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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COURSE STRUCTURE AND SYLLABUS

For

Final Year B. Tech. Instrumentation Engineering

With effect from the Academic Year 2020-2021(Final Year)

PROGRAM EDUCATIONAL OBJECTIVES. (PEOs)

The Board of Studies in Instrumentation Engineering of Dr. Babasaheb Ambedkar Technological University, Lonere has defined set of program educational objectives. The Program Educational Objectives of Instrumentation Engineering are designed to provide graduates with:

PEO1: Professional Knowledge: Graduates shall acquire the fundamental and advanced knowledge in Instrumentation Engineering subjects along with additional knowledge on other subjects such as Mathematics, Inter-disciplinary, Engineering, Management and Economics to solve basic and complex engineering problems. Graduates will be able to design system within realistic constraints for sustainable developments.

PEO2: Professional Employment: Graduates will have a successful career in Instrumentation Engineering. Graduates will succeed in getting the entry-level engineering positions as trainee engineer, project engineer, erection and commissioning engineer, automation engineer in process industries, Government Organizations at regional and national levels and as an Entrepreneur.

PEO3: Higher Studies & Life Long Learning: Graduates may pursue their professional development through self-learning, advanced degree and continue life-long learning. Graduates will be able to use software and modern engineering tools.

PEO4: Social Engineering: Graduates will aware of social responsibility, ethical values, safety standard, economical and environmental issues so that they serve the society better.

PROGRAM OUTCOMES (POs)

a. An ability to apply knowledge of mathematics, science, and engineering.

b. An ability to design and conduct experiments, as well as to analyze and interpret data.

c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

d. An ability to function on multidisciplinary teams.

e. An ability to identify, formulates, and solves engineering problems.

f. An understanding of professional and ethical responsibility.

g. An ability to communicate effectively.

h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.

i. Recognition of the need for, and an ability to engage in life-long learning.

j. Knowledge of contemporary issues.

k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

l. An ability to work professionally in both software and hardware system areas including the design and realization of such systems.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

B. Tech (Instrumentation Engineering)
Proposed Curriculum for Semester VII [Final Year]

Sr No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
01.	BTIEC701	PCC1	Process Instrumentation and Control	3	-	0	20	20	60	100	3
02.	BTIEC702	PCC2	Instrumentation System Design	3	-	0	20	20	60	100	3
03.	BTIEC703	PCC3	Industrial Project Planning and Estimation	3	-	-	20	20	60	100	3
04.	BTIEPE704A	PEC1 (Elective - IX)	Image Processing	3	-	0	20	20	60	100	3
	BTIEPE704B		Internet of things								
	BTIEPE704C		Clinical Instrumentation								
05.	BTIEOE705A	OEC1 Open (Elective - X)	Analytical Instrumentation	3	0	0	20	20	60	100	3
	BTIEOE705B		Adaptive Control System								
	BTIEOE705C		Automobile Instrumentation								
06.	BTIEL706	Lab	Process Instrumentation and Control Lab	0	0	2	-	30	20	50	1
07.	BTIEL707	Lab	Instrumentation System Design Lab	0	0	2	-	30	20	50	1
08.	BTIEL708	Lab	PEC1 Elective - IX Lab	0	0	2	-	30	20	50	1
09.	BTIES709	Seminar	Seminar	0	0	2	-	30	20	50	1
10.	BTIEP710	Project	Project Part-I	0	0	12	-	30	20	50	3
11.	BTIEF711	-	Industrial Training	-	-	-	-	-	50	50	1
			Total	15	0	20	100	250	450	800	23

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

B.Tech (Instrumentation Engineering)
Proposed Curriculum for Semester VIII [Final Year]

Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
			L	T	P	MSE	CA	ESE		
1. Control Engineering 2. The Joy of Computing using Python			3	-	-	20*	20*	60*	100	3
3. Biomedical Signal Processing 4. Industrial Automation and Control 5. Sensors and Actuators 6. Fuzzy Sets, Logic, Systems & Applications 7. Optical Engineering # *Student to opt any two subjects from above list*			3	-	-	20*	20*	60*	100	3
BTIEP803	Project	Project Part-II	-	-	30	-	100	150	250	15
		Total	06	-	30	40	140	270	450	21

