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

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COURSE STRUCTURE AND SYLLABUS

For

Final Year B. Tech.
Electrical and Instrumentation Engineering

With effect from the Academic Year

2020-2021(Final Year)

PROGRAM EDUCATIONAL OBJECTIVES. (PEOs)

The Board of Studies in Electrical and 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.

B.Tech (Electrical and 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.	BTEIEC701	PCC1	Process Instrumentation	3	-	0	20	20	60	100	3
02.	BTEIEC702	PCC2	Instrumentation System Design	3	-	0	20	20	60	100	3
03.	BTEIEC703	PCC3	High Voltage Engineering	3	-	0	20	20	60	100	3
04.	BTEIEPE704	PEC1 (Elective-VII)	PEC1: A. Electrical Power Quality B. Internet of things C. Optical Instrumentation	3	0	0	20	20	60	100	3
05	BTEIEOE705	OEC1 (Elective-VIII)	OEC1: A. Automobile Instrumentation B. Electromagnetic Field Theory C. Flexible AC Transmission System	3	-	0	20	20	60	100	3
06.	BTEIEL706	Lab	Process Instrumentation Lab	0	0	2	-	30	20	50	1
07.	BTEIEL707	Lab	Instrumentation System Design Lab	0	0	2	-	30	20	50	1
08.	BTEIEL708	Lab	High Voltage Engineering Lab	0	0	2	-	30	20	50	1
09.	BTEIES709	Seminar	Seminar	0	0	2	-	30	20	50	1
10.	BTEIEP710	Project	Project Part-I	0	0	6	-	30	20	50	3
11.	BTEIEF711	-	Industrial Training	-	-	-	-		50	50	1
			Total	15	0	14	100	250	450	800	23

B. Tech (Electrical and 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. Analog Circuits And Systems Through SPICE Simulation 2. Fuzzy Sets, Logic and Systems and Applications 3. Control Engineering 4. DC Power Transmission Systems 5. The Joy of Computing using Python 6. Biomedical Signal Processing 7. Sensors and Actuators *# Student to opt any two subjects from above list*			3	-	-	20*	20*	60*	100	3
			3	-	-	20*	20*	60*	100	3
BTEIEP803	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.	Analog Circuits And Systems Through SPICE Simulation	12 Week	IIT Kharagpur	Prof. Mrigank Sharad
2.	Fuzzy Sets, Logic and Systems and Applications	12 Week	IIT Kanpur	Prof. Nischal K. Verma
3.	Control Engineering	12 Week	IIT Madras	Prof. Ramkrishna Pasumarthy
4.	DC Power Transmission Systems	12 Week	IIT Madras	Prof. Krishna S.
5.	The Joy of Computing using Python	12 Week	IIT Ropar	Prof.Sudarshan Iyengar Prof. Yayati Gupta
6.	Biomedical Signal Processing	12 Week	IIT Kharagpur	Prof. Sudipta Mukhopadhyay
7.	Sensors and Actuators	12 Week	IISc Bangalore	Pro. Hardik Jeetendra Pandya

Semester VII

BTEIEC701 PROCESSINSTRUMENTATION 3Credits

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: Digital Control Method and Instrumentation schemes **10 Hours**

Overview of process Control System loop components, Block diagram, Concept and need of Advanced Process Instrumentation. Process Variables & degree of freedom. Digital control methods - Direct Digital Control, Supervisory computer control, Interactive multivariable control system, Alarm & alarm management system. Instrumentation schemes - Operation, controlled and manipulated variables, feedback, and feed forward, cascade control strategies for heat exchanger, dryers and crystallizers.

Unit 2: Distillation Column Control **7Hours**

Operation of distillation column, Feed forward Systems, Flow Control of Distillate and Bottoms, Reflux control, Composition Control, Pressure and Temperature Controls. Constant and maximum recovery methods, distillate optimization, Multiproduct control, distillation control using neural control

Unit 3:Boiler Instrumentation **7Hours**

Operation of boiler manipulated and controlled variables in boiler control. Safety interlocks and burner management system, instrumentation for boiler pressure control, air to fuel ratio control, boiler drum level control, steam temperature control, optimization of boiler efficiency.

