Dr. Babasaheb Ambedkar Technological University, Lonere

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No XXIX of 2014)
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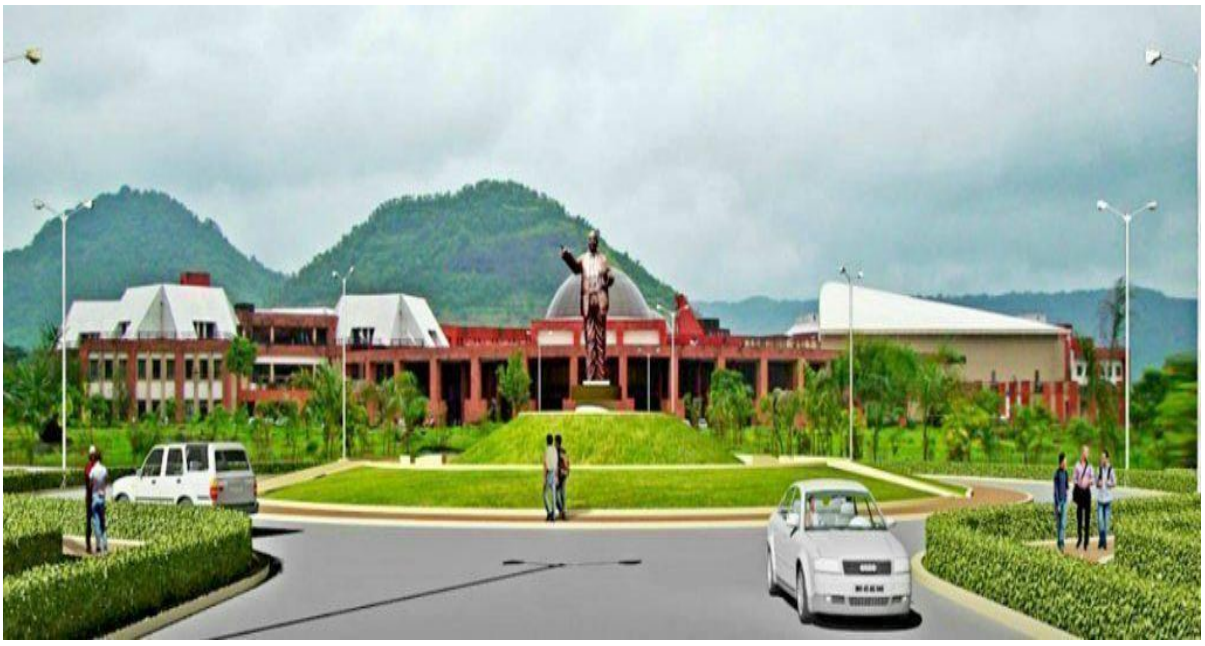
CURRICULUM

UNDERGRADUATEPROGRAMME

T. Y. B.Tech. (Instrumentation Engineering)

With effect from the Academic Year2022-2023



B. Tech in Instrumentation Engineering

Curriculum for Third Year

Semester V												
SR. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1	PCC 1	BTINC501	Process Loop Components	3	1	-	20	20	60	100	4
2	PCC 2	BTINC502	Microprocessor and Microcontroller	3	1	-	20	20	60	100	4
3	PCC 3	BTINC503	Digital Signal Processing	3	1	-	20	20	60	100	4
4	PEC 2	BTINPE504	Group B	3	-	-	20	20	60	100	3
5	OEC 1	BTINOE505	Group C	3	-	-	20	20	60	100	3
6	HSSMC	BTHM506	Human Rights	-	-	-	-	-	-	-	Audit
7	LC	BTINNL507	Process Loop Components Lab	-	-	2	60	-	40	100	1
8	LC	BTINNL508	Digital Signal Processing Lab	-	-	2	60	-	40	100	1
9	Project	BTINM509	Mini Project I	-	-	4	60	-	40	100	2
10	Internship	BTINP408	Internship – 2 Evaluation	-	-	-	-	-	50	50	1
Total				**15**	**3**	**8**	**220**	**100**	**430**	**850**	**23**

Semester VI												
SR. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1	PCC 1	BTINC601	Digital Control System	3	1	-	20	20	60	100	4
2	PCC 2	BTINC602	Industrial Automation and Control	3	1	-	20	20	60	100	4
3	PCC 3	BTINC603	Power Electronics and Drives	3	1	-	20	20	60	100	4
4	PEC 3	BTINPE604	Group D	3	-	-	20	20	60	100	3
5	OEC 2	BTINOE605	Group E	3	-	-	20	20	60	100	3
6	LC	BTINL606	Industrial Automation and Control Lab	-	-	2	60	-	40	100	1
7	LC	BTINL607	Power Electronics and Drives Lab	-	-	2	60	-	40	100	1
8	Project	BTINM608	Mini Project II	-	-	4	60	-	40	100	2
9	Internship	BTINP609	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	-	-	-	-	-	-	-	Credits To be evaluated in VII Sem.
Total				**15**	**3**	**8**	**220**	**100**	**380**	**800**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course HSSMC = Humanities and Social Science including Management Courses

- **Important Note: Minimum Eight Experiment to perform based on the syllabus for the laboratory subject.**

Group B [Sem - V] (Professional Elective)

Sr. No.	Course Code	Course Title
01	BTINPE504 A	Multi-sensors and Data Fusion
02	BTINPE504 B	Linear Techniques
03	BTINPE504 C	Soft Computing

Group C [Sem - V] (Open Elective)

Sr. No.	Course Code	Course Title
01	BTINOE505 A	Control System
02	BTINOE505 B	Artificial neural network
03	BTINOE505 C	Biomedical Instrumentation

Group D [Sem - VI] (Professional Elective)

