Dr.BabasahebAmbedkarTechnologicalUniversity,Lonere

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No XXIX of 2014)
P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra Telephone and Fax: 02140 – 275142
www.dbatu.ac.in

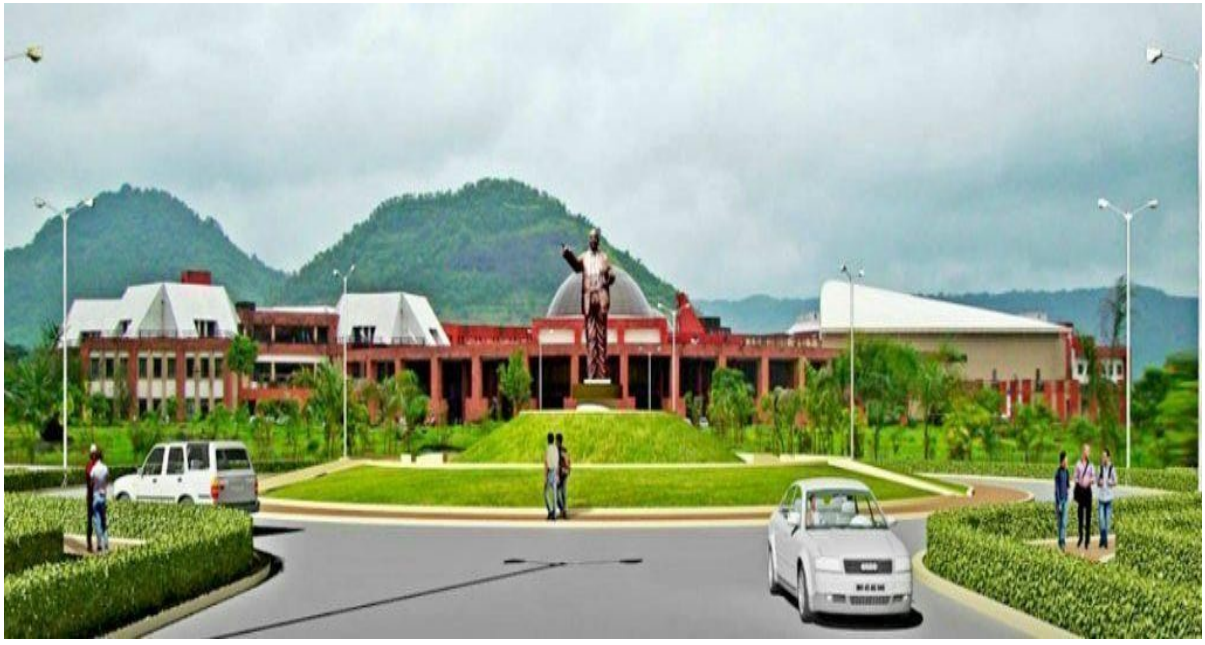
CURRICULUM

UNDERGRADUATEPROGRAMME

Final Year B.Tech.

(Instrumentation Engineering/Instrumentation & Control)

With effect from the Academic Year2023-2024



DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

B. Tech in Instrumentation Engineering

Curriculum for Final Year

Semester VII											
SR. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1	PCC 1	BTINC701	Process Instrumentation and Control	4	-	-	20	20	60	100	4
2	PEC 4	BTINPE702	Instrumentation System Design	3	-	-	20	20	60	100	3
3	OEC 3	BTINOE703	Group F	3	-	-	20	20	60	100	3
4	OEC 4	BTINOE704	Group G	3	-	-	20	20	60	100	3
5	HSSMC	BTHM705	Group H	3	-	-	20	20	60	100	3
6	HSSMC	BTHM706	Project Engineering and Management	-	-	-	-	-	-	-	Audit
7	LC	BTINL707	Process Instrumentation Lab	-	-	2	60	-	40	100	1
8	LC	BTINL708	Instrumentation System Design Lab			2	60		40	100	1
9	Project	BTINM709	Project Phase – I	-	-	4	60	-	40	100	2
10	Internship	BTINM609	Internship – 3 Evaluation	-	-	-	-	-	50	50	1
			Total	**16**	**0**	**8**	**220**	**100**	**430**	**850**	**21**

Semester VIII											
SR. No	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
				L	T	P	CA	MSE	ESE	Total	
1	PEC5	BTINPE801	NPTEL – online courses	3	-	-	20	20	60	100	03
2	Project/ Internship	BTINP802	Project work/ Internship	-	-	24	60	-	40	100	12
			Total	**-**	**-**	**24**	**60**	**-**	**40**	**200**	**15**

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

- **ImportantNote:MinimumEightExperimenttoperformbasedonthesyllabusforthe laboratorysubject.**

Group F [Sem - VII] (Professional Elective)

Sr. No.	Course Code	Course Title
01	BTINPE703 A	Industrial Project Planning and Estimation
02	BTINPE703 B	Agriculture Instrumentation
03	BTINPE703 C	Environmental Instrumentation

Group G [Sem - VII] (OpenElective)