Unit 4: Instrumentation for Pumps and Compressors **7 Hours**

Types and operation of pumps, manipulated and controlled variables in pump control, pump control methods and instrumentation for pump control, types and operation of compressors, capacity control method of compressors, instrumentation for control of different variables in centrifugal, rotary and reciprocating compressor including surge and anti-surge control.

Unit 5: Process Safety & Safety management Systems: 7 Hours

Introduction to process safety, risk, risk terminologies, consequence and risk, risk measurement, Process Hazard Analysis (PHA), Hazard and operability study (HaZOp), Safety Integrity Level (SIL), Introduction to IEC61 511 standard for Functional safety, protection layers, Safety Instrumented System: function, architecture, safety life cycle, Application of safety system.

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.marlin
9. Analog and Digital control – RamakantGaikwad.
10. Distributed computer control for industrial automation, Ppovik Bhatkar, DekkarPub.

BTEIEC702 Instrumentation System Design 3 Credit

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 likeliquid, gas, vapour and flashing fluids.
2. Control room and Control Paneldetails
3. The process of Electronic productdesign

Course Outcomes (COs):

1. Design and Analyse CVSizing
2. Identify various Control panels and Control Roomdetails
3. Design of Electronicproduct.
4. Understand Signal Conditioning forTransducers.

Unit 1:Introduction **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.

Unit2. Design **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. Reliability **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.Grounding and safety **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.

Unit5. PCB Design **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

BTEIEC703 High Voltage Engineering 3 Credit

Course Objectives:

1. To study conduction and breakdown in gases, liquids and solids.
2. To understand the methods and measurement of high voltage generation and measurement
3. To explain the lightening phenomenon and insulation co-ordination.
4. To know different non-destructive testing and standards in HV.

Course Outcomes:

1. Illustrate the concept of electric field stresses, applications of insulating materials and methods for Non-destructive testing of equipment like transformers, insulators, isolators, bushings, lightning arrestors, cables, circuit breakers and surge diverters.
2. Explain the breakdown process in solid, liquid, and gaseous materials
3. Analyze methods for generation and measurement of High Voltages and Currents (both ac and dc)
4. Describe the phenomenon of over-voltage and choose appropriate insulation co-ordination levels based on IS & IEC Standards.

UNIT I: INTRODUCTION TO HIGH VOLTAGE ENGINEERING 02 Hours

Electric Field Stresses,Poisson's equation, Estimation and Control of Electric Stress, Surge Voltages, their distribution and control.

UNIT II:CONDUCTION & BREAKDOWN IN GASES: 06 Hours

Gases as insulation media, ionization processes, Townsend's current growth equation, current growth in presence of secondary processes, Townsend's criterion for breakdown in electronegative gases, time lags for breakdown, Streamers theory, Paschen's law, breakdown in non-uniform fields and corona discharge, corona under positive & negative polarities, glow & arc discharge, considerations in using gases for insulation purpose.

UNIT III: BREAKDOWN IN DIELECTRIC MATERIALS: 08 Hours

Conduction & breakdown in liquid dielectrics: Pure and commercial liquids, breakdown in pure and commercial liquids, theories of breakdown in liquids. Breakdown in solid dielectrics: Intrinsic, electromechanical& thermal breakdown, chemical, electrochemical deterioration, treeing, tracking, internal discharges, breakdown in composite insulation, properties of solid insulators & other materials used in practice. Insulating materials: In power transformers, rotating machines, circuit breakers, cables, power capacitors & other equipment.

UNIT IV: OVER VOLTAGE DUE TO LIGHTENING PHENOMENON: 08 Hours

Natural causes for over voltages – Lightning phenomenon, Overvoltage due to switching surges, system faults and other abnormal conditions, propagation of lightning voltage & current waves on transmission lines, reflection & transmission of traveling wave at junction, system control of over voltage due to switching protection of transmission lines against over voltage. Insulation co-ordination, surge diverters, equipment insulation level & co-ordination of substations.