Sr. No.	Course Code	Course Title
01	BTINPE604 A	Instrumentation Unit Operations
02	BTINPE604 B	Power Plant instrumentation
03	BTINPE604 C	Embedded Systems

Group E [Sem - VI] (Open Elective)

Sr. No.	Course Code	Course Title
01	BTINOE605 A	Industrial data communication
02	BTINOE605 B	Fiber Optics and Laser instrumentation
03	BTINOE605 C	Robotics and Control

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 Control System Components	
Course Objective	The objective of the course is to provide students with a firm grasp of the essential principles of control system components	
Course Outcome	1. Apply the knowledge of the control system components for controlling various Industrial parameters. 2. Able to identify, formulate and solve a problem using hydraulic, electrical & pneumatic system. 3. Analyse the process characteristics and apply suitable controller to that process. 4. Correctly select type and size of control valves for industrial use.	
Unit	Contents	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.	8
2	Transmitters and Converters: Types of transmitters: Two and four wire transmitters, Electronic and Pneumatic transmitters Electronic Capacitive Differential Pressure Transmitter: Types, Mounting (Installation), Manifold, Calibration setup, DPT, Span & zero adjustment, Application of DPT for Flow and 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
3	Control Valves: Terminology, types and characteristics, Selection of control valves, Concept of Cv, calculation of Cv and trim size, Cavitation and flashing, Noise in control valves, testing of control valve, Valve positioners: necessity, types and effect on performance of control valves, Electrical, Pneumatic and Hydraulic Actuators, Electro-pneumatic and Electro-Hydraulic Actuators.	8

4	PID Controllers and PLC On-Off controller, Pneumatic, hydraulic and Electronic Proportional (offset), Integral (Reset windup), Derivative, Proportional- Integral, Proportional- Derivative, Proportional- Integral-derivative, reset windup, Rate before Reset, PID controllers and their tuning, Digital PID controllers: Velocity & Position algorithm. PLC Relay ladder diagrams, introduction to programmable logic controllers (PLC), Architecture and specifications of PLC, Ladder Programming, Development of ladder diagrams for various applications, Advance PLC programming.	8
5	Auxiliary components: Synchro transmitter and receiver, Servo motor, Stepper motor, Feeders and Dampers. Intrinsic safety and components. Gyroscope Indicators and Alarm Annunicator, Control Panel and their design.	8
	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: 1 hr
Total credit: 4

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

Pre requisite	Digital electronics, electronics devices and circuits	
Course Objective	To know the architecture of 8085 and 8051. To understand interfacing and interrupt features of 8085 and 8051. To develop program for basic applications	
Course Outcome	1. Understand concept of microprocessors and microcontrollers. 2. Design and debug programming of microprocessors and microcontrollers. 3. Identify and select an appropriate microcontroller as well as development tools for given 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.	8
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, Applications of microprocessors.	8
4	Intel 8051 Microcontroller : Architecture of 8051, Memory Organization, Addressing modes, Instruction set, Boolean processing, Simple programs	8
5	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	8
	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.	

BTINC503 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 Objective	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.	
Course Outcome	1. Ability to apply the various programming techniques on DSPs 2. Ability to design FIR and IIR filters using different techniques. 3. Ability to determine the frequency, steady state and transient response of LTI systems. 4. Ability to apply the DFT and FFT methods for various signals and determine their frequency response.	
Unit	Contents	Contact Hrs
1	Fourier series and Fourier transform & its properties. Discrete time Fourier series & its properties. Circular and Linear convolution, frequency response analysis of signal using DFT. Linear filtering based on DFT FFT algorithms. Use of FFT for spectral estimation, filtering & correlation.	8
2	Short Time Fourier Transform (STFT). Introduction to multi-resolution transform. Continuous wavelet transforms. Discrete Wavelet Transform (DWT). Simple application of DWT for noise filtering in one dimensional signal.	8
3	Introduction to Finite Impulse Response Filter, FIR filter design using different windowing techniques & frequency sampling method. Design of linear phase FIR filter. Introduction to computer-aided design of linear phase FIR filter. Basic structure of FIR system.	8
4	Introduction to Infinite Impulse Response Filter, impulse invariance and bilinear transformation, Design Specification of IIR Low pass filter and frequency transformation, Design of IIR filter using Butterworth, Chebyshev approximation. Introduction to computer-aided design of IIR filter. Realization methods for IIR filter.	8
5	Introduction to multirate DSP, Introduction to DSP hardware. TMS320C67XX processor, applications of TMS320C67XX e.g. square wave generator, matrix multiplication.	8

	Applications of DSP processor for biomedical, speech, image processing.	
	Reference Books: 1. Proakis J.G., and Manolakis, Introduction to DSP, PHI, 2007 2. Sanjit K. Mitra, "Applications DSP a Computer based approach", TMH, 2006 Oppenheium, Schaffer ,"Digital Signal Processing", PHI. 3. A. Nagoor Kani , "Digital Signal Processing", Mc. Graw Hill. 4. Rulph Chassaing ,"Digital Signal Processing, applications using C & TMS320CSX DSK", WILLEY publication.	