Sr. No.	Course Code	Course Title
01	BTINOE704 A	Image Processing
02	BTINOE704 B	Internet of Things
03	BTINOE704 C	Building Automation

Group H [Sem - VII] (OpenElective)

Sr. No.	Course Code	Course Title
01	BTINOE705 A	Analytical Instrumentation
02	BTINOE705 B	Adaptive Control System
03	BTINOE705 C	Automobile Instrumentation

NPTEL – online courses

Sr. No.	Course Name	Duration (Weeks)	Institute offering course	Name of Professor
1	Analog Circuits And Systems Through SPICE Simulation	12 Week	IIT Kharagpur	Prof. Mrigank Sharad
2.	Computer Aided Power System Analysis	12 Week	IIT Roorkee	Prof. Biswarup Das
3.	Control Engineering	12 Week	IIT Madras	Prof. RamkrishnaPasumarthy
4.	DC Power Transmission Systems	12 Week	IIT Madras	Prof. Krishna S.
5.	Fundamentals Of Power ElectronicsSystems	12 Week	IISc Bangalore	Prof. Vivek Agarwal, Prof. L. Umanand
6.	Biomedical Signal Processing	12 Week	IIT Kharagpur	Prof.SudiptaMukhopadhyay

Semester VII

BTINC701 Process Instrumentation 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	Concepts of process and its behaviour	
Course Objective	1.To understand principles of elements in the control loop 2.To appreciate the properties of different control loops and suggest suitable control for it 3.To develop problem-solving skills applicable to real-world problems in the process industries.	
Course Outcome	1. Summarize and classify characteristics of various control loops 2. Design and apply appropriate control for different control loops. 3. Familiarize with the advances in process instrumentation.	
Unit	Contents	Contact Hrs
1	Process characteristics: Types of Processes (Dead time, single and multi-capacity, Self and non-self-regulating, interacting and non-interacting, linear and nonlinear processes). Process gains, process reaction curve, process time constant and constant step analysis method for finding time constant, Dead time. Dynamic elements in control loops. PID control of processes. Process simulators.	6 Hours
2	Analysis and properties of some common loops: Flow, pressure level, temperature, composition, pH etc. Linear and non-linear controllers, review of PID with limitations(offset, saturation in D, & reset windup) rate before reset, PID variations, and tuning, Digital controller (position and velocity algorithms, effect of sampling g time)hardware structures, features and specification. Single loop and multiloop controllers and the application programs, Non-linear controller-two state, three state, proportional time, dual mode, optimal switching.	8 Hours
3	Multi-loop and multivariable process control systems: Feedback, Feed forward Control, cascade control, ratio control, auto selective control, spit range control. Predictive control systems and Adaptive control systems.	8 Hours

	Interaction and decoupling, Relative gain analysis, procedure to calculate relative gain, and its applications.	
4	Boiler instrumentation and Optimization, boiler equipment safety interlocks, Boiler efficiency and dynamics, boiler controls, combustion control, air to fuel ratio control. 3 element drum level control, steam pressure control, steam temperature control. Burner management and control boiler optimization. Furnace control of heat exchangers, steam and fired heaters control. Reboilers, vaporization, heat exchanger and condensers.	8 Hours
5	Instrumentation design for Pumps and compressor controls, Instrumentation design for multi effect evaporators, distillation, dryer, chemical reactor and cooling tower. Instrumentation design for size reduction, extruder, crystallizer, chiller.	8 Hours
	Text/Reference Books 1. Process Control Systems by F. G. Shinskey (TMH). 2. Process Control by B. G. LIptak (Chilton). 3. Computer Based Industrial Control by Krishna Kant (PHI). 4. Distributed Computer Control for Industrial Automation by Popovic and Bhatkar (Dekker). 5. Chemical Process Control by G. Stephanopoulos (PHI). 6. Distillation Column Control by F. G. Shinskey (TMH). 7. Process control Instrumentation – C.D. Johnson 8. Process control designing processes and control system for dynamic processes Thomes E. narlin 9. Analog and Digital control – RamakantGaikwad 10.Distributed computer control for industrial automation, PpovikBhatkar, Dekkar Pub	