UNIT V:GENERATION & MEASUREMENT OF HIGH VOLTAGES & CURRENTS: 10 Hours

Generation of a) high d. c voltage b) power frequency high alternating voltage c) high frequency a. c. d) impulse voltages Standard impulse waves shapes and it's equation, multistage impulse generator, matrix circuit, generation of switching surges, tripping & control of impulse generators, generation of impulse currents.

Measurement of High Direct Current voltages, Abraham Voltmeter Measurement of High Voltages alternating and impulse, Measurement of High Currents-direct, alternating and Impulse, Oscilloscope for impulse voltage and current measurements

UNIT VI:NON DESTRUCTIVE TESTING: 06 Hours

I.E.C. & IS codes for high voltage tests on electrical appliances & power apparatus &electrical motors, non-destructive testing, testing of insulators, bushings, isolators, circuit breakers, cables, transformers, surge diverter, layout of high voltage laboratories & test facilities.

Reference Books:

1) High Voltage Engineering: Fundamentals by E.Kuffel, W.S.Zaengl, J.Kuffel by Elsevier, 2nd Edition
2) High Voltage Insulation Engineering by Ravindra Arora, Wolfgang Mosch, New Age International (P) Limited, 1995.
3) High Voltage Engineering, Theory and Practice by Mazen Abdel Salam, Hussein Anis, Ahdan El-Morshedy, RoshdyRadwan, Marcel Dekker

Text Books:

1. Kamaraju V. & Naidu M. S., 'High Voltage Engineering', Tata-McGraw Hill
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Pvt. Ltd

BTEIEPE704A Electrical Power Quality 3Credits

Course Objectives:

1. To study the various power quality issues, their production, monitoring and mitigation.
2. To study the various power quality standards.
3. To study various power quality monitoring methods.
4. To apply appropriate solution techniques for power quality Problems.

Course Outcome:

After Completion of this Course….

1. Student will be able to get the in-depth understanding of power quality issues & standards.
2. Students will be able to understand working of power quality improving Equipment.

UNIT I: INTRODUCTION **07 Hours**

Understanding Power quality, definitions, growing concerns to Power Quality, Evaluation Procedure,General Classes of Power Quality disturbances, causes and effects of Power Quality disturbances

UNIT II: TRANSIENT OVER VOLTAGES **07 Hours**

Sources, causes and effects, Principle of Overvoltage protection and solutions. VoltageSag and Interruptions: causes and effects, estimation of voltage sag performance, principle ofprotection and solutions.

UNIT III: LONG-DURATION VOLTAGE VARIATIONS **07 Hours**

Long Duration Voltage variations, principles of regulating voltage Devices for voltage regulation, flickers, flicker sources and mitigation, quantifying flicker.

UNIT IV: FUNDAMENTALS OF HARMONICS **07 Hours**

Harmonic distortion, sources of harmonics, effects of harmonic distortion, Voltage Vs Current Harmonics,Active, Reactive, Volt-Amp power under non sinusoidal conditions, Harmonic Indices (THD and TDD),principles of harmonic control, mitigating devices, interharmonics, IEEE standard 519.

UNIT V: WIRING AND GROUNDING **04 Hours**

Reasons for Grounding, wiring and grounding problems and solutions

UNIT VI: POWER QUALITY MONITORING **07 Hours**

Monitoring Considerations, site survey, Monitoring Quality, monitoring location, PQ measuringinstruments, assessment of power quality measurement data, IEEE 1159 Standard. Impact of poor power quality on Reliability Indices.

References/Books:

1.Chattopadhyay, Surajit, Mitra, Electric Power Quality, Springer.
2.Haytt G. T., ―Electric Power Quality‖, Stars In Circle Publication.
3. NPTEL courses

a) NOC:Power Quality Improvement Technique, IIT Roorkee by Avik Bhattacharyya.
b) Power Quality in Power Distribution Systems, IIT Madras by Dr. Mahesh Kumar.

BTEIEPE704B	Internet Of Things	3Credits

Course Education Objectives (CEOs)

1. To explore to the interconnection and integration of the physical worldand 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 termsof layers, protocols, packets peer to peer communication
2. Learner will be able to interpret IOT working at transport layer with the help ofvarious 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 internetconnected devices.
5. Learner will be able to measure and schedule the performance of networked devicesin 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 suitefor 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 and Communication Protocols in IOT 7 Hours

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,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, IoTPrinter.

