Gondwana University, Gadchiroli

Instrumentation Engineering

Choice Based Credit System

VII/VIII Semesters

Syllabus

Board of Studies in Instrumentation Engineering

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AUDIT HEADS:

The students shall be required to qualify in minimum 10(TEN) Audit Heads from the available list. The Students shall be at the liberty to acquire assigned FIVE(05) non-academic Credits by the time he/she appears for the first ESE of VI semester of the Program. The Colleges shall send list of Ten Audit Heads qualified(Q) by the student and their single composite Grade Point(G) by that time. The Audit Heads shall be considered only if undertaken during the tenure of this program, during its first three years. For qualifying, the student has to secure minimum grade point of "5" in TEN different Audit Heads. The Audit Course Credits shall not be counted for calculation of GPA.

The Audit Heads Grade Point shall be shown in the Grade Sheet of VI semester B.E. in all the programs. If the composite Grade Points (G) is not sent from the college side till the above prescribed time, then such student shall be shown "F" (Fail) in the Grade Sheet of VI semester. The College shall send consolidated list of all the students in the Program and their "Composite Grade Point" in respect of Audit Heads qualified by them in the prescribed format "Form-AHCI".

The following Audit Heads shall be available to the students:

A	National Social Service(NSS)	H	National Cadet Corps (NCC)	O	Blood Donation
B	Paper Presentation	I	Quiz Competition	P	Debate Competition
C	Computer/Software/ Campus Recruitment courses (3-5 days)	J	Office Bearer in Departmental or higher Students Body/Professional Society (College level)	Q	Soft skills Development Course (3-5 days)
D	Hardware/Software Competition participation	K	Volunteer in minimum inter collegiate activities	R	Sports Team Participation
E	YOGA/Meditation Training Certificate (Minimum Three Days)	L	Cultural Activity Competition, National , State, District level Essay Competition.	S	Certificate of Noteworthy participation in National event like SWACHCHHA BHARAT ABHIYAAN, TREE PLANTATION
F	Certificate of service to the Home for the Aged/Orphans/Differently enabled (1-3 days)	M	Membership of any registered Non-Government Organization(NGO)	T	Plant/Industrial Visit
G	Certificate of Appreciation by local Civic/District /State/ National level Government Authority/Organizations	N	Certificate of Noteworthy participation in Environment Day/AKSHAY URJA Day or such other programs of national importance/Environmental day, Science day, Engineers Day, Teachers day etc.	U	Participation in 3 to 5 days youth Seminars on Social, Environmental, Wellbeing, Consciousness Programs.

The Audit Heads may be appended/revised/changed from time to time and shall be notified by the University.

Appendix A

GONDWANA UNIVERSITY, GADCHIROLI
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Choice Based Credit System
Third Semester B.E. (Instrumentation Engineering)

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours Per Week			Number of Credits	THEORY						PRACTICAL			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min . Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min . Passing Marks
								MSE	IE						
3BEIE01	Engineering Mathematics-III	3	1	0	4	3	80	10	10	100	40	--	--	--	--
3BEIE02	Electronic Devices & Circuits	4	0	0	4	3	80	10	10	100	40	--	--	--	--
3BEIE03	Network Theory	3	1	0	4	3	80	10	10	100	40	--	--	--	--
3BEIE04	Sensors & Transducers	4	0	0	4	3	80	10	10	100	40	--	--	--	--
3BEIE05	Electronic Measurements	4	0	0	4	3	80	10	10	100	40	--	--	--	--
Laboratories															
3BEIE06	Electronic Devices & Circuits	0	0	2	1	--	--	--	--	--	--	25	25	50	25
3BEIE07	Sensors & Transducers	0	0	2	1	--	--	--	--	--	--	25	25	50	25
3BEIE08	Electronic Measurements	0	0	2	1	--	--	--	--	--	--	25	25	50	25
3BEIE09	Programming Practice - I PSpice/OrCAD	0	0	2	1							25	--	25	12
Total		**18**	**2**	**8**	**24**					**500**				**175**	
Semester Total		**28**			**24**	**675**									