BTINC702 Instrumentation System Design

Teaching scheme:
Theory: 3 hrs

Total credit: 3

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

Pre requisite	Sensors and Transducers, Electronic Instrumentation	
Course Objective	1. ControlValveSizingconceptsanditsusualtermsforapplications likeliquid, gas, vapour and flashingfluids. 2. Control room and Control Paneldetails 3. The process of Electronic productdesign	
Course Outcome	1. Design and Analyse CVSizing 2. IdentifyvariousControlpanelsandControlRoomdetails 3. Design of Electronicproduct. 4. Understand Signal Conditioning forTransducers.	
Unit	Contents	Contact Hrs
1	Basic concepts of transducer design: General transducer design consideration, testing of transducer, and selection criteria of transducer. Design of temperature measurement system based on RTD, Thermocouple and thermisters, Design of Displacement measurement system based using LVDT, Potentiometer, Ultrasonic transducer, Complete signal conditioning circuits for above temperature and Displacement transducers.	6 Hours
2	Design of orifice, rotameter, venture based flow system and signal conditioning circuits for above system. Design of level sensors and its signal conditioning circuits, design of pressure gauge, diaphragm based pressure gauge, strain gauge cell and its signal conditioning, study of P/I and I/P converters, Design of smart transmitters.	8 Hours
3	Concept of reliability definition, Distinction between Quality and reliability, failures, Availability, Maintainability, (MTBF, MTTF, MTTR) Life Cycle and Bathtub curve, Reliability Modeling Exponential, Weibull and Gamma Distribution, Hazard rate and Derivation of MTTF Failure Density Function, Cumulative Distribution Function and Reliability, Importance of documentation in system design.	8 Hours
4	Guidelines for enclosure: components and accessories, Grounding and shielding techniques noise in electronic circuits, EMI/ EMC protection against EMI, ESD selection of cables, connectors, types of knobs,; mechanical fixture PCB holders, clamps, control panel layout and control room design. Safe and Hazardous area.	8 Hours
5	Printed circuit board design guidelines: general components layout scheme, grid system, PCB size mechanical stress, design rules for analog and digital circuit PCB, single, multi layer and SMD boards, Artwork CAD packages, soldering techniques.	8 Hours

	Text/Reference Books 1. Electrostatic Discharge and Electronic Equipment, "Warren Boxleitner" IEEE presses. 2. Printed Circuit Boards, "Walter C. Bosshart", CEDT series, TMH. 3. Noise Reduction Techniques, "Ott". 4. Reliability Engineering, "E. Balguruswamy", PHI. 5. Applications of AnalogIntergrated Circuit, "S. Soclof", PHI. 6. Process Control, "B.G.Liptak", Chilton. 7. National Instruments Catalog. 8. Measurement Systems, "E.O.Doebline". 9. Process control and Instrumentation technology, "C. D, Johnson", PHI	

BTINPE703A Industrial Project Planning and Estimation

Teaching scheme:
Theory: 3 hrs

Total credit: 3

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

Pre requisite	Basics of Industrial Projects	
Course Objective	The objective of the course is to provide students with a firm grasp of the essential principles of project, planning, controlling, estimation and economics.	
Course Outcome	1. Apply the knowledge of the documentation for project execution. 2. Able to do the documentation for procurement of instruments/equipment. 3. Apply the knowledge for project, planning, controlling, estimation and economics. 4. Do higher studies in field of project, planning, controlling, estimation and economic developments.	
Unit	Contents	Contact Hrs
1	Introduction: Definition of Project : Purpose, scope, time Quantity, and organization structure Degree of Automation, Manpower considerations, Inter-department and inter organization interactions, Process flow sheets, P & I diagrams, Interlock diagrams, Instrument Index Sheets, Instrumentation standards and practices, Legends and Symbols Instrumentation symbols and Identifications (ANSI/ISA-5.1), Plant layout General arrangement drawing (Plans and Elevations).	6 Hours
2	Instrumentation & Control Documentation & Cable Engineering: Instrument specification sheets, Loop diagrams, wiring diagrams isometrics, installation detail drawing bill of material (BOM), control panel drawing, instrument data sheet, document control as per ISA standards, check lists, legend sheets, instrument catalogues test and process reports different classes of conductors and their routines and NEMA Standards Types and specifications of cables, Cable schedule, Routing of cables, Types of glands, Ferruling and terminations	8 Hours
3	Procurement Activities and Construction Activities: Vendor registration, Tendering and bidding process, Bid evaluation, Purchase order Vendor documents, Drawing and reports as necessary at above activities, Site conditions and planning, Front availability, Installation and commissioning, Activities and documents, On-site inspection and testing (SAT), Installation sketches Contracting, Cold commissioning and hot commissioning CAT (Customer Acceptance Test Perform trials and final handover Control console, centers, panels and indicators: Types, Design, Inspection, and specification Intelligent operator interface (IOI). Field bus Wiring: Terminator, Power Conditioners, Spurs, Segments, and repeaters	8 Hours

	Networking: Hubs, routers, LAN cards, and Cat cables.	
4	Project Management: Process planning and scheduling Management: importance, characteristics, principles and levels of management Controlling, Directing, project authority, responsibility, Accountability Interpersonal influences Standard communication format, project reviews, The statement of work (SOW) Project specifications, milestone schedules, work breakdown structures, cost breakdown structure and the planning cycle Overview planning and execution mode (conceptual focus, design) Implementation, operation and support transition.	8 Hours
5	Cost Management, PERT and CPM: Cost and Estimation: Types of Estimates, Pricing process Salary overheads Labour hours, Material and support costs Network fundamentals Slack time network planning Estimating activity time and total program time Total PERT and CPM planning, crash times Software used in project management Software features and classification Evaluation and implementation	8 Hours
	Text/Reference Books 1. Andrew and Williams, "Applied Instrumentation in Process Industries", Gulf Publishing. 2. Liptak , "Process Control Instruments Engineer's Handbook", Chilton. 3. HardlodKerzner, "Project Management System Approach To Planning Scheduling and Controlling, 5th edition, Van Nostrand Reinhold Publishing. 4. John Bacon, " Management systems," (ISA). 5. T.G. Fisher, "Batch Control Systems", (ISA). 6. John Bacon, "Instrument installation project management", (ISA).	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