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. 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,WillyPublications.
3. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, WillyPublications.
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, WillyPublications.
7. Bernd Scholz-Reiter, Florian Michahelles, ―Architecting the Internet of Things‖, ISBN 978-3-642- 19156-5 e-ISBN 978-3-642-19157-2,Springer.

BTEIEPE704C OPTICAL INSTRUMENTATION 3Credits

Course Objectives:

To introduce the basic concepts of Optical Fibers and Lasers and their applications in the field of Instrumentation.

Course Outcomes:

- Use Optical fibers for measurement
- Apply LASER in Instrumentation and Biomedical applications.

Unit 1: Optoelectronic Fundamentals 6 Hours

Light and Elements of solid-state physics nature of light, wave nature of light, light sources black body radiation, units of light Energy bands in solids, semiconductor types, works function, functions.

Unit 2: Display Devices 8Hours

Luminescence and the light emitting diode, Radiative recombination processes, LED materials, Commercial LED materials, LED construction, response time of LEDs, LED drive circuitry plasma display liquid crystal displays. LASERS: Emission population inversion, optical feedback classes of laser, doped insulator lasers. Semiconductor lasers, gas lasers, liquid dye lasers, laser applications, measurement of distance holography. Optical Fibers: Classification of optical fiber, principle of light transmission through a fiber, fabrication of optical fibers, material consideration loss and band width limiting mechanism, perform fabrication techniques, fiber drawing, fiber optic communication system.

Unit 3: Optical Fiber Sensors 7 Hours

Fiber optic sensors, intensity modulated sensors, microbend strain intensity modulated sensor, liquid level types hybrid sensor, internal effect intensity modulated sensor, phase sensor, diffraction grating sensors, sensors using single mode fiber, interferometric temperature sensor, distributed fiber optic sensors, polarization problem in interferometric sensors using single mode fiber. Medical applications of fiber sensors, Fabry-Perot fiber optic sensors, Electric field and voltage sensors, Chemical fiber optic gyroscopes, magnetic field and current fiber sensor, military and aerospace applications, important applications of integrated optic fiber technology, Local areanetworks.

Unit 4: Optical Fiber Sensor Applications 7 Hours

Special applications, ADM, video link, satellite link, computer link, nuclear reactor link, digital transmission in optical fiber networks, video compression, N.A. measurement, working of OTDR, microprocessor based OTDR, applications of OTDR, dispersion measurements, Bit Error Rate

(BER) measurement, attenuation measurement using OTDR, cutoff wavelength measurement, microbending loss.

Unit 5: Laser Gyroscopes and Holography 7Hours

The Signac effect, Basic gyro configurations. Ring Laser Gyros (RLG): Dithered RLG, Ring Zeeman laser gyro, performance of RLG. Fiber Optics Gyros (FOG): Open loop FOG, Requirements on FOG components, technology to implement FOG, Closed loop FOG, the resonant FOG MEMS gyro, Piezoelectric gyro. The basic principles of Holography, viewing a hologram, volume hologram, multiplex hologram, white light reflection hologram. Measurement of strain, stress, bending moments and vibration by Holography, nondestructive testing, medical and dental research, solid mechanics.

Text/Reference Books

1. Semiconductor Optoelctronic Devices, Second Edtion, Pallab Bhattacharya, Pearson Education, New Delhi,2002.
2. Opto Electronics – An Introduction J. Wilson J.F.B.Hawkes, Prentice Hall of India New Delhi1996.
3. Optical fiber communications Principals and Practice J. M. Senior Prentice Hall of India, second Edition, 1996.
4. Fiber optics – communication and other application H. Zanger and C. Zanger McGrawPublication.Optical Fiber Communication, Gerd Keiser.
5. Chai Yeh, ―Handbook of fibre optics‖(1990).
6. Ghatak A K and Thyagrajan, India, ―Laser theory and applications‖, Macmillan(1988).
7. Sawhney A K, ―A course in Electrical and Electronics Measurement Instrumentation‖, Dhanpat Rai and Sons, New Delhi(1993).
8. Silvano D. ―Electro optical Instrumentation: Sensing and measuring with LASER‖, PHI, New Delhi (2004).