BTINPE 504 A. Multi-Sensor Data Fusion

Teaching scheme:
Theory: 3 hrs
Tutorial: 1 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 learn the concepts and techniques used in sensor data fusion	
Course Outcome	To understand the concept of sensor fusion. To apply algorithms for multi-sensor data fusion. Interpret high performance data structures.	
Unit	Contents	Contact Hrs
1	Multi-sensor data fusion: Introduction, sensors and sensor data, Use of multiple sensors, Fusion applications. The interference hierarchy: output data. Data fusion model. Architectural concepts and issues.	8
2	Benefits of data fusion, mathematical tools used: Algorithms, Co-ordinate transformations, rigid body motion. Dependability and Markov chains. Meta – heuristics	8
3	Taxonomy of algorithms for multisensory data fusion. Data association. Identify declaration.	8
4	Estimation: Kalman filtering, practical aspects of Kalman filtering, extended Kalman filters. Decision level identify fusion. Knowledge based approaches.	8
5	Data information filter, extended information filter. Decentralized and scalable decentralized estimation. Sensor fusion and approximate agreement. Optimal sensor fusion using range trees recursively. Distributed dynamic sensor fusion. High performance data structures: Tessellated, trees, graphs and function. Representing ranges and uncertainly in data structures. Designing optimal sensor system with in dependability bounds. Implementing data fusion system	8
	Ref Books: 1. David L. hall, Mathematical techniques in multisensory data fusion, Artech House, Boston. 2. R. R. Brooks and S. S. Iyengar, Multi-sensor Fusion: Fundamentals and applications with Software, Prentice Hall Inc., New Jersey. 3. Arthur Gelb, Applied Optimal Estimation, M.I.T. press 4. James V. Candy, Signal Processing: The Model Based Approach, Mc Graw Hill	

BTINPE 504 B. Linear Techniques

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

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

Course Objective	The objective of the course is to provide students with a firm grasp of the essential principles of Operational Amplifiers and its applications as well as signal sources and signal analysis.	
Course Outcome	1. Apply basic Knowledge of science and engineering subject to understand the concept, working and application of Operational Amplifier. 2. Understand concept of negative and positive feedback applications using Operational Amplifiers. 3. Understand the characteristics of operational amplifiers. 4. Understand fundamentals and design of different signal sources and voltage regulators	
Unit	Contents	Contact Hrs
1	Differential Amplifiers: dual input-balanced output ; single input-balanced output; their analysis, constant current bias, current mirror, level translators, Basic Operational amplifier; equivalent circuit, IC Operational amplifiers-characteristics, specification , parameter measurements, frequency response, types (741,308,356,OP07) and their properties.	8
2	Negative feedback applications: Voltage amplifier, current amplifier, Voltage to current and current to voltage converter, Op-amp as integrator and differentiator, Instrumentation amplifier. Positive feedback applications: Crystal oscillator and Function generator.	8
3	Comparator and Converter : basic comparator, zero-crossing detector, Schmitt trigger, precision AC/DC converters, logarithmic amplifier, sample-and –hold circuit, analog-todigital and digital-to –analog converters, clippers and clampers using op-amp.	8
4	Timer ICs.-Timer 555, its block diagram and applications- astable , monostable multivibrater, Timers- 7555 and XR2240, their block diagram and applications. Phase locked loop (PLL)- operating principle, IC 565 applications, Voltage controlled oscillator (VCO) and its applications.	8
5	Voltage regulators: 3 terminal positive and negative voltage regulators, variable voltage regulators (3085,723), tracking regulators. Active filters: Butterworth & Chebychev filter, design and evaluation of second order filterslow pass, high pass , band pass, band reject and all pass filter.	8
	References: 1. Ramakant A. Gayakwad, 'Op-Amp and Linear Integrated Circuits', Third edition, Prentice-Hall of India 2. Graeme,Tobey and Huelsman, 'Operational Amplifiers: Design and	

	Application', McGraw-Hill International edition. 3. D.Roy Choudhury and Shail Jaon, 'Linear Integrated Circuits' New Age International 4. Albert Paul Malvino, 'Electronic Principles', 6th edition, Tata McGraw-Hill. 6. R. Subburaj, 'The foundation for ISO 9000 and TQM', 7. Bouwens A. J., 'Digital Instrumentation'	

BTINPE 504 C. Soft Computing

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

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

Pre requisite	Set Theory	
Course Outcome	Various Soft Computing Techniques in Industrial Engineering.	
Unit	Contents	Contact Hrs
1	Introduction of Soft Computing Introduction : Natural language processing , Machine Learning and Neural Networks, Fuzzy Systems, Pattern Recognition and Text Processing, Intelligent systems and their applications , Intelligent interfaces. Swarm Intelligence, Genetic Algorithm . Robotics and Kinematics. soft computing vs. hard computing; various types of soft computing techniques; applications of soft computing	8
2	Neural network model and algorithms Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture, single layer and multilayer feed forward networks, Mc Culloch Pitts neuron model, perceptron model, Adaline and Madaline, multilayer perception model, back propogation learning methods, effect of learning rule coefficient, back propagation algorithm, factors affecting back propagation training, applications.	8
3	Advances in Neural Networks Introduction of back propagation learning methods and algorithm, Counter propagation network architecture, functioning & characteristics of counter Propagation Network-Hopfield/ Recurrent network configuration, stability constraints associative memory and characteristics- limitations and applications, Hopfield v/s Boltzman machine, Adaptive Resonance Theory, Architecture- classifications Implementation and training, Associative Memory.	8
4	Fuzzy Logic Modeling and Control Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control-Fuzzification inferencing and defuzzification-Fuzzy knowledge and rule Bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system.	8
5	Genetic Algorithm Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters- Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant	8

	colony search techniques for solving optimization problems.	
	Text / Reference Books: 1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Laurene V. Fausett, Pearson Education, 2. Fuzzy Logic with Engineering Applications, Timothy J. Ross, Wiley India. 3.Genetic Algorithms in Search, Optimization, and Machine Learning, David E. Goldberg, Pearson Education, 2009. 4. Fuzzy set theory and its Applications, Zimmermann H.J, Springer international edition, 2011. 5. Neural Networks for Control, W. T. Miller, R.S.Sutton and P.J.Webrose, MIT Press,	

