masons gain formula for deriving overall transfer function of systems. Feedback characteristics of control system: Concept of negative and positive feedback, Sensitivity of the system to parameter variation, using negative and positive feedback	6
4	Control system components: Derivation of transfer functions of following components a)DC servomotors (Armature and field control) b) AC servomotors, c) Synchros d) DC and AC tachogenerators , e) Potentiometer error detectors	6
5	Time domain analysis: Typical test signals, Time domain specifications, Steady state response, Types of system, Steady state error constants and steady state error, (With different input), Numerical examples, transient response, Numericals, Concept of stability, Determination of stability by Routh - Hurwitz criterion.	6
6	Frequency domain analysis: Introduction to frequency response, Advantages of frequency domain analysis, Polar plots, Numericals, Bode plots, Principle of argument, Nyquist criterion, Relative stability from Nyquist criterion, Numericals. Definition of Root Locus, Construction of root locus, and Stability from root locus plots, Root counters, Effect of addition of poles & zeros on root locus plots.	7
	Ref Books: 1 Ogata – Modern Control Engineering (Prentice Hall Of India). 2. Kuo .B. C– Automatic Control System.(Prentice Hall Of India). 3.Nagarath & Gopal – Control System(Willey Earstern) 4. Gopal .M. – Control System.(Prentice Hall Of India).	

BTEINE505 Elective III. B. Software Techniques

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite	Basic C programming	
Course Objective	To familiarize with software engineering project management	
Course Outcome	To understand different techniques of software models. To understand verification and validation of software. To analyze software project management.	
Unit	Contents	Contact Hrs
1	Introduction- Notion of Software as a Product – characteristics of a good Software Product. Engineering aspects of Software production – necessity of automation. Job responsibilities of Programmers and Software Engineers as Software developers	5
2	Process Models and Program Design Techniques- Software Development Process Models – Code & Fix model, Waterfall model, Incremental model, Rapid Prototyping model, Spiral (Evolutionary) model.	5
3	Good Program Design Techniques – Structured Programming, Coupling and Cohesion, Abstraction and Information Hiding, Automated Programming, Defensive Programming, Redundant Programming, Aesthetics. Software Modelling Tools – Data flow Diagrams, UML and XML. Jackson System Development	6
4	Verification and Validation: Testing of Software Products – Black-Box Testing and White-Box Testing, Static Analysis, Symbolic Execution and Control Flow Graphs – Cyclomatic Complexity. Introduction to testing of Real-time Software Systems.	6
5	Software Project Management: Management Functions and Processes, Project Planning and Control, Organization and Intra-team Communication, Risk Management. Software Cost Estimation – underlying factors of critical concern. Metrics for estimating costs of software products – Function Points. Techniques for software cost estimation – Expert judgement, Delphi cost estimation, Work break-down structure and Process break-down structure, COCOMO and COCOMO-II.	7
6	Advanced Topics: Formal Methods in Software Engineering – Z notation, Hoare‟s notation. Formalization of Functional Specifications – SPEC. Support environment for Development of Software Products. Representative Tools for Editors, Linkers, Interpreters, Code Generators, Debuggers. Tools for Decision Support and Synthesis, Configuration control and Engineering Databases, Project Management. Petrinets. Introduction to Design Patterns, Aspectoriented Programming.	8
	Reference books: 1. Fundamentals of Software Engineering – Carlo Ghezzi et. al. 2. Software Engineering – Design, Reliability Management – Pressman. 2. Software Engineering – Ian Sommerville. 2. Software Engineering - Shoeman. 3. Software Engineering with Abstraction – Berzins and Luqi	

BTINL 507 Computational Techniques Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 30 Marks
Pr/oral: 20 Marks

Pre requisite	Basic electrical engineering, control system I	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Study of analog computer components	
2	Simulation of first order differential equation on the analog computer	
3	Simulation of second order differential equations and sine waveform	
4	Simulation of nonlinear equations	
5	Nonlinear system analysis by DF method	
6	Nonlinear system analysis by phase method	
7	Finding transfer function from frequency response plots	
8	Analysis of control system using digital computer MATLAB and basic command	
9	MATLAB programming	
10	MATLAB simulation program	
11	MATLAB and its basic command	
12	Solution of state space equation using MATLAB	

Any 8-9 experiments from the list

BTINL508. Process loop components Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 2