Appendix A

GONDWANA UNIVERSITY, GADCHIROLI
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Choice Based Credit System
Fourth Semester B.E. (Instrumentation Engineering)

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours Per Week			Number of Credits	THEORY						PRACTICAL			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min . Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min . Passing Marks
								MSE	IE						
4BEIE01	Communication & Optical Instrumentation	4	0	0	4	3	80	10	10	100	40	--	--	--	--
4BEIE02	Automatic Control Systems	3	1	0	4	3	80	10	10	100	40	--	--	--	--
4BEIE03	Industrial Instrumentation	4	0	0	4	3	80	10	10	100	40	--	--	--	--
4BEIE04	Linear Integrated Circuits	3	1	0	4	3	80	10	10	100	40	--	--	--	--
4BEIE05	Digital Circuits and Fundamentals of Microprocessors	4	0	0	4	3	80	10	10	100	40	--	--	--	--
Laboratories															
4BEIE06	Industrial Instrumentation	0	0	2	1	--	--	--	--	--	--	25	25	50	25
4BEIE07	Linear Integrated Circuits	0	0	2	1	--	--	--	--	--	--	25	25	50	25
4BEIE08	Digital Circuits and Fundamentals of Microprocessors	0	0	2	1	--	--	--	--	--	--	25	25	50	25
4BEIE09	Programming Practice II: MATLAB/SCILAB	0	0	2	1							25	--	25	12
Total		**18**	**2**	**8**	**24**					**500**				**175**	
Semester Total		**28**			**24**	**675**									

Appendix A

GONDWANA UNIVERSITY, GADCHIROLI
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with]]] Choice Based Credit System
Fifth Semester B.E. (Instrumentation Engineering)

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours Per Week			Number of Credits	THEORY						PRACTICAL			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min . Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min . Passing Marks
								MSE	IE						
5BEIE01	Programme Elective (PE) - I *	3	0	0	3	3	80	10	10	100	40	--	--	--	--
5BEIE02	Professional Management & Entrepreneurship Skills	3	0	0	3	3	80	10	10	100	40	--	--	--	--
5BEIE03	Industrial Drives & Control	4	0	0	4	3	80	10	10	100	40	--	--	--	--
5BEIE04	Microcontroller and Interfacing	4	0	0	4	3	80	10	10	100	40	--	--	--	--
5BEIE05	Control System Design	3	1	0	4	3	80	10	10	100	40	--	--	--	--
Laboratories															
5BEIE06	Control System Design	0	0	2	1	--	--	--	--	--	--	25	25	50	25
5BEIE07	Industrial Drives & Control	0	0	2	1	--	--	--	--	--	--	25	25	50	25
5BEIE08	Microcontroller and Interfacing	0	0	2	1	--	--	--	--	--	--	25	25	50	25
5BEIE09	Seminar and Mini- Project	0	0	4	2							50	--	50	25
Total		**17**	**1**	**10**	**23**					**500**				**200**	
Semester Total		**28**			**23**	**700**									

* Any one from the following subjects will be offered by the Dept.:
1. Unit Operation & Power Plant Instrumentation 2. Industrial Data Communication 3. Mechatronics

Industrial Training /Internship/Case Studies:-It is to be completed during the summer vacation after completion of fourth semester and/or winter vacation after the completion of Fifth semester and its planning and allocation should be done during the fourth/ fifth semester and its marks will be awarded in the sixth semester for subject code 6BEIE09 on submission of the certified relevant report at the end of sixth semester.