- * *Six months of Internship in the industry*
- * *Students doing project at institute will have to appear for CA/MSE/ESE*
- * *Student doing project at Industry will give NPTEL examination / Examination conducted by university i.e. CA/MSE/ESE*
- *These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source*
- *Teacher who works as a facilitator for the course should be allotted 3 hrs/week load.*
- *Project Load: 2hrs/week/project*

Mapping of Courses with MOOCs Platform SWYAM / NPTEL

Sr. No.	Course Name	Duration (Weeks)	Institute offering course	Name of Professor
1.	Control Engineering	12 Week	IIT Madras	Prof. Ramkrishna Pasumarthy
2.	The Joy of Computing using Python	12 Week	IIT Ropar	Prof. Sudarshan Iyengar Prof. Yayati Gupta
3.	Biomedical Signal Processing	12 Week	IIT Kharagpur	Prof. Sudipta Mukhopadhyay
4.	Industrial Automation and Control	12 Week	IIT Kharagpur	Prof. Siddhartha Mukhopadhyay
5.	Sensors and Actuators	12 Week	IISc Bangalore	Pro. Hardik Jeetendra Pandya
6.	Fuzzy Sets, Logic, Systems & Applications	12 Week	IIT Kanpur	Prof. Nischal K. Verma
7.	Optical Engineering	12 Week	IIT Madras	Prof. Shanti Bhattacharya

Semester VII

BTIEC701 Process Instrumentation and Control 3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

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 Outcomes (COs):

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: 1 **7 Hours**

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.

Unit: 2 **7 Hours**

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.

Unit: 3 **7 Hours**

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.

Interaction and decoupling, Relative gain analysis, procedure to calculate relative gain, and its applications.

Unit: 4 **7 Hours**

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.

Unit: 5 **8 Hours**

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.

Recommended 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
8. Analog and Digital control – Ramakant Gaikwad
9. Distributed computer control for industrial automation, Ppovik Bhatkar, Dekkar Pub

BTIEC702 Instrumentation System Design 3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

1. Control Valve Sizing concepts and its usual terms for applications like liquid, gas, vapour and flashing fluids.
2. Control room and Control Panel details
3. The process of Electronic product design

Course Outcomes (COs):

1. Design and Analyse CV Sizing
2. Identify various Control panels and Control Room details
3. Design of Electronic product.
4. Understand Signal Conditioning for Transducers.

Unit 1. **07 Hours**

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.

Unit 2 **07 Hours**

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

Unit3. **07 Hours**

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.

Unit4. **07 Hours**

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.

Unit 5. **07 Hours**

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.

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 Analog Intergrated 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

BTIEC703 Industrial Project Planning and Estimation 3 Credits

Course Education Objectives (CEOs)
Upon completion of this course, student should be able to:

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 Outcomes (COs):

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: 1 Introduction: 7 Hours

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).

Unit: 2 Instrumentation & Control Documentation & Cable Engineering: 7 Hours

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

Unit: 3 Procurement Activities and Construction Activities: 7 Hours

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 Networking: Hubs, routers, LAN cards, and Cat cables.

Unit: 4 Project Management: **7 Hours**

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.

Unit: 5 Cost Management, PERT and CPM: **7 Hours**

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

Reference Books :

1. Andrew and Williams, "Applied Instrumentation in Process Industries", Gulf Publishing.
2. Liptak , "Process Control Instruments Engineer's Handbook", Chilton.
3. Hardlod Kerzner, "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).

BTIEPE704A Image Processing 3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

The fundamentals of digital image processing and algorithms that are used. Useful skill base that would allow them to carry out further study should they be interested and to work in the field. The students are expected to develop a foundation that can be used 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 operations etc.

Course Outcomes (COs):

Upon the completion of course the students will be able to:

1. Acquire the fundamental concepts of a digital image processing system
2. Identify and exploit analogies between the mathematical tools used for 1D and 2D signal analysis and processing
3. Analyze 2D signals in the frequency domain through the Fourier transform
4. Design and implement with Mat lab algorithms for digital image processing operations such as histogram equalization, enhancement, restoration, filtering, and denoising.