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Any 8-9 experiments from the list

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Study of D.P. Transmitter and its application for flow or level.	
2	. Study of Square Root Extractor	
3	Study and Calibration of I/P converter	
4	Study & verification of different control actions (P, I, D, PI, PD, PID) for step Input	
5	Tuning of PID controller	
6	Study of Control valve & plot the characteristics of Control valve	
7	Control valve design using any software package.	
8	Study of PLC and PLC Programming.	
9	Study & Implementation of cascading of Timers and Counters	
10	Interfacing PLC to hydraulic & pneumatic circuits	
11	Designing of intrinsic safety circuits	
12		
13		

BTINL509. Microprocessor and Microcontroller Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 30 Marks
Pr/oral: 20 Marks

Any 8-9 experiments from the list

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Programming exercises to programmable peripheral interface.	
2	Programming exercises using interrupts.	
3	Programming exercises to use the timer.	
4	Familiarization with 8051 micro-controller board and its assembler.	
5	Programming exercises using 8051 micro-controller.	
6	Basic I/O operations and ADC Interfacing using KEIL software.	
7	Counting Pulses using Interrupt and Serial Data Transmission.	
8	Interfacing 8051 with DAC.	
9	Interfacing 8051 with stepper motor.	
10	Real time clock and memory interfacing with 8051.	
11	Programming exercise using ARM processor	
12		

SEMESTER VI

BTINC601. Digital System

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course outcome		
Unit		Contact Hrs
1	Introduction to digital control: Configuration of basic digital control system, discrete transfer function, discrete model sampled data systems using z-transform, transfer function model, signal analysis and dynamic response, zero-order hold equivalent, introduction to first order hold equivalent, transformation between =s, =z, =w plane, z-domain description of sampled continuous time systems	8
2	Controller design using transform techniques: root locus and frequency domain analysis compensator design	6
3	State space theory: Control system analysis using state variable method, vector and matrices, state variable representation, conversion of state variable to transfer function and vice-versa, conversion of transfer function to canonical state variable models, system realization, and solution of state equations	6
4	State space design: Design using state space methods- controllability and observability, control law design, pole placement, pole placement design using computer aided control system design (CACSD)	6
5	Observer design: Observer design, Deadbeat controller design, delayed system, controller design for delayed systems	6
6	Stability analysis and Jury's stability criterion, Lyapunov stability analysis to linear systems and discrete systems, Stability improvement by state feedback.	7
	References: 1. K. Ogata, Discrete Control System 2. M. Gopal, Digital Control and state variable methods, Tata McGraw Hill	

BTINC602. INDUSTRIAL AUTOMATION AND CONTROL

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 hr
Total credit: 4

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Control system I, industrial automation	
Course outcome	To understand construction and working principle of different industrial measurement systems. To understand new trends in industrial process control.	
Unit	Contents	Contact Hrs
1	Introduction to Industrial Automation and Control: Architecture of Industrial Automation Systems. Introduction to sensors and measurement systems.	8
2	measurement: Temperature measurement, Pressure and Force measurements, Displacement and speed measurement, Flow measurement techniques, Measurement of level, humidity, pH etc, Signal Conditioning and Processing, Estimation of errors and Calibration	6
3	Process Control: Introduction to Process Control P I D Control, Controller Tuning. Implementation of PID Controllers. Special Control Structures: Feed forward and Ratio Control. Predictive Control, Control of Systems with Inverse Response, Cascade Control, Overriding Control, Selective Control, Split Range Control.	6
4	Sequence Control: Introduction to Sequence Control PLCs and Relay Ladder Logic Sequence Control, Scan Cycle, RLL Syntax Sequence Control, Structured Design Approach Sequence Control, Advanced RLL Programming Sequence Control : The Hardware environment	6
5	Control of Machine tools: Introduction to CNC Machines Control of Machine Tools, Analysis of a control loop, Introduction to Actuators, Flow Control Valves. Hydraulic Actuator Systems: Principles, Components and Symbols, Hydraulic Actuator Systems: Pumps and Motors, Proportional and Servo Valves.	6
6	Pneumatic Control Systems: System Components Pneumatic Control Systems, Controllers and Integrated Control Systems. Networking of Sensors, Actuators and Controllers: The Fieldbus, The Fieldbus Communication Protocol, Introduction to Production Control Systems	7
	References NPTEL course	

BTINC603 Power Electronics and Drives.