BTINOE 505 A. Control System

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

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

Pre requisite	Basics of Control systems	
Course Outcome	1. Concept of control system in industry. 2. Design of Controllers. 3. Analysis of non-linear systems.	
Unit	Contents	Contact Hrs
1	Non-linear Control Systems: Peculiar behaviour of non-linear systems such as sub harmonics, jump resonance, limit cycle, Different types of non-linearities, Phase plane method, Singular Points, Methods of isoclines, Limit Lines & dividing lines on phase plane, Construction of phase plane, Obtaining time domain response from phase plane plots, merits & demerits. Describing function (DF) method, definition & assumptions, Derivation for describing function for different non- linearities, Stability analysis using DF method.	8
2	PID controllers: Introduction to Proportional (P), Integral (I) & Derivative (D) controller, individual effect on overall system performance, P-PI & PID control and effect on overall system performance, Numerical examples.	8
3	State Variable Technique: Concept of state & state variable, General form of state equations, formulation of state equations for the physical system, (RLC network, Armature controlled & Field controlled DC servo motor, mechanical systems).	8
4	State Variable Analysis: Different forms of state variable representations (Phase, physical & canonical form), Concept of diagonalization, Obtaining state equations from transfer function representation and vice versa, solution of state equations, State transition matrix (STM), Methods of finding STM, Power series method, Laplace transform method, Calay Hamilton method, Controllability & observability of linear system, Kalman's test.	8
5	Discrete Data Control System: Methods of representation, Z-transform, Inverse Z-transforms, Pulse transfer function of closed loop system, Response between sampling instants, Concept of stability of discrete time systems, Stability by Jury's test. Introduction to control system design, Compensation technique-Cascade & Feedback, Compensation network (lag, lead & lag-lead), Design by reshaping of Bode plots & Root locus technique.	8
	References: 1.Ogata K., 'Modem control Engineering', Prentice Hall 2.Kuo B. C., 'Automatic Control System' Prentice Hall 3. Nagarath I. J., Gopal M., 'Control System Engineering' Willey Eastern.	

BTINOE 505 B. Artificial Neural Network

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

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

Pre requisite	Concept of biological systems	
Course Objective	To study concept of neural network in engineering applications.	
Course Outcome	To review basic principles of neuron structure. To understand building blocks artificial neural network. To understand different networks of ANN To develop different algorithm for learning. To study and understand Fuzzy neural networks.	
Unit	Contents	Contact Hrs
1	Introduction and ANN Structure: Biological neurons and artificial neurons. Model of an ANN. Activation functions used in ANNs. Typical classes of network architectures. Mathematical Foundations and Learning mechanisms: Re-visiting vector and matrix algebra. State-space concepts. Concepts of optimization. Error-correction learning. Memory-based learning. Hebbian learning. Competitive learning.	8
2	Single layer perceptron: Structure and learning of perceptron. Pattern classifier introduction and Bayes' classifiers. Perceptron as a pattern classifier. Perceptron convergence. Limitations of a perceptron.	8
3	Feed forward ANN: Structures of Multi-layer feedforward networks. Back propagation algorithm. Back propagation - training and convergence. Functional approximation with back propagation. Practical and design issues of back propagation learning.	8
4	Radial Basis Function Networks: Pattern reparability and interpolation. Regularization Theory. Regularization and RBF networks. RBF network design and training. Approximation properties of RBF	8
5	Competitive Learning and Self organizing ANN: General clustering procedures. Learning Vector Quantization (LVQ). Competitive learning algorithms and architectures. Self -organizing feature maps. Properties of feature maps. Fuzzy Neural Networks: Neuro-fuzzy systems. Background of fuzzy sets and logic. Design of fuzzy stems. Design of fuzzy ANNs	8
	References NPTEL course	

BTINOE 505 C. Biomedical Instrumentation

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	Human Anatomy and Physiology, Analytical Instrumentation, Electronic Instrumentation, Signal Processing, Sensors and Transducers, Human Diseases	
Course Objective	Study of various biomedical instruments.	
Course Outcome	1. Understands structure of human body 2. Understands use of Biomedical Instruments 3. Understands Transducers for biomedical instrumentation 4. To evolve an instrumentation system for diagnosis, supplementation, therapy of body functions. 5. Function in interdisciplinary team to solve engineering impact on human pathology . 6. Serve as engineer in medical field for safety of human being.	
Unit	Contents	Contact Hrs
1	Introduction to gross anatomy of human body, major physiological systems, their structure and function. Cell structure, basic cell functions, Origin of bio potentials, electrical activity of cells, Introduction to biomedical instruments, classification and justification.	8
2	Transducers for biomedical instrumentation and selection, biomedical electrodes Cardiological systems: Structure of heart, rhythamicity, cardiac cycle, heart sounds, cardiac output, blood pressure measurement, direct, indirect, Spygmomanometer, Digital B. P. Cardio vascular instrumentation: ECG electrodes, & leads, Cinthoven triangle, ECG quantification, PC based ECG analysis.	8
3	Pacemakers, Defibrillators, Biotelemetry, bedside monitors, ICU, Heart Lang machine, Phonocardio graph, plentysmograph, Artificial Kidney, Blood cell counters,	8
4	Central Nervous system: The Brain, Receptors, sensory pathway and motor systems, Evoked potential, Electron rephalogram, EEG analysis, EMG. Mechanics of breathing O2/CO2 transport between lungs and tissue cells, Spirometer, Artificial respiration.	8
5	Imaging system: X-ray, CT Scan, Ultrasonography, MRI, Endoscopy. Electrical safety: Significance of electrical danger, Physiological effects of	8

	electrical current, Ground shock hazard, and methods of accident prevention.	
	Text / Reference Books: 1. Handbook of Biomedical Instrumentation , R S Khandpur, TMH, 2003 2. Cromwell, "Biomedical Instrumentation and Measurement, PHI 3. Introduction to Biomedical instrumentation, S G Kahalekar, 4. Handbook of Biomedical Instrumentation, Webster. http://nptel.iitm.ac.in	