GONDWANA UNIVERSITY, GADCHIROLI
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Choice Based Credit System
Sixth Semester B.E. (Instrumentation Engineering)

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours Per Week			Number of Credits	THEORY						PRACTICAL			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min . Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min . Passing Marks
								MSE	IE						
6BEIE01	Programme Elective (PE)–II#	3	0	0	3	3	80	10	10	100	40	--	--	--	--
6BEIE02	Biomedical Instrumentation-I	3	0	0	3	3	80	10	10	100	40	--	--	--	--
6BEIE03	Process Automation	3	0	0	3	3	80	10	10	100	40	--	--	--	--
6BEIE04	Control System Components	4	0	0	4	3	80	10	10	100	40	--	--	--	--
6BEIE05	Digital Signal Processing	3	1	0	4	3	80	10	10	100	40	--	--	--	--
Laboratories															
6BEIE06	Biomedical Instrumentation-I	0	0	2	1	--	--	--	--	--	--	25	--	25	12
6BEIE07	Process Automation	0	0	2	1	--	--	--	--	--	--	25	25	50	25
6BEIE08	Digital Signal Processing	0	0	2	1	--	--	--	--	--	--	25	25	50	25
6BEIE09	**# #** Industrial Training /Internship/Case Studies (2 to 4 Weeks)	0	0	0	2							25	25	50	25
Total		**16**	**1**	**6**	**22**					**500**				**175**	
Semester Total		**24**			**22**	**675**									

#Any one from the following subjects will be offered by the Dept.**:**
1. Introduction to Robotics 2. Automotive Instrumentation 3. Smart Sensors

Industrial Training /Internship/Case Studies:-It is to be completed during the summer vacation after completion of fourth semester and/or winter vacation after the completion of Fifth semester and its planning and allocation should be done during the fourth/ fifth semester and its marks will be awarded in the sixth semester for subject code 6BEIE09 on submission of the certified relevant report at the end of sixth semester.

Appendix A

GONDWANA UNIVERSITY, GADCHIROLI
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Choice Based Credit System
Seventh Semester B.E. (Instrumentation Engineering)

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours Per Week			Number of Credits	THEORY						PRACTICAL			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional		Total	Min. Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min . Passing Marks
								MSE	IE						
7BEIE01	Instrumentation System Design	3	1	0	4	3	80	10	10	100	40	--	--	--	--
7BEIE02	Process Control	3	0	0	3	3	80	10	10	100	40	--	--	--	--
7BEIE03	Instrumentation in Agriculture & Food Industries	4	0	0	4	3	80	10	10	100	40	--	--	--	--
7BEIE04	Core Elective-I i) Wireless Sensor Networks ii) Fuzzy Logic& Neural Networks iii) Engineering Optimization iv) Biomedical Instrumentation-II	4	0	0	4	3	80	10	10	100	40	--	--	--	--
Laboratories															
7BEIE05	Instrumentation System Design	0	0	2	1	--	--	--	--	--	--	25	25	50	25
7BEIE06	Process Control	0	0	2	1	--	--	--	--	--	--	25	25	50	25
7BEIE07	Major Project Phase-I	0	0	4	4							50	50	100	50
Total		**14**	**1**	**8**	**21**					**400**				**200**	
Semester Total		**23**			**21**	**600**									

GONDWANA UNIVERSITY, GADCHIROLI
Four Year Degree Course in Engineering and Technology
Course and Examination Scheme with Choice Based Credit System
Eighth Semester B.E. (Instrumentation Engineering)