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Electronic Devices And Circuits	
Course outcome	To review principle of construction, operation and characteristics of basic semiconductor devices. To understand and analyze performance of controlled and uncontrolled converters. To understand and analyze performance of DC to DC converters. Dc to AC converters. To understand and analyze performance of AC voltage controllers.	
Unit	Contents	Contact Hrs
1	Power semiconductor devices & their characteristics : Characteristics and operation of power diodes, Thyristors, power transistors (BJTs, MOSFETs, IGBTs, SITs), Ratings of power semiconductor devices, Turn on and Turn off circuits for power semiconductor devices; BJT base drive requirements and drive circuit, MOSFET & IGBT gate drive circuits, Isolation of gate/base drives: Pulse transformers, optocouplers Thyristor firing schemes, Gate drive ICs	8
2	Basic introduction to electrical drives, Electric drive system – dynamic and steady state stability. Components of electrical drives, electric machine, power converter, controllers, dynamics of electrical drive, torque equation, equivalent values of drive parameters, components of load torques types of load, four quadrant operation of motor, steady state stability, load equalization, classes of motor duty, determination of motor rating	6
3	DC Motor Drives : Review of basic characteristics of DC motors, Single phase drives : Single phase half wave converter drives, semi converter drives, Full converter drives, Dual converter drives. Three phase drives : Three phase half wave drives, semiconverter drives, full converter drives, dual converter drives, DC-DC converter drives : Principle of Rheostatic and regenerative braking control, combined control, two and four quadrant DC-DC converter fed drives. Introduction to closed loop control of DC drives.	6
4	AC voltage controllers (AC-AC converters) : Principle of on-off control, principle of phase control in single phase and three phase circuits, Cycloconverters: single phase cycloconverter operation, three phase cycloconverter operation	6
5	Induction Motor Drives : Review of starting, braking and speed control of three phase induction motors, Stator voltage control, Rotor voltage control, frequency control, Voltage and frequency control, Current control, Closed loop control of Induction motors, Principle of Scalar and Vector control of Induction motor, Multiquadrant operation of induction motor drives fed from Voltage Source Inverters.. Static rotor resistance control method, static slip power recovery control-Static Scherbius drive and Static Kramer drive	6
6	.Synchronous motor drives, speed control of synchronous motors, adjustable frequency operation of synchronous motors, principles of synchronous motor control, voltage source inverter drive with open loop control, self-controlled synchronous motor with electronic communication, self-controlled synchronous motor with electronic communication, self-controlled synchronous motor drive using load commutated thyristor inverter	7
	References: 1.RashidM. H – Power Electronics circuits, devices and applications-(New Delhi Pearson Education). 2.Murthi.V. R- Power Electonics Devices, circuits and Industrial Applications.(Oxford). 3. Bimbhra.P. S- Power Electronics.(Khanna Publication).	

BTINOE604 Elective-VI.A. Project Engineering and Management

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite	Communication skills.	
Course outcome	To understand concepts of project management. To develop a project plan. To understand the project implementation strategy. To analyze post project affects.	
Unit	Contents	Contact Hrs
1	Introduction to Project management: Characteristics of projects, Definition and objectives of Project Management, Stages of Project Management, Project Planning Process, Establishing Project organization.	8
2	Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management,	6
3	Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks	6
4	Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Levelling and Resource Allocation. Time Cost Trade off: Crashing Heuristic.	6
5	Project Implementation: Project Monitoring and Control with PERT/Cost, Computers applications in Project Management, Contract Management, Project Procurement Management	6
6	Post-Project Analysis	7
	Text/Reference Books: 1. Shtub, Bard and Globerson, Project Management: Engineering, Technology, and Implementation, Prentice Hall, India 2. Lock, Gower, Project Management Handbook. 3. Cleland and King, VNR Project Management Handbook. 4. Wiest and Levy, Management guide to PERT/CPM, Prentice Hall. Ibdia 5. Horald Kerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002. 6. S. Choudhury, Project Scheduling and Monitoring in Practice. 7. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.	