Unit 1. **7 Hours**

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.

Unit 2. **7 Hours**

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.

Unit 3. **7 Hours**

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.

Unit 4. **7 Hours**

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.

Unit 5. **7 Hours**

Representation and Description Representation schemes, Boundary descriptors, Regional descriptors, Morphology, Applications of Image Processing in Instrumentation and Control

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.

BTIEPE704B Internet of Things 3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

1. Students will be explored to the interconnection and integration of the physical world and the cyber space.
2. To provide ability to design and develop IOT devices.

Course Outcomes (COs):

1. Learner will be able to understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
2. Learner will be able to interpret IOT working at transport layer with the help of various protocols.
3. Learner will be able to understand IOT concept at data link layer.
4. Learner will be able to apply the concept of mobile networking to the internet connected devices.
5. Learner will be able to measure and schedule the performance of networked devices in IOT.
6. Learner will be able to analyze the challenges involve in developing IOT architecture.

Unit: 1 Introduction to Internet of Things : 7 Hours

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

Unit: 2 IOT Platform Design Methodology: 7 Hours

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

Unit: 3 Embedded suite for IoT: 7 Hours

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

Unit: 4 Connectivity Technologies & Communication Protocols in IOT RFID: 7 Hours

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, WirelessHART

Unit: 5 IOT Physical Server and Cloud Offerings: 7 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, SkyNet IoT 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

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. Rajkumar Buyya, Amir Vahid Dastjerdi Internet of Things –Principals and Paradigms, Morgan Kaufmann is an imprint of Elsevier, ISBN: 978-0-12-805395-9 Hakima Chaouchi, — 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

BTIEPE704C Clinical Instrumentation 3 Credits

Course Education Objectives (CEOs):

Upon completion of this course, student should be able to:

1. the study of different types of electrodes used in bio-potential recording.
2. To understand how to measure various biochemical and nonelectrical parameters of human system

Course Outcomes (COs):

Upon completion of this course, student should be able to

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, therapy, supplementation 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: 1 **7 Hours**

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.

Unit: 2 **7 Hours**

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.

Unit: 3 **7 Hours**

Pacemakers, Defibrillators, Biotelemetry, bedside monitors, ICU, Heart Lang machine, Phonocardio graph, plentysmograph, Artificial Kidney, Blood cell counters.

Unit: 4 **7 Hours**

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.

Unit: 5 **7 Hours**

Imaging system: X-ray, CT Scan, Ultrasonography, MRI, Endoscopy.

Electrical safety: Significance of electrical danger, Physiological effects of electrical current, Ground shock hazard, and methods of accident prevention.

Reference Books:

1. Handbook of Biomedical instrumentation, "R S Khandpur", TMH
2. Biomedical instrumentation and measurement, "Cromwell", PHI
3. Introduction to Biomedical instrumentation, "S G Khalekar".
4. Handbook of Biomedical instrumentation, "Webster".

BTIEOE705A Analytical Instrumentation 3 Credits

Course Education Objectives (CEOs)

Upon completion of this course, student should be able to:

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 Outcomes (COs):

Students should be able to

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: 1 **7 Hours**

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.

Unit: 2 Security System: **7 Hours**

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

Unit: 3 Introduction: **7 Hours**

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.

Unit: 4 Processes: **7 Hours**

Mass spectrometr: basic mass spectrometer components, types, magnetic 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.

Unit: 5 Control Panel: **7 Hours**

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.

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.

BTIEOE705B Adaptive Control System 3 Credits

Course Education Objectives (CEOs)
Upon completion of this course, student should be able to:

Applications of adaptive controls are growing in practical and industrial control systems. The objective of this course is to present an overview of theoretical and practical aspects of adaptive control. The theory of adaptive control techniques and related issues are covered in detail.

Course Outcomes (COs):

After completion of subject students will be able to:

1. Design and implement system identification experiments.
2. Use input-output experimental data for identification of mathematical dynamical models.
3. Use system identification methods to design adaptive controllers.
4. Explain the advantages and disadvantages of adaptive control relative to other control approaches**.**

Unit: 1 Introduction: 7 Hours

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?