BTEIEOE705A AUTOMOBILE INSTRUMENTATION 3Credits

Course Education Objectives (CEOs):

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

1. Know the fundamentals of automotiveelectronics
2. Understand automotive controlsystems
3. Know basics of safety factors inautomobile.

Course Outcomes (COs):

1. Ability to understand electronic controlunit.
2. Acquire knowledge of various automotive standards andProtocols.
3. Design aspects of measurement and control strategies in automotiveapplication

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 7Hours

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.

Unit5: AutoBody Electronic Control Technology and Ergonomics 10 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: Driver information system, lighting system components, battery monitoring and control, Air conditioning, steering control techniques, Automatic gear control systems, Emission standards.

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‖ 1stEdition
   , Wiley
4. T. Mellard, Automotive Electronic Systems‖1987 by HeinenmannProfessional.

BTEIEOE705B ELECTROMAGNETIC FIELD THEORY 3 Credits

Course Education Objectives (CEOs):

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

Electromagnetic field theory is the subject of great research, academic and industrial importance and has a large number of applications. The objectives to understand basic concepts of static electric field and its associated quantities, Know the boundary condition particularly a boundary between conducting material and free space. The course also deals with significance of moving charges, force between two current carrying conductors, time varying field and radiation and antennas

Course Outcomes (COs):

1. To apply the basic concept of mathematics and laws of electromagnetism to solve the complex engineering problem.
2. To obtain the electric and magnetic fields for simple configurations under static conditions
3. To analyze the different conditions of conductors, dielectrics and capacitance
4. To analyze static magnetic fields
5. To analyze time varying electric and magnetic fields and apply Maxwell‟s equation in different form

Unit 1: Vector Analysis 7Hours

Introduction, co-ordinate–system transformation, vector calculus, Divergence of vector and Divergence theorem, curl of a vector and Stokes theorem, Laplacian of a scalar, classification of vector fields.

Unit2: Electrostatics 7Hours

Coulomb‘s law, Electric field strength, field due to a line charge, sheet charge and volume charge. Electric

flux-density, Gauss‘s law (Maxwell‘s first equation in electrostatics), applications of Gauss‘s law. Electric Potential and potential difference, Potential of a point charge and system of charges, Conservative property, potential gradient, dipole. Energy density in electrostatic field.

Unit3: Magnetostatics 7Hours

Biot-Savart‘s law- magnetic field due to filamentary current, distributed current surface and volume currents. Ampere‘s circuital law, Scalar and vector magnetic potentials. Maxwell‘s equations for steady magnetic fields, force on a current element in a magnetic field. Force between two current elements and torque in a currentloop.

Unit 4: Electromagnetic field 7Hours

Faraday‘s law, Lorentz-force equation, displacement current and modified Ampere‘s circuital law in integral form. Continuity equation. Power flow in electromagnetic field - the Poynting theorem,

sinusoidally time- varying fields and its Maxwell‘s equation. The retarded potentials, polarization of vector fields.

Unit 5: Materials, fields and Electromagnetic waves: 7 Hours

Current and current density. Conductors in fields- drift velocity, mobility, conductivity. Dielectrics in fields- polarization, flux-density, electric susceptibility, relative permittivity. Magnetic materials, magnetization, permeability and magnetic boundary conditions. Electromagnetic waves - Helmontz equation, radiation of electromagnetic waves. Wave motion in free space, perfect dielectric, lossy dielectric, propagation in good conductors-skin effect. Reflection and refraction, Guided EMwaves.

Text/Reference Books

1. J. Griffiths, _Introduction to Electrodynamics‘, Addison Wesley,1999.
2. K. Cheng, _Field and Wave Electromagnetics‘, Addison Wesley,1999.
3. W. H. Hayt, _Engineering Electromagnetic‘, Fifth Edition. TMH,1999.
4. N. N. Rao, _Elements of Engineering Electromagnetics‘, Pearson Education, Inc,2004.
5. Mathew N.O. Sadiku,Elements of Electromagnetics, Oxford UnivPress.
6. N.N. Rao, Basic electromagnetic and applications, McGrawHill.