BTINOE Elective-VI.B. DESIGN OF EXPERIMENTS FOR ENGINEERS AND MANAGERS

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course outcome	To understand experimental design principles. To understand different experimental design used in industry. To deign computer experiments to use with engineering problems.	
Unit	Contents	Contact Hrs
1	Introduction to experimental design principles, simple comparative experiments, introduction to R language and its applications in DOE problems	8
2	Single factor experiments, randomized blocks, Latin square designs and extensions, introduction to R language Introduction to factorial designs, two levels, 2k factorial designs, confounding and blocking in factorial designs, applications to manufacturing problems.	6
3	Fractional factorial designs, two-level, three-level and mixed-level factorials and fractional factorials, applications to quality control problems. Regression models including multiple regression models and its application to transportation scheduling problems	6
4	Response surface methodology, parameter optimization, robust parameter design and its application to control of processes with high variability	6
5	Random and mixed effects models, nested and split plot and strip plot designs and its application to semiconductor manufacturing problem. Repeated measures design, analysis of covariance and its applications in comparing alternatives	6
6	Design of computer experiments and the applications in industrial engineering problems	7
	References NPTEL course	

BTEINE605 Elective-V.A. Analytical Instruments

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Pre requisite		
Course Objective	• To understand various techniques and methods of analysis which occur in the various regions of the spectrum. • To study important methods of analysis of industrial gases. . To understand the important radio chemical methods of analysis	
Course Outcome	Ability to understand and analyze Instrumentation systems and their applications to various industries.	
Unit		Contact Hrs
1	**Colorimetry and spectrophotometry:** Spectral methods of analysis- Beer-Lambert law - Colorimeters - UV-Visible spectrophotometers - Single and double beam instruments , Sources and detectors - IR Spectrophotometers - Types - Attenuated total reflectance flame photometers - Atomic absorption spectrophotometers - Sources and detectors - FTIR spectrophotometers - Flame emission photometers - Fluorescence spectrophotometer.	6
2	**Chromatography:** Different techniques - Techniques by chromatographic bed shape- Column chromatography-Planer Chromatography-Paper Chromatography-Thin layer Chromatography-Applications - Techniques by physical state of mobile phase- Gas chromatography - Sources- Detectors - Liquid chromatographs-sources- detectors-Applications - High-pressure liquid chromatographs – sources detectors-Applications-Techniques by separation mechanism-Ion exchange chromatography-size exclusion chromatography-Applications.	7
3	**Industrial gas analyzers and pollution monitoring instruments:** Types of gas analyzers- Oxygen, No2 and H2S types, IR analyzers, Thermal conductivity analyzers, and analysis based on ionization of gases.	5
4	**Dust and smoke measurements:** Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulpher dioxide estimation	4
5	**PH Meters and dissolved component analyzers:** Principles of pH measurement, glass electrodes, hydrogen electrodes, selective ion electrodes, ammonia electrodes, biosensors, dissolved oxygen analyzer- Sodium analyzer, silicon analyzer	6
6	**Nuclear Magnetic Resonance and microscopic Techniques:** NMR Basic principles , NMR spectrometer and Applications - Electron spin Resonance spectroscopy: - Basic principles, Instrumentation and applications. Scanning Electron Microscope (SEM) :- Basic principles, Instrumentation and applications. Transmission Electron Microscope (TEM) Basic principles - Instrumentation and applications. Mass spectrometers Different types and Applications.	8
	REFERENCES: 1. R.S. Khandpur, Handbook of Analytical Instruments, Tata McGraw Hill 2nd edition, 2006. 2. G.W. Ewing, Instrumental Methods of Analysis, McGraw Hill, 2004. 3. Liptak, B.G., Process Measurement and Analysis, CRC Press, 2005 1. Braun, R.D., Introduction to Instrumental Analysis, McGraw - Hill, Singapore, 2006. 4. Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and francis group, 2007	

BTEINE605 Elective-V.B. Measurement and Data Analysis

Teaching scheme:	**Examination Scheme:**
Theory: 3 hrs	Mid-term test: 20 Marks
Tutorial: 0 hr	Internal Assessment: 20 Marks
Total credit: 3	End semester exam: 60 Marks