Unit: 2 Model Reference Adaptive System: 7 Hours

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

Unit: 3 Analysis and Design of Model Reference Adaptive Systems: 7 Hours

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

Unit: 4 Self-Tuning Regulators: 7 Hours

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.

Unit: 5 Gain Scheduling: 7 Hours

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.

Recommended Books:

1. I. B Landau, Adaptive Control - The Model Reference Approach, New York; Marcel 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

BTIEOE705C Automobile Instrumentation 3 Credits

Course Education Objectives (CEOs):

Upon completion of this course, student should be able to:

1. Know the fundamentals of automotive electronics
2. Understand automotive control systems
3. Know basics of safety factors in automobile.

Course Outcomes (COs):

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: 1 Fundamentals of Automotive Electronics: 7 Hours

Open loop and closed loop systems, Components for electronic engine management, vehicle motion control, Current trends in modern Automobiles

Unit: 2 Electronic Fuel Injection and ignition systems: 7 Hours

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,

Unit: 3 Engine control system: 7 Hours

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

Unit: 4 Automobile chassis electronic control system: 7 Hours

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

Unit: 5 Auto Body Electronic Control Technology: 7 Hours

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.

Recommended 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

BTIEL706 Process Instrumentation and Control Lab 1 Credit

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

BTIEL707 Instrumentation System Design Lab 1 Credit

List of Experiments:

1. Design of signal conditioning for displacement measurement transducer..
2. Design of signal conditioning RTD (Pt-100)
3. Design of signal conditioning for thermocouple
4. Study and Calibration of I/P & P/I converter
5. Study of D.P. Transmitter and its application for flow
6. Study of D.P. Transmitter and its application for level
7. Study of smart transmitter
8. Design of signal conditioning for strain gauge.
9. Study of Enclosure design for circuit and instrument.

BTIEL708A Image Processing Lab 1 Credit

List of Experiments:

1. Study of IP Toolbox in Matlab
2. Perform Arithmetic & Logical operations on Image
3. To study application of Histogram Equalization for image contrast improvement
4. To study application of Edge detection in IP for image identification
5. Application of FFT to perform operations on image like Convolution, Translation.
6. Application of FFT to perform operations on image like Rotation.
7. To Study application of Transform, Filtering by applying LPF & Mask for smooth imaging.
8. To Study application of Transform, Filtering by applying HPF & Mask for Image shaping

BTIEL708B Internet of Things Lab 1 Credit

List of Experiments:

1. Study of Raspberry-Pi, Beagle board, Arduino and other micro controller.
2. Study of different operating systems for Raspberry-Pi. Understanding the process of OS installation on Raspberry-Pi.
3. Study of Connectivity and configuration of Raspberry-Pi circuit with basic peripherals, LEDS. Understanding GPIO and its use in program.
4. Understanding the connectivity of Raspberry-Pi circuit with temperature sensor. Write an application to read the environment temperature. If temperature crosses a threshold value, the application indicated user using LEDSs.
5. Understanding the connectivity of Raspberry-Pi circuit with IR sensor. Write an application to detect obstacle and notify user using LEDs.
6. Understanding and connectivity of Raspberry-Pi with camera. Write an application to capture and store the image.
7. Study of different CPU frequency governors. Write an application to change CPU frequency of Raspberry-Pi.
8. Write an application using Raspberry-Pi to control the operation of a hardware simulated traffic signal.
9. Write an application using Raspberry-Pi to control the operation of a hardware simulated lift elevator.

BTIEL708C Clinical Instrumentation Lab 1 Credit

List of Experiments:

1. Study of different biomedical transducers.
2. Study of cardiovascular systems
3. Study of ECG machine
4. Study of EEG simulator.
5. Study of EMG simulator.
6. Study of blood sugar meter.
7. Measurement of heartbeats using heart beat monitor.
8. Measurement of lung capacity using spirometer.
9. Demonstration of defibrillator.
10. Measurement of blood pressure by indirect method.
11. Electrical safety measures in hospitals.