BTHM 506 Human Rights/ Foreign Language Audit Course

Online NPTEL Course

BTINL507. Process Loop Components Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 1

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

Pre requisite	Basic electrical engineering	
Expt. No.	Title of Expt.	Contact Hrs
1	Study and calibration of D.P. Transmitter and its application for flow or level.	
2	Study and Calibration of 2 wire and 4 wire transmitter.	
3	Study of Square Root Extractor	
4	Study and Calibration of I/P and P/I converter	
5	Study & verification of different control actions (P, I, D, PI, PD, PID) for step Input	
6	Study of Control valve & plot the characteristics of Control valve	
7	Study of pneumatic components and simple pneumatic circuits.	
8	Study of PLC and PLC Programming.	
9	Study of hydraulic components and simple hydraulic circuits.	
10	Study of Alarm Annunicator	
11	Designing of intrinsic safety circuits	

BTINL508. Digital Signal Processing Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 1

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

Pre requisite	Digital Signal Processing Operations	
Expt. No.	Title of Expt.	Contact Hrs
1	Shifting and folding of digital signal.	
2	Linear convolution.	
3	Discrete Fourier transforms.	
4	Fast Fourier transforms.	
5	Design and implement FIR filter using windowing method.	
6	Design and implement IIR filter using Butterwoth approximation.	
7	Design and implement IIR filter using Chebeshev approximation.	
8	Sine/square wave generation using TMS32OC67XX.	
9	FIR filter implementation using TMS32OC67XX.	
10	IIR filter implementation using TMS32OC67XX.	
11	Filtering Using Discrete Wavelet transforms.	

SEMESTER VI

BTINC601 Digital Control 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

Pre requisite	Knowledge of Control systems at SE level & Control system	
Course Objective	Study and Analysis of Digital Control Systems	
Course Outcome	1. Use and handle various blocks and instructions in control system toolbox of Matlab. 2. Plot response and stability analysis of the Discrete Time Control System for different standard signals. 3. Design and investigate State Space Analysis of Control Systems. 4. Find controllability and observability of a system.	
Unit	Contents	Contact Hrs
1	Introduction to Discrete-Time Control Systems: Introduction of DCS, Basic building blocks of Discrete time Control system, Quantization and Quantization Error, Sampling process and theorem, Z transform applications for solving differential equations	8
2	Z plane Analysis of Discrete-time Control Systems: Introduction, Impulse Sampling and Data Hold, Transfer function of Zero Order Hold and First Order Hold, Pulse Transfer Function	8
3	Design of Discrete Time Control System by conventional methods: Introduction, Mapping between the S plane and Z plane, Stability analysis in Z-plane, Jury stability criterion, Bilinear transformations, Digital Controller Design using Analytical Design Method	8
4	State Space Analysis of Discrete Time Control System, State space representation of discrete time systems, Solution of discrete time state space equations, Pulse transfer function matrix, Discretization of continuous time state space equations, Similarity transformations.	8
5	Pole Placement and Observer Design, Concept of Controllability and Observability, Useful transformations in state space analysis and design Stability improvement by state feedback, Design via pole placement, State observers, Quadratic Optimal Control, Steady-State Quadratic Optimal Control	8
	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

Pre requisite	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	Control Systems and Automation Strategy: Control Systems and Automation Strategy, Evolution of instrumentation and control, Types of industries, Types of automation, Role of automation in industries, Benefits of automation, Automation strategy evolution.	8
2	**Instrumentation Standard Protocols** Instrumentation Standard Protocols: Definition of protocol, Introduction to Open System Interconnection (OSI) model, Communication standard (RS232, RS485), Modbus (ASCII/RTU), Introduction to third party interface, concept of OPC (Object linking and embedding for Process Control), HART Protocol: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Foundation Fieldbus H1: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Comparison of HART, Foundation Fieldbus, Devicenet, Profibus, Controlnet, Industrial Ethernet.	8
3	**Programmable logic controllers (PLC)** Introduction, architecture, definition of discrete state process control, PLC Vs PC, PLC Vs DCS, relay diagram, ladder diagram, ladder diagram examples, relay sequencers, timers/counters, high speed counter, PTO, PWM and PID blocks in PLC, PLC design, study of at least one industrial PLC. PLC programming methods as per IEC 61131, PLC applications for batch process using SFC, PLC interface to SCADA/DCS using communication links (RS232, RS485).	8
4	**Supervisory Control and Data Acquisition (SCADA)** Introduction to (SCADA), Evolution of SCADA, Types of SCADA, Hardware and Software architecture of SCADA System, Objectives of SCADA, Functions of SCADA, SCADA in Process Control, SCADA applications.	8
5	**Distributed Control Systems** Introduction to DCS. Evolution of DCS, DCS flow sheet symbols, architecture of DCS. Controller, Input and output modules, Communication module, data highway, local I/O bus, Workstations, Specifications of DCS.	8

	Introduction to database management. Supervisory computer tasks DCS configuration. Supervisory computer functions, Control techniques, DCS & Supervisory computer displays.	
	Reference Books: 1. John Webb & Ronald, "PLC Principles and Application", Prentice Hall India. 2. S. K. Sigh, "Computer Aided Process Control", Prentice Hall India. 3. John Hackworth & Frederick D Hackworth, "PLC: Programming Methods and Applications", Pearson Education. 4. Krushna kant, "Computer Based Process Control" Prentice Hall India. 5. Prof. Rajesh Mehra and Er. Vikram Vij, "PLC and SCADA", Laxmi Publication, 6. Distributed Computer Control for Industrial Automation, Poppovik Bhatkar, Dekkar Publications 7. http://nptel.iitm.ac.in	