BTINPE703B Agriculture Instrumentation

Teaching scheme:
Theory: 3 hrs

Total credit: 3

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

Pre requisite	Basics of Sensors and Transducers	
Course Objective	Toacquaintandequipwiththeconceptofinstrumentationused in farm power & machinery and measuring devices for force, torque and other parameters.	
Course Outcome	1. Demonstrateknowledgeofdigitalandanalogelectronicsincludingdedicated microcomputersininstrumentationandcontrolsystemsforagricultural 2. Evaluatecollecteddatafromaninstrumentationsystem. 3. Identifysecurityriskanddeterminestandardprecautionarymeasures. 4. Applycorrectpracticetoinstallation,calibrationandmaintenanceof instruments 5. Configureinstrumentscorrectlytovendorinstructionsheets. 6. Predictandavoidtheproblemswithinstallingmeasurementequipment	
Unit	Contents	Contact Hrs
1	Introduction to Agricultural Instrumentation` Necessity of instrumentation & control for agriculture, engineering properties of soil: fundamental definitions & relationships, index properties of soil, permeability & seepage analysis, shear strength, Mohr's circle of stress, active & passive earth pressures, stability &slopes, Sensors: introduction to sonic anemometers, hygrometers, fine wire thermocouples, open& close path gas analyzers, brief introduction to various bio-sensors	6 Hours
2	Irrigation Systems Irrigation systems: necessity, irrigation methods: overhead, centre pivot, lateral move, micro irrigation systems &it's performance, comparison of different irrigation systems, soil moisture measurement methods: resistance based method, voltage based method, thermal based method, details of gypsum block soil moisture sensor, irrigation scheduling, irrigation efficiencies, design considerations in irrigation channels.	8 Hours
3	Batch Processes Flow diagram of sugar plant & instrumentation set up for it, flow diagram of fermenter & control(batch process),flow diagram of dairy industry & instrumentation set up for it, juice extraction control process & instrumentation set up for it	8 Hours
4	Automation in Green House Application of SCADA for DAM parameters & control, irrigation control	8 Hours

	management upstream & down - stream control systems, green houses &instrumentation: ventilation, cooling & heating, wind speed, temperature & humidity, rain gauge carbon dioxide enrichment measurement & control.	
5	Agro metrological Instrumentation Leaf area length evaporation, transpiration, temperature, wetness & respiration measurement & data logging, electromagnetic radiations photosynthesis, infrared & UV bio sensor methods in agriculture, agro metrological instrumentation weather stations, surface flux measurement, soil water content measurement using time-domain reflectometry (TDR),ground water occurrence confined & unconfined aquifers, evaluation of aquifer properties, ground water recharge.	8 Hours
	Text/Reference Books 1. Andrew and Williams, "Applied Instrumentation in Process Industries", Gulf Publishing. 2. Liptak , "Process Control Instruments Engineer's Handbook", Chilton. 3. HardlodKerzner, "Project Management System Approach To Planning Scheduling and Controlling, 5th edition, Van Nostrand Reinhold Publishing. 4. John Bacon, " Management systems," (ISA). 5. T.G. Fisher, "Batch Control Systems", (ISA). 6. John Bacon, "Instrument installation project management", (ISA).	

BTINPE703C Environmental Instrumentation

Teaching scheme:
Theory: 3 hrs

Examination Scheme:
Mid-term test: 20 Marks

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

Tutorial: Internal Assessment: 20 Marks

Total credit: 3 End semester exam: 60 Marks

Pre requisite	Awareness about environment	
Course Objective	1. To introduce the instrumentation methodologies for environment monitoring. 2. To deal with water quality monitoring and waste water treatment 3. To discuss the instrumentation required for air pollution monitoring	
Course Outcome	1. design instrumentation systems for environment monitoring. 2. develop algorithms for waste water treatment 3. measure and analyze air quality and other parameters.	
Unit	Contents	Contact Hrs
1	Introduction Necessity of instrumentation & control for environment, Importance of environmental Instrumentation sensor requirement for environment. Instrumentation methodologies: Ultraviolet analyzers, total hydrocarbon analyzers using flame ionization detector, Gas chromatography in environmental analysis, photo ionization, portable & stationary analytical instruments.	6 Hours
2	Quality of water Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters: Thermal conductivity, detectors, Opacity monitors, pH analyzers& their application, conductivity analyzers& their application. Water treatment: Requirement of water treatment facilities, process design.	8 Hours
3	Sedimentation & flotation General equation for settling or rising of discrete particles, hindered settling, effect of temperature, viscosity, efficiency of an ideal settling basin, reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation. Ground water monitoring: Level measurement in ground water monitoring wells, laboratory analysis of ground water samples, instrumentation in ground water monitoring, instrumentation in assessment of soil & ground water pollution.	8 Hours
4	Waste water and Flow monitoring system Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants. Flow monitoring: Non-open channel flow measurement, open channel waste water flow measurement. Rain water harvesting: necessity, methods, role of NGOs & municipal corporation.	8 Hours
5	Air Pollution and Sound Monitoring Systems Definitions, energy environment relationship, importance of air pollution, Air sampling methods & equipments, analytical methods for air pollution	8 Hours