Subject Code	Subject	Teaching Scheme				Examination Scheme									
		Hours Per Week			Number of Credits	THEORY						PRACTICAL			
		L	T	P		Duration of Paper (Hrs.)	Max. Marks ESE	Max. Marks Sessional MSE	Max. Marks Sessional IE	Total	Min . Passing Marks	Max. Marks TW	Max. Marks POE	Total	Min . Passing Marks
8BEIE01	Analytical and Environmental Instrumentation	4	0	0	4	3	80	10	10	100	40	--	--	--	--
8BEIE02	Project Planning Estimation and Assessment	3	1	0	4	3	80	10	10	100	40	--	--	--	--
8BEIE03	Open Elective (Biomedical Engineering)	4	0	0	4	3	80	10	10	100	40	--	--	--	--
8BEIE04	Core Elective II: i) Building Automation ii) Embedded System for Instrumentation iii)Robotic System and Control	4	0	0	4	3	80	10	10	100	40	--	--	--	--
Laboratories															
8BEIE05	Analytical and Environmental Instrumentation	0	0	2	1	--	--	--	--	--	--	25	25	50	25
8BEIE06	Project Planning Estimation and Assessment	0	0	2	1	--	--	--	--	--	--	25	25	50	25
8BEIE07	Major Project Phase-II	0	0	12	6							75	75	150	75
Total		**15**	**1**	**16**	**24**					**400**				**250**	
Semester Total		**32**			**24**	**650**									

GONDWANA UNIVERSITY, GADCHIROLI

FACULTY OF ENGINEERING AND TECHNOLOGY

CONSLIDATED STATEMENT OF VARIOUSPARAMETERS IN TEACHING & EXAMINATION SCHEME OF B.E. (INSTRU ENGINEERING)

SR.NO.	SEMESTER	NO. OF THEORY SUBJECTS	NO OF LABS/PRACT	TEACHING HOURS(TH) (L+T)	TEACHING HOURS (PRACT)	TOTAL CREDIT	MAX. THEORY MARKS	MAX.PRACT MARKS	MAX. MARKS TOTAL
1	I					23			
2	II					24			
3	III	5	4	20	8	24	500	175	675
4	IV	5	4	20	8	24	500	175	675
5	V	5	4	18	10	23	500	200	700
6	VI	5	4+1*	17	6	22	500	175	675
7	VII	4	3+1*	15	8	21	400	200	600
8	VIII	4	3	16	16	24	400	250	650
		28	**22+2***	**106**	**56**	**185**	**2800**	**1175**	**3975**

***Audit course. It is neither considered as passing head nor considered for earning some credit(s).However, this is mandatory to be taken up at the respective college level**

Subject wise Board of Studies Affiliation

Board of Studies	Subject Codes
APPLIED SCIENCES & HUMANITIES	3BEIE01
INSTRUMENTATION ENGINEERING	Rest All subjects.

VII Semester

Instrumentation Engineering

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE01

Title of the Course : Instrumentation System Design

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	1	0	3	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Acquire* the reliability concepts for sustainable system.
2. *Justify* the suitability of sensors/transducers/components for a given application.
3. *Design* signal conditioning circuits for conversion of process variables into standard signals.
4. *Estimate* the control valve sizing for given flow conditions.
5. *Apply* the principles and practices for design and development of instrument system.

Units	Contents	Hours
1	**Design of temperature Transducers:** An overview of static and dynamic performance characteristics of instruments, Selection criteria for temperature transducers, Design of cold junction compensation and linearizing circuit for thermocouple and thermistor, Calibration and installation procedure for thermocouple and RTD, Design considerations for transducers such as thermocouple, RTD.	07
2	**Design of flow Transducers:** Selection criteria for flow transducers, Orifice meter - design of orifice for given flow condition - design of rotameter, Design of square root extractor for variable head flowmeters, zero and span adjustment in transmitters, Design of 2 and 4 wire transmitters with 4-20mA output, Design of smart transmitters	10
3	**Design of pressure and level transducers:** Bourdon gauges, factors affecting sensitivity, design of Bourdon tube, design of pressure gauge, diaphragm based pressure gauge, design of level sensors and its signal conditioning circuits, Load cell and its signal conditioning, Design of P/I and I/P converters,	09
4	**Design of Control Valve:** Review of flow equations. Valve selection and sizing for liquid service, gas or vapor service, selection of body and trim materials and characteristics of control valves for typical applications, flashing liquids, mixed phase flow. Control valve noise. Actuator sizing. Types of pumps pump performance, characteristics of different pumps, selection of pumps.	10
5	**Microprocessor based design and Reliability:** Design of logic circuits for alarm and annunciator circuits, PCB design, interlocks - design of microcontroller based system for data acquisition - design of microprocessor based P+I+D controller. Concept of reliability definition, Distinction between Quality and reliability, failures, Availability, Maintainability, (MTBF, MTTF, MTTR) Life Cycle and Bathtub curve, Reliability Modelling Exponential, Weibull and Gamma Distribution, Hazard	09