BTINC603 Power Electronics

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	Knowledge of basic components of electronics and electrical circuits and networks	
Course Objective	The objective of the course is to provide students with a firm grasp of the essential principles of power electronics circuits and their classifications. The course aimed at acquiring an understanding of basic principles, operation, performance and applications of power electronics circuits. The subject is helpful in the study of technological aspects such as utilization semiconductor devices and technology in power systems, industrial drives, automation and control.	
Course Outcome	1.To review principle of construction, operation and characteristics of basic semiconductor devices. 2. To understand and analyze performance of controlled and uncontrolled converters. 3. To understand and analyze performance of DC to DC converters. DC to AC converters. 4. To understand and analyze performance of AC voltage controllers.	
Unit	Contents	Contact Hrs
1	Power Family Components Characteristics constructional details and working of Thyristor/SCR, Triac, Diac, SCS, SUS, LASCR. Methods of turning on an SCR, turn-on, turn-off mechanism and characteristic, device specifications, rating and nomenclature of SCR. SCR triggering circuits, R, RC, pulse and UJT triggering circuits, Protection circuits for SCR. Multiple connection of SCR: series operation, parallel operation, string efficiency. Commutation of SCR: Natural and Forced commutation techniques.	8
2	Rectifier and Inverter Controlled rectifier: Single phase and three-phase controlled rectifier circuits, with R, RL Load, with FWD, Dual converters. Inverters: Principle of operation of series inverter, parallel inverter and bridge inverter, designing of commutating component. Design and operation of UPS & SMPS.	8
3	AC Voltage Controllers and Cycloconverters AC Voltage controllers: single-phase & three-phase with R and RL load Cycloconverter: Single-phase and Three-phase Cycloconverter. Induction heating and dielectric heating, Resistance welding.	8
4	Chopper and Speed Control of Motor	8

	Choppers: Classification of choppers, step-up, step-down chopper, Jones chopper, Morgan chopper, and principle of operation for each method. Chopper control techniques. Speed control of single- phase induction motor-using SCR and Triac: various methods their circuit diagrams and working.	
5	Industrial Applications Thyristor control Applications: AC and DC Static circuit breaker, Over Voltage protection circuit. Zero voltage switch, Integral-cycle triggering, Time delay circuit, Soft start circuit. Temperature regulator, SCR-controlled dimmer circuit, Emergency light using SCR, Automatic water level indicator, automatic battery charger using SCR.	8
	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). 4. Dr. P.S. Bimbhra, 'Power Electronics', Khanna Publisher. 5. M. Ramamoorty, 'An introduction to Thyristors and their applications', second edition, East-West Press. 6. M.D. Singh and K.B. Khanchandani, 'Power Electronics', Tata McGraw Hall. 7. S.K.Bhattacharya, S.Chatterjee, 'Industrial Electronics and Control' , Tata McGraw-Hill. 8. P.C.Sen, 'Power Electronics', Tata McGraw-Hill.	

BTINPE 604 A. Instrumentation in Unit Operations

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

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

Pre requisite	Chemical Processes, Laws of Thermodynamics, Control Systems, Controllers etc.	
Course Objective	Study concept of various unit operations in industry	
Course Outcome	1. List chemical processes, units, and the corresponding equipments. 2. Make material balances and energy balance on unit operations and processes. 3. Understanding of the degrees of freedom analysis and its significance. 4. Get knowledge of basic principles of fluid mechanics 5. Analyze fluid flow problems with the application of the momentum and energy equations	
Unit	Contents	Contact Hrs
1	Introduction: - Concept of unit operations & unit processes, material balance and energy balance. Evaporation: - Liquid characteristics, types of evaporators, Methods of Feeding, operation of single effect and multi effect evaporator, capacity & economy of multiple effect evaporation, Vapour recompression, Operation of mechanical and thermal Recompression, Instrumentation and control for this process. Drying: - Classification of dryers, Principle & operations, Drying equipments, Instrumentation for this process.	8
2	Distillation:- Equipment set up, Operation of flash Distillation, Batch Distillation, Continuous Distillation, Fractionating Column; slue plate arrangement, Rectification and stripping, Instrumentation and control for this process. Leaching and Extraction: - Principles, Various types of equipments for this process.	8
3	Material Handling Equipments: - Transport Equipments, Positioning Equipments, Unit load formation Equipment, Storage equipment, Identification & control equipment. Size Reduction:-Principle of commutation Equipments, Classification and operation of crushers & grinders.	8
4	Crystallization: - Definition, Magma, Super-saturation, formation of Crystal, Equipment classification& operation. Instrumentation & control for this process. Mechanical separation: Screening, Filtration – Mechanisms of filtration, Types of Industrial filters- Rotary filter, filter press, Centrifuges, cyclones, Bag filter, electrostatic precipitators and Centrifuge separator.	8
5	Heat Exchangers:-Theory, Types of heat exchanger, temperature pattern in heat exchanger, condensers, Boilers. Application of above Unit operations in Paper, Cement, Fertilizer, Petrochemical and sugar industry.	8
	Reference Books: -	

	1.McCabe Smith, 'Unit Operation of Chemical Engineering', 5thEdition, McGraw Hill. 2.Perry, 'Chemical Engineers Handbook', 6thEdition, McGraw Hill int. Student ed. 1984. 3.Felder, Rotsseau, Herriot, 'Elementary principles of Chemical Processes', Wiley 1978 4.W.F. Stoeker, 'Design of Thermal System', 3rdEdition McGraw Hill int. ed. 1989. 5.M. Gopalrao& M. Sitting , 'Outline of Chemical Technology', 2ndedition east west 973. 6.http://nptel.iitm.ac.in	