	studies. Control of air pollution. Sound pollution: basics of sound pollution, its effect to environment. Acoustic noise measurement & monitoring.	
	Text/Reference Books 1. Environmental Engineering and Science, Gilber M Masters, Pearson Education , 1997 2. Environmental Instrumentation & Analysis Handbook, Randy D. Down & Jay H. Lehr, Wiley. 3. Environmental Engineering, Peany Howard S, Donal R Rowe and George TachoBanoylous Teddy. 4. Air pollution control technology, Wark& Warner. 5. Air pollution engineering, M. N. Rao & H. V. N. Rao 6. Environmental noise pollution, Patrick F. Cunniff, Wiley, May-1977. 7. Water treatment technology,Walter J. Weber.	

BTINOE704A Image Processing

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	Digital Signal Processing, Signals and Systems	
Course Objective	Thefundamentalsofdigitalimageprocessingandalgorithmsthatareused.Usefulskill basethatwouldallowthemtocarryoutfurtherstudyshouldtheybeinterestedandto work in the field. The students are expected to develop a foundation that can beused as the basis for further study and research in this field. The syllabus gives great emphasis on basic principles as well as more advanced techniques for image enhancement, segmentation, morphological operationsetc	
Course Outcome	1. Acquirethefundamentalconceptsofadigitalimageprocessingsystem 2. Identifyandexploitanalogiesbetweenthemathematicaltoolsusedfor1Dand 2D signal analysis andprocessing 3. Analyze2DsignalsinthefrequencydomainthroughtheFouriertransform. 4. Design and implement with Mat lab algorithms for digital image processing operationssuchashistogramequalization,enhancement,restoration,filtering, anddenoising.	
Unit	Contents	Contact Hrs
1	Digital Image representation, steps in Image processing, Elements of IP system, Frame Grabber, Digital camera, Elements of visual perception, Image model, Sample and Quantization, Basic relationship between pixels, Image Geometry.	6 Hours
2	Image Transforms, Introduction to Fourier Transform, DFT, Properties of 2-D fourier transform, FET, Walsh transform, Hazard Transform, Discrete Cosine transform, Harr transform, Wavelet transform.	8 Hours
3	Image Enhancement methods by Spatial and Frequency domain methods, point processing, Spatial filtering, Color Image processing, Image Restoration, Degradation model, Digitalization of circulant and block circulant matrices, Algebraic approach, inverse filtering, Least Mean Square filter, constrained Least square restoration, Restoration in spatial domain, geometric Transformation.	8 Hours
4	Image Compression by Redundancies, Image compression models, Elements of Information theory, Error-Free compression, Lossy compression, compression standards: JPEG & MPEG. Image Segmentation Detection of Discontinuities, Edge linking and Boundary detection, Thresholding, Region oriented segmentation, use of motion in segmentation.	8 Hours

5	Representation and Description Representation schemes, Boundary descriptors, Regional descriptors, Morphology, Applications of Image Processing in Instrumentation and Control	8 Hours
	Text/Reference Books 1. Digital Image Processing, "R. C. Gonzalez and R. E. Woods", Addison-Wesley Longman, Inc, 1999 2. Digital Image Processing, , "A.K.Jain", PHI 3. Image processing, Analysis and Machine vision, "M. Sonka, V. Hlavac, and R. Boyle", Thomson Asia pvt. Ltd, 1999.	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

BTINOE704B Internet of Things

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	Sensors and Processes	
Course Objective	Study different components of IOT. Study different techniques of communication. Study advanced processors	
Course Outcome	Students will able to design various applications using IOT.	
Unit	Contents	Contact Hrs
1	Introduction to Internet of Things : Definition & Characteristics, Physical Design of IOT, Logical Design of IOT, IOT Enabling technologies, IOT Levels & Deployment Templates Domain specific IOTs – Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle IoT and M2M, IoT System Management with NETCONF-YANG	6 Hours
2	IOT Platform Design Methodology: Purpose & Requirements Specification, Process Specification, Domain Model Specification, Information model Specification, Service specification, IOT level Specifications, Functional View Specifications, Operational View Specification, device and component integration, application development, case study on IOT system for weather monitoring	8 Hours
3	Embedded suite for IoT: Physical device – Arduino / Raspberry Pi Interfaces, Hardware requirement of Arduino / Pi, Connecting remotely to the Arduino /Raspberry Pi , GPIO Basics, Controlling GPIO Outputs Using a Web Interface,– Programming , APIs / Packages, Arduino Interfaces, Integration of Sensors and Actuators with Arduino, Introduction to Python programming – Python data types & data structure, Control flow (if, for, while, range, break/continue, pass), Functions, Modules, packages, file handling, date/time operations, classes, Python packages of interest for IOT	8 Hours
4	Connectivity Technologies & Communication Protocols in IOT RFID: Introduction, Principle of RFID, Components of an RFID system, Wireless Sensor Networks: WSN Architecture, the node, Connecting nodes, Networking Nodes, Securing Communication WSN specific IoT applications, Protocols in IOT: CoAP, XMPP, AMQP, MQTT, Communication Protocols: IEEE 802.15.4, Zigbee, 6LoWPAN, Bluetooth, Wireless HART	8 Hours
5	IOT Physical Server and Cloud Offerings:	8 Hours

	Cloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits and challenges of cloud computing, public, private clouds community cloud, Fog Computing, SDN Cloud Storage Models & Communication APIs, Web Application Messaging Protocol (WAMP), Python web application framework – Django, Developing Application with Django, Developing REST web services, SkyNetIoT Messaging Platform, Case Studies Illustrating IOT Design – Smart lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring System, Weather Report Bot, Air Pollution Monitoring, Forest fire Detection,Smart Irrigation, IoT Printer	
	Text/Reference Books 1. Pethuru Raj, Anupama C. Raman, The Internet of Things Enabling Technologies, Platforms, and Use Cases, CRC Press Taylor & Francis Group, International Standard Book Number-13: 978-14987-6128-4 2. RajkumarBuyya, Amir VahidDastjerdi Internet of Things – Principals and Paradigms, Morgan Kaufmann is an imprint of Elsevier, ISBN: 978-0-12-805395-9 HakimaChaouchi, ― The Internet of Things Connecting Objects to the Web‖ ISBN : 978-1- 84821140-7, Willy Publications 3. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications 4. Daniel Kellmereit, Daniel Obodovski, ―The Silent Intelligence: The Internet of Things‖,. Publisher: Lightning Source Inc; 1 edition (15 April 2014). ISBN-10: 0989973700, ISBN-13: 978-0989973700. 5. Fang Zhaho, Leonidas Guibas, ―Wireless Sensor Network: An information processing approach‖, Elsevier, ISBN: 978-81-8147-642-5. 6. Daniel Minoli, ―Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications‖, ISBN: 978-1-118-47347-4, Willy Publications 7. Bernd Scholz-Reiter, Florian Michahelles, ―Architecting the Internet of Things‖, ISBN 78-3	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

BTINOE704C Building Automation

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

Prerequisite	Needs of building automation	
Course Objective	Study various systems in building	
Course Outcome	After completion of course students will able to design various control systems in building.	
Unit	Contents	Contact Hrs
1	Introduction - Introduction, concept and application of Building Management System and Automation. Requirements and design considerations and its effect on functional efficiency of building automation system.	6 Hours
2	HVAC system --- Different components of HVAC system like heating, cooling system, chillers, AHUs, compressors and filter units and their types. Design issues in consideration with respect to efficiency and economics. Concept of district cooling.	8 Hours
3	Access Control & Security System - Concept of automation in access control system for safety. Manual security system. RFID enabled access control with components like active, passive cards, controllers, antennas.	8 Hours
4	Fire &Alarm System-- Different fire sensors, smoke detectors and their types. CO and CO2 sensors. Fire control panels. Design considerations for the FA system. Concept of IP enabled Fire& Alarm system.	8 Hours
5	CCTV System & Energy Management System -- Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system. Concept of energy management system, occupancy sensors, fans & lighting controller. PA System & EPBX System-- Components of Public Access System like speakers, Indicators, control panels, switches. Design aspects of PA system. Design consideration of EPBX system and its components. Integration of all the above systems to design a total building management system.	8 Hours
	Text/Reference Books 1. Jim Sinopoli,' Smart Buildings', fairmont Press (March 8, 2007). 2. Barney Capehart, 'Web Based Enterprise Energy and Building Automation Systems', C.E.M, Editor. 3. AntoBudiardjo, 'Building Automation Beyond the Simple Web Server', Clasma Events, Inc. 4. Paul Ehrlich,'What is an Intelligent Building?',Building Intelligence Group	