	rate and Derivation of MTTF Failure Density Function, Cumulative Distribution Function, Reliability, Importance of documentation in system design. Quality Assurance.	
		45

Text Books:

1. Process Control and Instrumentation technology by C. D. Jonson.
2. Balaguruswamy E, "Reliability", Tata McGraw-Hill Pub.co. New Delhi, 1999.
3. E. O. Doebline, Measurement Systems, McGraw-Hill, 2003.
4. John Bentley, Principles of Measurement Systems, Prentice Hall, 2004.
5. Anderson N.A., Instrumentation for Process Measurment and Control, 3/e, Routledge, 1997.

Reference Books:

1. Bela G. Liptak, "Instrument Engineer's Hand Book – Process Control", Chilton Company, 3rd Edition, 1995.
2. Andrew Williams, "Applied instrumentation in the process industries", 2nd Edition, Vol. 1 &3, Gulf publishing company.

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE02

Title of the Course : Process Control

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	0	0	3	3	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. Identify control strategies for different control strategies to chemical processes.
2. Derive mathematical models for chemical process.
3. To analyze various process characteristics and dynamics.
4. Analysis and Design of Multiple Loop & Multivariable Processes.
5. Design Fuzzy-PI/PID controllers for Process.

Units	Contents	Hours
1	**Introduction to Process Control** Process characteristics, Representative control problems, Classification of process control strategies, An overview of control system design, Regulatory and servo control systems	07
2	**Theoretical Modeling of Chemical Processes** Why do we need modeling, General modeling principles (Fundamental Law), Examples of model of chemical processes: Stirred tank heating process (Constant hold-up, variable hold-up), Liquid storage tank, Continuous stirred tank reactor, Electrically heated stirred tank, Steam heated stirred tank, Series of Isothermal constant hold-up CSTR'S, Additional Examples	10
3	**Analysis of Dynamic Behavior of Chemical Processes** Standard process Inputs, Dynamic behavior of I^{st} order system/process, Dynamic behavior of II^{nd} order system/process Linearization (Function of one variable and two variables)	09
4	**Analysis and Design of Multiple Loop & Multivariable Processes** Process interactions and Control loop interactions, Pairing of controlled and manipulated variables**:** RGA, Inverse Nyquist Array, Singular Value Decomposition, Robustness**:** Doyle-Stein criteria, Skogestad-Morari method, Stability: Niederlinsky Index, Decoupler design	10
5	**Fuzzy Logic and Neural Networks in Control applications** Introduction, Definitions, Considerations for design of controller based on fuzzy logic and neural networks, Design of PI controller using fuzzy logic for Process Control application, Case studies	09
		45

Text Books:

1. "Process, Modeling, Simulation and Control for Chemical Engineers", W. L. Luyben, McGraw Hill.
2. "Chemical Process Control", Stephanopoulos George, PHI.
3. Process Dynamics and Control, Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Francis J. Doyle, Willey

4. “Fuzzy logic with engineering applications”, Timothy J Ross, McGraw Hill

Reference Books:

1. B.A.Ogunnaike and W. H. Ray, Process dynamics, modeling, and control Oxford University Press.
2. “Process Control Modeling, Design, and Simulation”, B. W. Bequette, PHI
3. “Process Control”, F. G. Shinskey, McGraw Hill Book Company

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE03

Title of the Course : Instrumentation In Agriculture and Food Industries

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. CO1. Characterize problems and possible technological solution of agro industries.
2. CO2. Familiarize with current literature, research in agricultural instrumentation
3. CO3. Analyze and design of automation system by evaluating agricultural parameter measurement constraint.