BTIES709	Seminar	1 Credit

Student shall choose a topic of his/her interest in consultation with faculty in the department. The topic for seminar may be related to Recent Developments in Instrumentation Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary information and present a summary indicating comprehension of the topic and acquired depth of knowledge. A brief report on topic of seminar shall be submitted. Evaluation shall be based on report and power point presentation.

BTIEP710	Project Stage I	3 Credits

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.

BTIEF711	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.

BTIEPE801A Control Engineering 3 Credits

Prof. Ramkrishna Pasumarthy Department of Electrical Engineering IIT Madras

Course Duration: 12 week

Course Outline:

This course shall introduce the fundamentals of modeling and control of linear time invariant systems; primarily from the classical viewpoint of Laplace transforms and a brief emphasis on the state space formulation as well. The course will be useful for students from major streams of engineering to build foundations of time/frequency analysis of systems as well as the feedback control of such systems. The 11th module of the course will cover a detailed application of filter design in the field of navigation and human movement (gait). Students will be able to design their very own basic navigational system using inertial sensors and microcontrollers.

Course Plan:

Week 1: Mathematical Modelling of Systems
Week 2: Laplace Transforms, transfer functions, block diagram representation.
Week 3: Block diagram reduction, Time response characteristics.
Week 4: Introduction to stability, Routh Hurwitz stability criterion.
Week 5: Root locus plots, stability margins.
Week 6: Frequency response analysis: Nyquist stability criterion, Bode plots and stability margins in frequency domain.
Week 7: Basics of control design, the proportional, derivative and integral actions.
Week 8: Design using Root Locus
Week 9: Design using Bode plots
Week 10: Effects of zeros, minimum and non-minimum phase systems.
Week 11: State space analysis
Week 12: Design using State space

BTIEPE801B The Joy of Computing using Python 3 Credits

Prof. Sudarshan Iyengar and Prof. Yayati Gupta IIT Ropar

Course Duration: 12 week

Course Outline:
A fun filled whirlwind tour of 30 hrs, covering everything you need to know to fall in love with the most sought after skill of the 21st century. The course brings programming to your desk with anecdotes, analogies and illustrious examples. Turning abstractions to insights and engineering to art, the course focuses primarily to inspire the learner's mind to think logically and arrive at a solution programmatically. As part of the course, you will be learning how to practice and culture the art of programming with Python as a language. At the end of the course, we introduce some of the current advances in computing to motivate the enthusiastic learner to pursue further directions.

Course Plan:
- Motivation for Computing
- Welcome to Programming
- Variables and Expressions : Design your own calculator
- Loops and Conditionals : Hopscotch once again
- Lists, Tuples and Conditionals : Lets go on a trip
- Abstraction Everywhere : Apps in your phone
- Counting Candies : Crowd to the rescue
- Birthday Paradox : Find your twin
- Google Translate : Speak in any Language
- Currency Converter : Count your foreign trip expenses
- Monte Hall : 3 doors and a twist
- Sorting : Arrange the books
- Searching : Find in seconds
- Substitution Cipher : What's the secret !!
- Sentiment Analysis : Analyse your Facebook data
- 20 questions game : I can read your mind
- Permutations : Jumbled Words
- Spot the similarities : Dobble game
- Count the words : Hundreds, Thousands or Millions.
- Rock, Paper and Scissor : Cheating not allowed !!
- Lie detector : No lies, only TRUTH
- Calculation of the Area : Don't measure.
- Six degrees of separation : Meet your favourites
- Image Processing : Fun with images
- Tic tac toe : Let's play
- Snakes and Ladders : Down the memory lane.
- Recursion : Tower of Hanoi
- Page Rank : How Google Works !!

BTIEPE801C Biomedical Signal Processing 3 Credits

Prof. Sudipta Mukhopadhyay Department of Electronics & Comm. Engg IIT Kharagpur

Course Duration: 12 week

Course Outline:

This course is prepared for the engineering students in their final year of undergraduate studies or in their graduate studies. Electrical Engineering students with a good background in Signals and Systems are prepared to take this course. Students in other engineering disciplines, or in computer science, mathematics, geo physics or physics should also be able to follow this course. While a course in Digital Signal Processing would be useful, it is not necessary for a capable student. The course has followed problem solving approach as engineers are known as problem solvers. The entire course is presented in the form of series of problems and solutions.