BTINOE705A Analytical 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	Sensors and Transducers	
Course Objective	1.To understand principles of instrumental analysis 2.To study the theory and design of analytical instruments 3.To develop problem-solving skills applicable to real-world problems	
Course Outcome	1.Summarize and classify capabilities and limitations of analytical instruments. 2.Ability to select and use an analytical instrument in the physical, chemical and biological world and appreciate the role of instrumentation. 3.Familiarize with the advances in analytical instrumentation. Explain Energy management systems	
Unit	Contents	Contact Hrs
1	Introduction to classical and instrumental methods for chemical analysis: comparison of these methods, classification of Instrumental methods (spectral, electroanalytical and separative methods) U.V. Visible and spectroscopy: laws of photometry, Beer and Lambert's law, monochromator design and monochromator performance. Colorimeters, single beam and double beam spectrophotometers, dual wavelength and double monochromatic systems, direct reading multichannel spectrophotometers, diode array rapid scanning spectrophotometers, reverse optics technique.	6 Hours
2	IR spectroscopy: Instrumentation, sources, detectors, FTIR. Raman Spectrometry; Raman effect, Raman spectrometer components, LASER Raman spectrophotometer. Flame photometry: Principle, Instrumentation constructional details, fuel gases, atomizer, burner, optical system, Recording system. Interferences in Flame photometry, Applications Atomic Absorption Spectroscopy(AAS): Principle, instrumentation-hollow cathode lamps, burners and flames, plasma excitation sources, optical and electronic systems. Interferences in AAS, Applications	8 Hours
3	Nuclear Magnetic Resonance (NMR) spectrometry: Principle ,nuclear spin, nuclear energy levels, resonance condition, NMR absorption spectra, chemical shift, constructional details of NMR spectrometer, sensitivity enhancement techniques, spin decoupler ;Fourier transform NMR Spectroscopy; Electron spin resonance (ESR) spectrometry – principle, constructional details. Fluorimeters and phosphorimeters; principle, single and double beam filter fluorimeter, ratio fluorimeter, spectrofluorimeter, microprocessor-based instruments, phosphorescence spectrometer.	8 Hours
4	Mass spectrometr: basic mass spectrometer components, types, magnetic	8 Hours

	deflection type, time of flight, radio frequency, double focusing, quadrupole type ,Gas chromatograph mass spectro-meter, y GCMS Sy stems; resolution of mass spectrometer, applications. Electron and ion spectroscopy: surface spectroscopic techniques, electron spectroscopy for chemical analysis (ESCA), Auger spectroscopy (AES), Secondary ion mass spectrometry (SIMS) and ion scattering Spectroscopy (ISS), densitometer. Radio chemical instrumentation: Radio chemical methods, radiation detectors – ionization chamber, Geiger Muller counter, proportional counter, Scintillation counter, Semiconductor detectors, pulse height analyzer. X-ray spectrometry: Xray spectrum, instrumentation for X-ray spectrometry, X-ray diffract meters, X-ray absorption meter.	
5	Gas and liquid chromatography: Classification; basic parts of gas chromatograph – carrier gas, sample injection system, chromatographic column, thermal compartment, temperature programming, dual column system, detectors-thermal conductivity, flame ionization, electron capture, Argon ionization detector, recording instruments; introduction to liquid chromatography and its classification, HPLC , Introduction to optical densitometer, Refractometry. Different types of gas analyzers: oxygen, carbon monoxide, carbon dioxide, Nitrogen analyzer, gas density analyzers. Environment monitoring system.	8 Hours
	Text/Reference Books 1. 'Handbook of Analytical instruments', R.S. Khandpur, Tata McGraw-Hill. 2. 'Instrumental methods of Analysis', Willard, Merrit, Eean,CBS Publishers & distributor, New Delhi. 3. 'Instrumental Methods of Chemical Analysis', E.W.Ewing , McGraw-Hill, fifth edition 4. 'Introduction to Instrumental Analysis' Robert D. Braun, McGraw-Hill. 5. 'Instrumental Methods of Chemical Analysis', B.K.Sharma, goyal publications 6. 'Principles of Instrumental Analysis', S.G.Skoog, Thomson	

BTINOE705B Adaptive Control System

Teaching scheme:
Theory: 3 hrs

Examination Scheme:
Mid-term test: 20 Marks

Internal Assessment: 20 Marks

Total credit: 3

End semester exam: 60 Marks

Pre requisite	Control System	
Course Objective	To learn Basics of adaptive control systems, types	
Course Outcome	After completing this course students are able to apply adaptive control for various processes.	
Unit	Contents	Contact Hrs
1	Introduction: Definitions, History of adaptive Control, Essential aspects of adaptive control, Classification of adaptive control system: Feedback adaptive controllers, Feed forward adaptive controllers, Why adaptive control?	6 Hours
2	Model Reference Adaptive System: Different configuration of model reference adaptive systems; classification of MRAS, Mathematical description, and Equivalent representation as a nonlinear time-varying system, direct and indirect MRAS	8 Hours
3	Analysis and Design of Model Reference Adaptive Systems: Model reference control with local parametric optimization (Gradient method), MIT rule, MRAS for a first order system, MRAS based on Lyapunov stability theory, Design of a first order MRAS based on stability theory, Hyper stability approach, Monopoli's augmented error approach	8 Hours
4	Self-Tuning Regulators: Introduction: The basic idea; process models, disturbance models, General linear difference equation models, model simplification, Different approaches to self-tuning, Recursive Parameter Estimation Methods: The RLS method, extended Least squares, Recursive instrumental variable method; U-D factorization, Covariance resulting, variable data forgetting. Estimation accuracy, Direct and Indirect Self-tuning regulators, Clarke and Gawthrop's Self tuning Controller, Pole Placement approach to self-tuning control; Connection between MRAS and STR.	8 Hours
5	Gain Scheduling: Introduction, The Principal, Design of Gain Scheduling Regulators, Nonlinear transformations, Applications of gain scheduling. Alternatives to Adaptive Control, Why not Adaptive Control? Robust High gain feedback control, Variable Structure schemes.	8 Hours
	Text/Reference Books 1. I. B Landau, Adaptive Control - The Model Reference Approach, New York; arcel Dekker, 1979 2. K. J. Astrom and B. Wittenmark, Adaptive Control, Addison	