BTINPE605 B. Power Plant Instrumentation

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

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

Pre requisite	Basic Knowledge of Power Plants	
Course Objective	To create awareness of energy resources and its scenario in India. To study the concept of power generation using various resources. To study the role of Instrumentation in power plants. To study and compare various power plants for optimal performance	
Course Outcome	1. Understand the over view of different power plants and its operation. 2. Understand the application of instrumentation for measurement, monitoring and safety of human being and assent of power plants. 3. Discharge the technical duties in field of power generation as maintenance and automation engineer. 4. Understand the safety awareness through latest through latest safety equipments. 5. Use latest software and tools of instrumentation for power plant.	
Unit	Contents	Contact Hrs
1	Power generation from conventional sources Thermal, hydro, nuclear and gas power plants - their functions and control; types of prime movers, generators and excitation systems; Economic considerations in power systems. Alternate sources of power generation - solar, wind, geo-thermal, ocean-thermal, tidal, wave and MHD.	7 Hours
2	Hydro-electric power plants Selection of site, elements of power plant, classification, water turbines, governor action, hydro- electric generator, plant layout, pumped storage plants Thermal steam power plants: Selection of site, elements and operational circuits of the power plant, turbo-alternators, plant layout, steam turbines, controls and auxiliaries.	7 Hours
3	Nuclear power plants Selection of site, nuclear reaction – fission process and chain reaction, constituents of power plant and layout, nuclear reactor – working, classification, control, shielding and waste disposal.	7 Hours
4	Renewable power plants Solar power generation, Photo-voltaic and solar thermal generation, solar concentrators, Wind power generation, types of wind mills, wind generators, tidal, biomass, geothermal and magneto- hydro dynamic power generation, micro-hydel power plants, fuel cells and diesel and gas power plants	7 Hours

5	Combined operation of power plants Plant selection, choice of size and number of generator units, interconnected systems, real and reactive power exchange among interconnected systems. Major electrical equipment in power plants, DC systems in power plants, station control - switch yard and control room. Economic considerations – types of costs, tariff and consumers.	7 Hours
	Text/References Books 1. Wadhwa, C.L., _Generation Distribution and Utilisation of Electrical Energy', New Age International Publishers, 3rd Edition, 2010. 2. J.B.Gupta, _A Course in Power Systems‘, S.K.Kataria and Sons, Reprint 2010-2011. 3. M. M. El-Wakil, Power Plant Technology, Mcgraw Hill, Digitized on Dec 2000 4. B. G. A. Skrotzki & W. A. Vopat, Power Station Engineering & Economy, McGraw Hill, Digitized on Dec 2007. 5. Chakrabarti A., Soni M.L., Gupta P.V., and Bhatnagar U.S., 'A Text Book on Power Systems Engg', Dhanpat Rai and Sons, New Delhi, 2nd Revised Edition, 2010.	

BTINPE 604 C. Embedded Systems

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

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

Pre requisite	Knowledge of Microcontrollers	
Course Objective	To learn about the Embedded Processors with Real World applications. To introduce the concept of control applications in embedded systems. To enhance the knowledge in interfacing processes with embedded controllers.	
Course Outcome	Write programs in an IDE and download it to the Processor. Design and program Embedded circuits. Design control algorithms in an embedded processor.	
Unit	Contents	Contact Hrs
1	Introduction to Embedded systems, the build process for embedded systems, Structural units in Embedded processor, selection of processor & memory devices, DMA, Memory management methods, timer and counting devices, watchdog timer, real time clock, in circuit emulator, target hardware debugging.	8
2	Embedded networking: Introduction, I/O Device ports and buses, serial bus communication protocols, RS 232 standard, RS 422, RS 485, CAN Bus, Serial Peripheral Interface (SPI), Inter Integrated Circuits (I2C), need for device drivers.	8
3	Embedded Product Development Life Cycle: objectives, different phases of ELDC, Modelling of ELDC, issues I Hardware- software co-design Data flow graph, state machine model, sequential program model, concurrent Model, object oriented model.	8
4	OS Concepts and types, tasks & task states, process, threads, inter process communication, task synchronization, semaphores, and role of OS in real time systems, scheduling resource allocation, interrupt handling.	8
5	Introduction to basic concept of RTOS, multiprocessing and multitasking, preemptive and non- preemptive scheduling, task communication shared memory, message passing, inter process communication- synchronization between processes semaphores, mailbox, pipes, priority inversion, priority inheritance, comparisons of real time operating systems: Vx Works, uc/OS-II, RT Linux. Case study of washing machine- automotive application- smart card system application.	8
	Text/Reference Books: 1. Rajkamal, Embedded system- architecture, programming, design, Mc Graw Hill 2. Peckol, Embedded system design, John Wiley & Sons. 3. Lyla B Das, Embedded Systems-an integrated approach, Pearson.	

BTINOE605 A. Industrial Data Communication

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

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

Pre requisite	Basics of Communication Techniques	
Course Objective	Study concepts of communications techniques in industry at various levels.	
Course Outcome	Upon completing the course, the student should have understand the concepts required for building industrial systems.	
Unit	Contents	Contact Hrs
1	Interface: Introduction, Principle of interface, serial interface and its standards. Parallel interfaces and buses.	8
2	Fieldbus: Use of fieldbuses in industrial plants, functions, international standards, Performance, use of Ethernet networks, fieldbus advantages and disadvantages. Fieldbus design, installation, economics and documentation	8
3	Instrumentation network design and upgrade: Instrumentation design goals, cost optimal and accurate sensor networks.	8
4	Global system architectures, advantages and limitations of open networks, HART network and Foundation fieldbus network.	8
5	PROFIBUS-PA: Basics, architecture, model, network design and system configuration, Designing PROFIBUS-PA and foundation Fieldbus segments: general considerations, network design.	8
	Text/Reference Books: 1. Noltingk B.E., Instrumentation Reference Book, Butterworth Heinemann 2. B. G. Liptak, Process software and digital networks, CRC press.	