Prerequisite		
Course outcome		
Unit	Contents	Contact Hrs
1	General Information about Measurement: basic concept and terms, metrology and the basic metrology problems, classification of measurements, classification of measurement errors, Presentation of results of measurements, rules for rounding off. Measuring Instruments and their Properties: Types of measuring instruments, the concept of an ideal instrument: Metrological Characteristics of measuring instruments, standardization of the metrological characteristics of measuring instruments, Dynamic characteristics of measuring instruments and their Standardization. Statistical Analysis of the errors of measuring instruments based on data provided by calibration laboratories.	8
2	Statistical methods for experimental data processing: Requirements of statistical estimations, Estimation of the parameters of the normal distribution, Construction of confidence intervals, Methods for testing Hypotheses about the form of the distribution function of a random quantity, Methods for testing sample homogeneity, Trends in applied statistics and experimental data processing.	6
3	Direct measurements: Relation between single and multiple measurements, Identification and elimination of systematic errors, method for calculating the errors and uncertainties of single measurements, Method for calculating the uncertainty in multiple measurements, Comparison of different methods for combining systematic and random errors. Indirect measurements: Basic terms and classification, correlation coefficient and its calculation, the method of reduction, the method of transformation, Errors and uncertainty of indirect measurement results.	6
4	Examples of Measurements and measurement data processing: An indirect measurement of the electrical resistance of a resistor, The measurement of the density of a solid body, the measurement of ionization current by the compensation method. The measurement of power at high frequency, the measurement of voltage with the help of a potentiometer and a voltage divider, calculation of the uncertainty of the value of compound resistor.	6
5	Combined Measurement: General remarks about the method of least squares, Measurements with linear equally accurate conditional equations, Reduction of linear unequally accurate conditional equations to equally accurate conditional equations, Linearization of nonlinear conditional equations, Examples of the application of Least squares, determination of the parameters in formulas from empirical data and construction of calibration curves. Combing the results of measurements: Introductory remarks, Theoretical principles, Effect of the error of the weighted mean, combining the results of measurements in which the random errors predominate, combining the results of measurements containing both systematic and random errors, Example: Measurement of the activity of the nuclides in a source.	6
6	Calculation of the Errors of Measuring Instruments: The problems of calculating measuring instrument errors, Methods for calculating measuring instrument errors, calculation of the error of electrical balances (unique instrument), Calculation of error of voltmeters (mass-produced instrument), Calculation of the error of digital thermometers (mass-produced instrument).	7
	Ref Books: 1. Semyon G. Rabinovich, Measurement Errors and uncertainties- theory and practice 2. S. V. Gupta, Measurement Uncertainties: Physical Parameters and Calibration of Instriuments 3. Ifan Hughes and Thomas Hase, Measurements and their Uncertainties: A practical Guide to Modern Error Analysis, Oxford University Press 4. Michael, Grabe, Measurement Uncertainties in Science and Technology.	

BTINE606 Elective-IV.A. Communication Systems

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course outcome	Ability to understand and analyze, linear and digital electronic circuits	
Unit	Contents	Contact Hrs
1	Need for modulation, Amplitude modulation, Frequency spectrum of AM wave, Representation of AM, Power relation, Frequency modulation, Frequency spectrum of FM wave, AM transmitter, FM transmitter, Super heterodyne AM receiver, FM receivers. FM & PM frequency spectrum, power relations: NBFM & WBFM, Generation of FM & DM, And Armstrong method & reactance modulations: FM & PM frequency.	8
2	Principles of pulse modulation – sampling theorem, PAM – PWM – PPM– Conversion of PWM wave to PPM wave – Generation of PAM, PPM and PWM waves – Demodulation of PAM, PWM, PPM – An introduction to digital modulation systems – PCM, ASK, FSK and PSK, BSK, QPSK, QAM, MSK, GMSK, application of data communication.	6
3	Primary communication, entropy, properties, BSC, BEC, source coding: Shaum, Fao, Huffman coding: noiseless coding theorem, BW – SNR trade off codes: NRZ, RZ, AMI, HDBP, ABQ, MBnB codes: Efficiency of transmissions, error control codes and applications: convolutions & block codes.	6
4	Microwave communication systems: advantage, block diagram of a microwave radio system, microwave radio stations- Terminal station and repeater station. Satellite Communication system: Satellite Orbits, launch vehicles, look angles, satellite parameters, satellite link model, personal communication systems- GPS services.	6
5	Need for fiber optics, introduction to optical fiber, principle of light transmission through a fiber, fiber characteristics and classification, various fiber losses- Light sources and photo detectors- Block diagram of a fiber optic system- Power budget analysis for a optical link- Recent applications of fiber optics.	6
6	Cellular concept, basic cellular concept and its operation, uniqueness of mobile radio environment- Performance metrics in cellular system-Elements of cellular mobile radio- Handoff- Frequency management and channel assignment- Introduction to various cellular standards like AMPS, GSM, GPRS, IS-95A, IS-95B, CDMA-2000 and WCDMA.	
	Text/Reference Books: 1. Kennedy Davis, “Electronic Communication Systems”, Tata McGraw Hill Publishing Company Limited, New Delhi, 1999. 2. Wayne Tomasi, “Electronic Communication Systems”, Pearson education Private Limited, Delhi, 2004.	