Course Plan:

Week 1: Preliminaries; Biomedical signal origin & dynamics (ECG)

Week 2: Biomedical signal origin & dynamics (EEG, EMG etc.)

Week 3: Filtering for Removal of artifacts Statistical Preliminaries; Time domain Filtering (Synchronized Averaging, Moving Average)

Week 4: Filtering for Removal of artifacts contd. Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter)

Week 5: Filtering for Removal of artifacts contd. Optimal Filtering: The Weiner Filter

Week 6: Filtering for Removal of artifacts contd. Adaptive Filtering Selecting Appropriate Filter

Week 7: Event Detection Example events (viz. P, QRS and T wave in ECG) Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection

Week 8: Event Detection contd. Dicrotic Notch Detection Correlation Analysis of EEG Signal

Week 9: Waveform Analysis Illustrations of problem with case studies Morphological Analysis of ECG Correlation coefficient The Minimum phase correspondent and Signal Length

Week 10: Waveform Analysis contd. Envelop Extraction Amplitude demodulation The Envelogram Analysis of activity Root Mean Square value Zero-crossing rate Turns Count, Form factor

Week 11: Frequency-domain Analysis Periodogram

Week 12: Frequency-domain Analysis Averaged Periodogram Blackman-Tukey Spectral Estimator Daniellâ€™s Spectral Estimator Measures derived from PSD.

BTIEPE802A Industrial Automation and Control 3 Credits

Prof. Siddhartha Mukhopadhyay Electrical Engineering IIT Kharagpur

Course Duration: 12 week

Course Outline:

This course provides an overall exposure to the technology of Industrial Automation and Control as widely seen in factories of all types both for discrete and continuous manufacturing. The course, in 40 lectures, discusses a wide range of related topics from the advantage and architecture of automation systems, measurement systems including sensors and signal conditioning, discrete and continuous variable control systems, hydraulic, pneumatic and electric actuators, industrial communication and embedded computing and CNC Machines. A student of IIT Kharagpur once commented - ? because of the course I can identify and relate to much of the equipment that I see in a factory?.

Course Plan:

I. Introduction
Architecture of Industrial Automation Systems
II. Measurement Systems Characteristics
Data Acquisition Systems
III. Introduction to Automatic Control
P-I-D Control
PID Control Tuning
Feed forward Control Ratio Control
Time Delay Systems and Inverse Response Systems
Special Control Structures
Concluding Lesson on Process Control (Self-study)
Introduction to Sequence Control, PLC, RLL
Sequence Control. Scan Cycle, Simple RLL Programs
Sequence Control. More RLL Elements, RLL Syntax
A Structured Design Approach to Sequence Control
PLC Hardware Environment
IV. Flow Control Valves
Hydraulic Control Systems - I
Hydraulic Control Systems - II
Industrial Hydraulic Circuit
Pneumatic Control Systems - I
Pneumatic Systems – II
Energy Savings with Variable Speed Drives
Introduction To CNC Machines
V. The Field bus Network - I
Higher Level Automation Systems
Course Review and Conclusion (Self-study)

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY, LONERE

BTIEPE802B Sensors and Actuators 3 Credits

Prof. Hardik Jeetendra Pandya **Electronics Systems Engineering** **IISc Bangalore**

Course Duration: 12 week

Course Outline:

This course is designed with an aim of educating students in microtechnology and its use to fabricate sensors and systems. The students will have an exposure to sensors and its importance in the real world. The students will also able to understand how to fabricate some of those sensors. Students will have an exposure towards how to fabricate the sensors and its application in real world. The students will provide an understanding on modern day microsensors and micro actuators. The students will have an idea about how to simulate some of those sensors and characterise before fabricating it. Below are some of the course objectives. The first objective of this course is to understand basics of sensors, actuators and their operating principle. The second objective is to educate the students on different types of microfabrication techniques for designing and developing sensors (Several applications from Electronics to Biomedical will be covered). The third objective is to explain working of various types of electrochemical sensors and actuators. Fourth objective is to provide information about interfacing of sensors and signal conditioning circuits to establish any control system or monitoring system. Fifth objective is to provide knowledge about simulation and characterization of different sensors. The final objective is to provide an understanding on characteristic parameters to evaluate sensor performance