	Wesley Publication Company, 1989. 3. B. Roffel, P. J. Vermeer, P. A. Chin, Simulation and Implementation of self-Tuning Controllers, Prentice-Hall, Englewood cliffs, NJ, 1989. 4. R. Isermann, K. Lashmann and D. Marko, Adaptive Control Systems, Printice-Hall International (UK) Ltd. 1992. 5. K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

BTINOE705C Automobile 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	Sensors and Transducers	
Course Objective	1.Know the fundamentals of automotive electronics 2.Understand automotive control systems 3.Know basics of safety factors in automobile.	
Course Outcome	1.Ability to understand electronic control unit. 2.Acquire knowledge of various automotive standards and Protocols. 3.Design aspects of measurement and control strategies in automotive application	
Unit	Contents	Contact Hrs
1	Fundamentals of Automotive Electronics: Open loop and closed loop systems, Components for electronic engine management, vehicle motion control, Current trends in modern Automobiles	6 Hours
2	Electronic Fuel Injection and ignition systems: Introduction, throttle body ignition and multi-port or point fuel injection, Advantages of electronic ignition system, Types of solid state ignition systems and their principle of operation, electronic spark timing control system,	8 Hours
3	Engine control system: Engine cranking and warm up control, Acceleration enrichment – Deceleration leaning and idle speed control, integrated engine control system, exhaust emission control system, Engine performance testing	8 Hours
4	Automobile chassis electronic control system: Principle of electronic braking, automatic transmission electronic control circuit, cruise control circuit, the electronic steering control theory, ABS, ASR, ESP, and other electronic control method	8 Hours
5	Auto Body Electronic Control Technology: Automotive central locking and anti-theft system control technology, electronically controlled windows and doors and airbag technology, principle of control circuit components and characteristics, Ergonomics and safety: Driver information system, lighting system components, battery monitoring and control, Air conditioning, steering control techniques, Automatic gear control systems, Emission standards.	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. ,NewJeresy.	

	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	

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

BTHM706 Project Engineering and Management — Audit Course

Pre requisite	Basics of Management Systems	
Course Objective	Study various aspects while developing project	
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.	6 Hours
2	Work definition: Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, Project Risk Management,	8 Hours
3	Project scheduling and Planning Tools: Work Breakdown structure, LRC, Gantt charts, CPM/PERT Networks	8 Hours
4	Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resource constraints: Resource Levelling and Resource Allocation. Time Cost Trade off	8 Hours
5	Post-Project Analysis	8 Hours
	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. HoraldKerzner, 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.	

BTINL707 Process Instrumentation and Control Lab

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

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

Expt. No.	List of Experiments:
1	Study of the time constant of single capacity / Multi-capacity process by graphical methods.
2	Study of interacting and non-interacting process.
3	Study the analysis of flow controller control loop.
4	Study the analysis of Pressure control system
5	Study of Temperature control using PID
6	Study of Level control using PID
7	Study of Cascade control system
8	Study of ratio control loop.
9	Study of Split range control

BTINL708 Instrumentation System Design Lab

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

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

Expt. No.	List of Experiments:
1	Design of signal conditioning RTD (Pt-100)
2	Design of signal conditioning for thermocouple
3	Design of signal conditioning for displacement measurement transducer.
4	Study and Calibration of I/P converter
5	Study and Calibration of P/I converter
6	Study of D.P. Transmitter and its application for flow
7	Study of D.P. Transmitter and its application for level
8	Study of smart transmitter
9	Design of signal conditioning for strain gauge.
11	Study of Enclosure design for circuit and instrument.

BTINM709 Project Phase -I 3 Credit

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarize the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student. In case of students opting for Internship in the eighth semester, the Project may be industry-based.

BTINM710 Industrial Training / Internship 1 Credit

Students are expected to undergo industrial training for at least four weeks at factory / design offices or in combination of these after VI semester. Training session shall be guided and certified by qualified engineer / industry expert. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII. A brief report of industrial training shall be submitted. Evaluation shall be based on report and power point presentation.

SEMESTER VIII

BTINPE801 NPTEL Online Course 3 Credit

NPTEL Course in semester VIII available relevant to branch not covered in previous semester

BTINP802 Project Phase- II/ Internship 13 Credit

Since Project Stage II is in continuation to Project Stage I, the students are expected to complete the total project by the end of semester VIII. After completion of project work, they are expected to submit the consolidated report including the work done in stage I and stage II.

The report shall be comprehensive and presented typed on A4 size sheets and bound. The number of copies to be submitted is number of students plus two. The assessment would be carried out by the panel of examiners for both, term work and oral examinations.