BTINOE605 B. Fiber Optics and Laser Instrumentation

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

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

Pre requisite	Basic Knowledge of Fiber Optics and Laser	
Course Outcome	Identify various sensors, Fiber optic and its specifications. Understand principle of working of Fiber Optic used to measure Temperature, Displacement, Level, and various miscellaneous other sensors Understand applications of Fiber Optics in industry.	
Unit	Contents	Contact Hrs
1	Optical Fiber and Their properties: Ray theory, wave guiding principles, Theory of optical wave propagation, Types and classification of optical fibers, optical fiber mode, single mode fiber, special fiber, fiber materials, fiber fabrication, transmission characteristics of fiber, absorption losses, scattering losses, dispersion, polarization, non-linear phenomena.	8
2	Optical Sources and Detectors, Power Launching and Coupling: Laser theory, Laser diodes, LED, PN diode, Pin diode, avalanche diode, solid, liquid, gas and semiconductor laser their characteristics modulation circuits, optical detection principles, quantum efficiency and detector noise, Source to fiber power launching, fiber alignment and fiber to fiber joints, splices, connectors, coupling losses, lensing schemes for coupling improvement, LED coupling to single mode fiber.	8
3	Optical Fiber Measurements: Measurement of attenuation, dispersion, refractive index profile of fiber and cut off wavelength, numerical aperture, OTDR, Measurement of flow, pressure, Temperature, displacement, acceleration and fluid level vibration measurement.	8
4	Fiber Optic Sensing Principles and Techniques: Classification and principle of fiber optic sensors, fiber grating and fiber Bragg grating technology and distributed optical fiber sensing.	8
5	Optical Amplification and Integrated Optics: Beam splitter, directional coupler, opto isolators, multimode interference coupler(MMIC) optical modulators, fiber modulator optical amplifiers, optical switches, frequency translators, optoelectronic integration, Holography and Laser instruments in medical application and Remote Sensing: Basic principle, methods, Holographic interferometry. Application of laser in medical application, laser in industrial application.	8
	Text/Reference Books: 1. "Fiber optics – communication", Gerd Keiser. 2. "Integrated circuits and semiconductor devices theory and application" Deboo Burrous, McGraw Hill Second Edition.	

BTINOE 605 C. Robotics Control

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

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

Pre requisite	Basic Knowledge of Robots and its elements	
Course Outcome	After studying the subject students will be able to design various controls in robotics.	
Unit	Contents	Contact Hrs
1	Introduction Introduction to robots, Robot manipulators, Mobile robots, Robot anatomy, Coordinate systems, Work envelope, Types and classification, Specifications, Sensors, Actuators and drives.	6 Hours
2	Forward and Inverse Kinematics Introduction Representation of position and orientation of a rigid body, Homogeneous transformations Forward and inverse kinematics problems, Denavit - Hartenberg (D-H) notations and parameters Representation of joints, link representation using D-H parameters, Closed-form solutions, Geometric and Numerical methods	8 Hours
3	Velocity and Statics analysis Linear and angular velocity of links Velocity propagation, Jacobians for robotic manipulators, Statics and force transformation of robotic manipulators, Singularity analysis.	8 Hours
4	Robot Dynamic analysis Introduction, Forward and inverse dynamics, Mass and inertia of links, Lagrangian formulation for equations of motion for robotic manipulators, Newton- uler formulation method, Dynamic modelling, State space representation of dynamic equations of robotic manipulators.	8 Hours
5	Trajectory Planning and Control 7 Hours Joint and Cartesian space trajectory planning and generation – Classical control concepts using the example of control of a single link – Independent joint PID control – Control of a multi-link manipulator – Nonlinear model-based control schemes. Simulation and experimental case studies on robotic manipulators.	8 Hours
	Text/Reference Books 1. William B. Riddens, ―Understanding Automotive Electronics‖, 5th Edition, (Butterworth Heinemann Woburn), (1998). 2. Tom Weather Jr and Cland C. Hunter, ―Automotive Computers and Control System‖,Prentice Hall Inc. ,New Jeresy. 3. Jiri Marek, Hans Peter trah, ―Sensers Applications, Sensers for Automotive Technology‖ 1st Edition , Wiley 4. T. Mellard, Automotive Electronic Systems‖1987 by Heinenmann Professional.	

BTINL606. Industrial automation and Control Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 1

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

	List of Experiments
Expt. No.	Title of Expt.
1	Study of different PLC and their specification.
2	Study of installations and troubleshooting of PLC.
3	Solving example by LD and ST programming in PLC.
4	Solving example by timer and counter in PLC.
5	Solving example using SFC programming in PLC.
6	Study of Interfacing between PLC and Process loop.
7	Study of SCADA system.
8	Study different type of DCS and their latest trends.
9	Selection steps of DCS for industrial automation.
10	Study of specification list for DCS.

BTINL607. Power Electronics and Drives Lab

Teaching scheme:
Lab work : 4 hrs
Total credit: 1

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

	List of Experiments
Expt. No.	Title of Expt.
1	To plot the characteristics of SCR.
2	To plot the characteristics of Diac.
3	To plot the characteristics of Triac.
4	To Plot voltage vs firing angle for AC phase control using Triac.
5	Study of Forced commutation circuits.
6	To study and plot the line vs Load regulation for SMPS
7	To study Single phase half wave controlled converter
8	To study Single phase full wave controlled converter
9	Study and implement series inverter.
10	Study and implement parallel inverter.

BTINM608. Mini Project II

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

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

Students in group of three or four are expected to develop minor project on the concept learned in Semester V and VI subjects.