BTEIEOE705C FLEXIBLE AC TRANSMISSION SYSTEM 3 Credits

Course Objectives:

This course objectives to study power transmission by EHV AC and FACTS. Enhancement of controllability, stability and power transfer capability of AC transmission system. Study different FACTS component and power qualityissues.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Apply basic knowledge power electronic for enhancing power transfer capability of AC transmissionsystem.
2. Understand FACTS, concepts its location in transmissionnetwork.
3. Analyze the characteristics FACTS controller and able to solve engineering problems.
4. Understand the sources of harmonics and itsmitigation.
5. Discharging duties as power system engineer in technical and professionalway.
6. Do higher studies in stability with modern tools for increasingly complex interconnected power system.

Unit 1: Transmission Interconnection 7 Hours

Flow of power in the AC system, factors affecting loading capability, power flow and dynamic stability consideration of a Transmission interconnection, Description and application of HVDC transmission, DC System components and their functions, Converter configuration, Principles of DC Link control and Converter control characteristics, Firing angle, Current and extinction angle control, DC link power control

Unit 2: Flexible AC Transmission 7 Hours

Benefits of FACTS, Basic Realities & Roles, Types of FACTS Controller, Principles of Series and Shunt Compensation. Introduction to Voltage source and Current source converter. Shunt compensation (SVC): Objectives of shunt compensation, Midpoint voltage regulation for long transmission line, voltage instability prevention, improvement of transient stability

Unit 3: Reactive power control and VAR sources 7 Hours

Reactive power control and VAR sources Methods of controllable VAR generation, Description of Static VAR Compensators (SVC), Variable impedance type VAR generators. Thyristor controlled reactor (TCR), Thyristor Switched Capacitor (TSC), TSC-TCR, Fixed capacitor TCR (FC-TCR). Shuntcompensation

Unit 4: 7Hours

Variable impedance type series compensator, Thyristor Switches Series Capacitor (TSSC), Thyristor Controlled Series Compensators (TCSC). Switching Converter type Series Compensator Introduction to interline power flow controller, Special purpose FACTS controllers, Thyristor controlled voltage limiter and voltage regulator, Thyristor controlled braking resistor and current limiter.

Unit 5: STATCOM and SynchronousSeriesCompensator 7 Hours

Switching type VAR generator, Static Synchronous Compensator (STATCOM), Basic operating principle, Configuration. Basic control approach, Comparison between SVC and STATCOM. Series Compensator: Objectives of series compensation, improvement of transient stability. Synchronous Series Compensator: (SSSC) and Controller for SSSC, Basic configuration and working of Unified Power Flow Controller (UPFC). Unified Power Flow Controller, Circuit Arrangement, Basic Principle of P and Q Control, independent real and reactive power flow control, Applications GCSC, TSSC, TCSC &SSSC.

Text Books/ Reference Books

1. N.G Hingorani, L. Gyugyi, ―Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems‖, IEEE Press Book, Standard Publishers and Distributors, Delhi,2001.
2. Padiyar K.R., ―HVDC Power Transmission System‖, Wiely Eastern PVTLimited.
3. Thyristor Based FACTS Controllers for Electrical Transmission System, R.M. Mathur, and R. K.Verma
4. FACTS: Controller in Power Transmission & Distribution, K. R. Padiyar, New AgeInternational.
5. HVDC and F ACTS controllers, Application of Static converter in Power System, V.K. Sood New AgeInternational
6. E.W. Kimbark ―Direct Current transmission‖, Vol.1, John Wielly, NewYork.
7. J.E Miller, ―Reactive Power Control in Electric Systems‖, John Wiley &Sons

BTEIEL706	Process Instrumentation Lab	1 Credit

1 Study of feedback and feed forward system.

2 Study of safety management system.

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 heat exchanger control loop.

9 Study of Split range control

BTEIEL707 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.