BTEINE606 Elective-IV.B. Virtual Instrumentation

Teaching scheme:
Theory: 3 hrs
Tutorial: 0 hr
Total credit: 3

Examination Scheme:
Mid-term test: 20 Marks
Internal Assessment: 20 Marks
End semester exam: 60 Marks

Prerequisite		
Course outcome		
Unit	Contents	Contact Hrs
1	Review of Virtual Instrumentation, Historical perspective, Need of VI, Advantages of VI, Define VI, block diagram & architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming.	
2	Programming Techniques, VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input.	
3	Data Acquisition basics, ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation.	
4	Common Instrument Interfaces for Current loop, RS 232C/Rs 485, GPIB, System basics, interface basics: USB, PCMCIA, VXI, SCXI, PXI etc, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control.	
5	Use of Analysis Tools, Fourier transforms Power spectrum, Correlation methods, windowing & flittering. Application of VI: Application in Process Control Designing of equipment like Oscilloscope, Digital Millimeter using Lab view Software, Study of Data Acquisition & control using Lab view	
6	Virtual instrumentation for an Innovative Thermal Conductivity Apparatus to measure the Thermal Conductivity Apparatus- to measure the conductivity of non-Newtonian fluids white they are subjected to sharing force	
	Text/Reference Books: 1. Virtual instrumentation using Lab View, Sanjay gupta, Tata McGraw Hill Publishing, first reprint, 2006. 2. LabVIEW Graphical Programming, “Gary Johnson”, second edition, MC Graw Hill, New York.	

BTINL 607. Digital System Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 30 Marks
Pr/oral: 20 Marks

Any 8-9 experiments based on course content of BTINC601

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1		
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BTINL 608 Industrial Automation & Process Control Lab

Teaching scheme:
Lab work : 2 hrs
Total credit: 1

Examination Scheme:
Continuous Assessment (T/W): 30 Marks
Pr/oral: 20 Marks

Any 8-9 experiments from list

Pre requisite	Basic electrical engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Identification of FOPDT and SOPDT process using time domain and frequency domain techniques.	
2	Design of different PID controller for FOPDT and SOPDT process using different standard technique and evaluate qualitative & quantitative performance.	
3	Design and Verification of Combinational & Sequential Circuits Using PLC	
4	Design of PID Controller for a Level Process/Temperature/Flow/Pressure process stations and evaluate servo/regulatory responses.	
5	Study the effect of different PID Controller Parameters using real time process trainer.	
6	Pressure to Current & Current to Pressure Convertor using real time process trainer.	
7	Design of Timer and Counter Using PLC.	
8	Design of PLC programming for practical applications.	
9	Design of Cascade and Feed forward-feedback Controller using simulation software.	
10	Verification of Control Valve Characteristics using pneumatic and electronic control value trainer.	
11	Development of P&I design using Distributed control system (DCS)	
12		

BTINL 609 Power Electronics and drives Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 2

Examination Scheme:
Continuous Assessment (T/W): 60 Marks
Pr/oral: 40 Marks

Any 8-10 experiments covering syllabus of Power Electronics and Drives

Pre requisite	electrical Machines , basic electronics engineering	
Course Objective		
Course Outcome		
Expt No	Title of Expt	
1	Characteristics of MOSFET/IGBT	
2	To study Gate drive circuit	
3	Study of commutation circuits	
4	To study Single phase half wave controlled converter	
5	AC phase control using SCR	
6	Study of semi converter and full converter	
7	Speed control of DC motor using converter	
8	Speed control of IM motor using chopper	
9	Study of industrial drive mechanism. Workshop/ small scale industry	