Course Plan:

Week 1: Basics of Energy Transformation: Transducers, Sensors and Actuators

Week 2: Understanding of thin film physics: Application in MOSFET and its variants

Week 3: Thin Film Deposition Techniques: Chemical Vapor Deposition (APCVD, LPCVD, UHVCVD, PECVD, ALCVD, HPCVD, MOCVD)

Week 4: Thin Film Deposition Techniques: Physical Vapor Deposition (Thermal Deposition, E-beam Evaporation, Sputtering, Pulsed Laser Deposition)

Week 5: Basic understanding of Photolithography for pattering layer. Detailed overview of Etching methods.

Week 6: Understanding various gas sensors: Optical gas sensor, Metal oxide semiconductor gas sensor, Field effect transistor gas sensor, Piezoelectric gas sensor, Polymer gas sensor, Nano-structured ba sed gas sensors

Week 7: Design and fabrication process of Microsensors: Force Sensors, Pressure Sensors, Strain gauges and practical applications

Week 8: Explain working principles of Actuators. Piezoelectric and Piezoresistive actuators, micropumps and micro actuators with practical applications

Week 9: Understanding basics of microfluidics to assist Photomask design using Clewin Software, pattern transfer techniques, PDMS moulding and degassing, device bonding techniques.

Week 10: Simulation, Optimization and characterization of various sensors using COMSOL Multiphysics

Week 11: Understanding of Sensor Interfacing with Microprocessor to build electronic system

Week 12: Static and Dynamic Characteristic Parameters for Sensors and Actuators, Calibration of Sensor based electronics systems.

BTIEPE802C Fuzzy Sets, Logic, Systems & Applications 3 Credits

Prof. Nischal K. Verma **Electrical Engineering** **IIT Kanpur**

Course Duration: 12 week

Course Outline:
The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future should get these concepts.

Course Plan:

Week 1: Introduction and Fuzzy Sets Theory

Week 2: Membership Functions

Week 3: Set Theoretic Operations

Week 4: Fuzzy Arithmetic

Week 5: Fuzzy Relations

Week 6: Fuzzy Inference Systems I

Week 7: Fuzzy Inference Systems II

Week 8: Wang and Mendel Model

Week 9: TSK Model

Week 10: Fuzzifiers and Defuzzifiers

Week 11: ANFIS Architecture

Week 12: Fuzzy Systems and Machine Learning

BTIEPE802D Optical Engineering 3 Credits

Prof. Shanti Bhattacharya **Electrical and Electronics Engineering** **IIT Madras**

Course Duration: 12 week

Course Outline:

Optics is used in many applications today. In fact, the field of optics has quietly gone from the research table to being used in numerous applications ranging from devices to metrology. Opto-electronics and metrology are already well-developed fields merging the areas of optics and a variety of other engineering areas (such as electronics, mechanical engineering, etc) in many advanced and commonly used devices. For an engineering student to be able to understand and design optics for such applications, it is important to understand some basic optics. This course will introduce these concepts at a level relevant for an engineer. The course will also study specific engineering examples with a detailed look at the optics of these.

Course Plan:

Week 1: Introduction to Optical Engineering Postulates of Geometric Optics, Geometric Optics and Imaging, Refraction at a single surface

Week 2: Thin lens, Lens imaging conditions, Aperture stop, pupils, important rays

Week 3: Ray tracing using matrix method, Thick lenses, principal planes

Week 4: Monochromatic Aberrations, means of quantifying aberrations

Week 5: Chromatic Aberrations, correcting aberrations

Week 6: Gaussian beams, transmittance of an optical element

Week 7: Gaussian beam transformation through a lens

Week 8: Basics of Interference

Week 9: Applications of Interference, holography

Week 10: Basics of diffraction

Week 11: Applications - Barcode readers, Finger print sensors, Pick-up heads used in DVD/CD players, Biomedical instrumentation, Interferometers for metrology (Optical coherence tomography), Sensors

Week 12: Applications contd.

BTIEP803 Project Stage II 15 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.