BTEIEL708 High Voltage Engineering Lab 1 Credit

List of Experiment

1. Study of Faraday Cage for HV labs.
2. Study of Standard HV Laboratory layouts.
3. One min. (1-min.) DC high voltage withstand test on Equipment. (Max. up to 10 KV).
4. Effect of gap length on liquid insulating material.
5. Breakdown Strength of composite dielectric material.
6. Study of impulse generator.
7. High voltage withstand test on cables/safety gloves/shoes, as per IS. (Max. 2.25 KV DC)
8. Horn gap arrangement as surge diverter.
9. Measurement audible and visible corona inception and extinction voltage
10. Development of tracks and trees on polymeric insulation.
11. Study of Effect of EHV field on Human, Animals & Plants.

BTEIES709	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 Electrical and 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.

BTEIEP710	Project Stage I	3 Credit

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarise 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.

BTEIEF711	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.

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

1. Analog Circuits and Systems Through SPICE Simulation:

Prof. Mrigank Sharad, IIT Kharagpur

Course Duration: 12 Weeks Credits: 3

Course Outline:

This course is supposed to provide a comprehensive design example utilizing (and building upon) the basic concepts covered in a UG Analog circuits course.All the essential circuit fundamentals like DC biasing, small signal analysis, signal swing, linearity, noise, frequency response, single stage, multi stage & differential amplifier topologies, stability & oscillation, Operational amplifier circuits (transistor level), will be applied to a practical design example.

Syllabus:

Week 1: System description & block and circuit level specifications, GUI based SPICE simulations for basic single stage amplifiers

Week 2: Differential amplifier (fully differential and current mirror load), 2-stage OP-AMP (with single ended and fully differential outputs).

Week 3: Feedback amplifiers circuits using OP-AMP, stability & compensations, stability of common mode feedback.

Week 4: Design of common mode feedback for fully differential OP-AMP.

Week 5: Node analysis for frontend amplifier

Week 6: Transistor level design for frontend amplifier with VGA

Week 7: Design of Gm-C filters

Week 8: Single slope ADC specifications and building blocks

Week 9: Comparator design considerations

Week 10: Design and descriptions of digital control.

Week 11: Transistor level implementations of Digital building blocks

Week 12: Dynamic offset cancellation using servo loop.

2. Fuzzy Sets, Logic And Systems & Applications Credits: 3

Prof. Nishchal Kumar Verma, IIT Kanpur

Course Duration: 12 weeks

CourseOutline:

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

3. Control Engineering:

Prof. Ramkrishna Pasumarthy, IIT Madras

Course Duration: 12 Weeks Credits: 3

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.

Syllabus:

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

4. DC Power Transmission Systems:

Prof. Krishna S, IIT Madras

Course Duration: 12 Weeks Credits: 3

Course Outline:

This course gives an introduction to the DC power transmission using the conventional line commutated converters. The topics covered include a detailed analysis of the 6 pulse line commutated converter (LCC), 12 pulse LCC, capacitor commutated converter, DC link control & design of single tuned filter

Syllabus:

Week 1: Introduction, choice of converter configuration

Week 2: Converter configuration for pulse number equal to 6, analysis of 6 pulse LCC neglecting overlap

Week 3: Fourier series, analysis of 6 pulse LCC neglecting overlap

Week 4: 2 and 3 valve conduction mode of 6 pulse LCC

Week 5: Extinction angle, 3 and 4 valve conduction mode and 3 valve conduction mode of 6 pulse LCC

Week 6: Commutation margin angle, normalization, characteristics of 6 pulse LCC, steady state analysis of a general LCC

Week 7: 6 pulse LCC with other circuits on the AC and DC sides

Week 8: Capacitor commutated converter, 12 pulse LCC

Week 9: Mode of operation of 12 pulse LCC, purposes of transformer, applications of DC transmission, types of DC link, DC link control

Week 10: Converter control characteristics, MTDC systems, non-characteristic harmonics

Week 11: Design of single tuned filter

Week 12: Double tuned and damped filters, reactive power requirement, comparison of AC and DC transmission

5. The Joy of Computing using Python:

Prof. Sudarshan Iyengar; Prof. Yayati Gupta, IIT Ropar
Course Duration: 12 Weeks Credits: 3

Course Outline:

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.

Syllabus:

- 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 !!

6. Biomedical Signal Processing:

Prof. Sudipta Mukhopadhyay, IIT Kharagpur

Course Duration: 12 Weeks Credits: 3

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.

Syllabus:

Week 1:Preliminaries, Biomedical signal origin & dynamics (ECG), Biomedical signal origin & dynamics (EEG, EMG etc.)

Week 2:Filtering for Removal of artifacts: Statistical Preliminaries, Time domain filtering (Synchronized Averaging, Moving Average), Time domain filtering (Moving Average Filter to Integration, Derivative-based operator), Frequency Domain Filtering (Notch Filter), Optimal Filtering: The Weiner Filter.

Week 3:Filtering for Removal of artifacts contd.: Optimal Filtering: The Weiner Filter, Adaptive Filtering Selecting Appropriate Filter

Week 4:Event Detection: Example events (viz. P, QRS and T wave in ECG), Derivative based Approaches for QRS Detection Pan Tompkins Algorithm for QRS Detection, Dicrotic Notch Detection Correlation Analysis of EEG Signal

Week 5:**Waveform Analysis:** Illustrations of problem with case studies, Morphological Analysis of ECG, Correlation coefficient, The Minimum phase correspondent.

Week 6:**Waveform Analysis contd.:** Signal length, Envelop Extraction, Amplitude demodulation, The Envelogram, Analysis of activity, Root Mean Square value, Zero-crossing rate, Turns Count, Form factor.

Week 7:**Frequency-domain Analysis:** Periodogram, Averaged Periodogram, Blackman-Tukey Spectral Estimator, Daniell's Spectral Estimator, Measures derived from PSD.

Week 8:**Modelling of Biomedical Systems:** Motor unit firing pattern, Cardiac rhythm, Formants and pitch of speech, Point process, Parametric system modelling, Autoregressive model, Autocorrelation method, Application to random signals, Computation of model parameters,

Levinson-Durbin algorithm, Computation of gain factor, Covariance method, Spectral matching and parameterization, Model order selection, Relation between AR and Cepstral coefficients.

Week 9:**Modelling of Biomedical Systems & Tutorials:** ARMA model, Sequential estimation of poles and zeros, Tutorial 1.1: Notch filter design, Tutorial 1.2: Synchronized averaging, Tutorial 1.3: Design Butterworth low pass filter.

Week 10:**Tutorials:** Tutorial 2.1: Design derivative-based filter, Tutorial 2.2: Design Butterworth high pass filter, Tutorial 2.3: Design Wiener filter, Tutorial 3.1: Implement the Pan-Tompkins method for QRS detection.

Week 11:**Tutorials:** Tutorial 3.2: Use cross-correlation to detect alpha rhythm, Tutorial 3.3: Design a matched filter, Tutorial 3.4: Pan-Tompkins method for QRS detection and the Lehner and Rangayyan method to detect dicrotic notch, Tutorial 4.1: Half wave and full wave rectification, Tutorial 4.2: RMS value calculation, Tutorial 4.3: Turns count calculation, Tutorial 4.4: RMS, Turns count and Zero-crossing rate calculations

Week 12: **Tutorials:** Tutorial 4.5: Derive the Envelogram, Tutorial 4.6: RR interval and Form Factor calculations, Tutorial 5.1: Power spectrum calculations using different windows, Tutorial 5.2: Mean frequency and variance of PSD, Tutorial 5.3: Compute PSDs of Voiced, Unvoiced and Silent portion of sound signal, Tutorial 5.4: Compute mean frequency of PSDs and ratio of energies, Tutorial 5.5: Study the changes in the PSDs by varying window width, number of segments averaged, and type of the window used.

7. Sensors & Actuators:

Prof. Hardik Jeetendra Pandya, IISc Bangalore

Course Duration: 12 Weeks Credits: 3

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.

Syllabus:

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: Basics 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 based 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.

BTEIEP803	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.