Units	Contents	Hours
1	Necessity of instrumentation & control for agriculture and food processing requirement, remote sensing, biosensors in agriculture, standard for food quality. Soil science and sensors: Engineering properties of soil pH, conductivity, resistivity, temperature, soil moisture and salinity, ion concentration measurement, method of soil analysis, Instrumentation for environmental conditioning of seed germination and growth.	8
2	Flow diagram of sugar plant & instrumentation set up for it, flow diagram of fermenter & control (batch process), flow diagram of dairy industry & instrumentation set up for it, Juice extraction control process & instrumentation set up for it Oil extraction plant and instrumentation set up for it. Pesticides manufacturing process and control	9
3	Application of SCADA for DAM parameters & control, Irrigation canal management up- stream & down - stream control systems, Water distribution and management control, Auto drip irrigation systems.	9
4	Automation in earth moving equipment& farm equipment, application of SCADA & PLC in packing industry and cold storage systems, implementation of hydraulic, pneumatic & electronics control circuits in harvesters cotton pickers, tractor etc.	9
5	Green houses & instrumentation: ventilation, cooling & heating, wind speed, temperature & humidity, rain gauge, carbon dioxide enrichment measurement & control. Leaf area length evapotranspiration, temperature, wetness & respiration,measurement& data logging, electromagnetic radiations photosynthesis, infrared & UV bio sensor methods in agriculture, agro-metrological instrumentation weather stations, Non-conventional energy sources: Wind power, solar power, tidal power, smart grid, energy harvesting.	10
		45

Text Books:

1. Industrial Instrumentation by D. Patranabis, Tata McGraw Hill pub
2. Process control and instrumentation technology by C.D. Johnson, 7th edition, Pearson education
3. Process Instrumentation and control handbook by Considine D. M., McGraw Hill pub.

4. Mineral Processing Technology by Wills B.A., Pergamon Press, 4th Ed.
5. G.S. Sawhney ―Non-Conventional Energy Resources, PHI Learning Private Limited, 1st ed., 2012

Reference Books:

1. Instrumentation Engineers Handbook- Process measurement volume I and Process control volume II, by B.G.Liptak, Chilton Book Company, 2001

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE04

Title of the Course : Wireless Sensor Network (Core Elective-I)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. Use of Wireless Sensor Networks for basic applications such as environmental Monitoring.
2. Verify the various WSN protocols and design challenges.
3. Implement various wireless technologies for WSN
4. Establish different Routing protocols for WSN
5. Use Middleware for WSN and known OS for WSN

Units	Contents	Hours
1	Introduction and Overview of Wireless Sensor Networks: Commercial and Scientific Applications of Wireless Sensor Networks, Basic Wireless Sensor Technology, Sensor Taxonomy, wireless network environment, wireless network trends.	09
2	Radio technology primer, Available wireless technologies, Wireless Sensors Networks Protocols, Physical Layer, Fundamentals of Medium Access Control Protocols for Wireless Sensor Networks, MAC protocols for WSN, Case Study, IEEE 802.15 4LR WPAN, Standard case studies.	09
3	Sensors Network Protocols, Data dissemination and gathering, Routing Challenges and design issues in wireless sensor network, Network Scale and Time-Varying Characteristics, Resource Constraints,Sensor ApplicationsData Models,Routing strategies in WSN.	09
4	Transport Control Protocols for Wireless Sensors Networks, Traditional transport control protocol and transport protocol design issues, Examples of existing transport control protocol, performance of TCP. WSN Protocol design issues & Performance modeling.	09
5	Middleware for Sensor Networks, WSN middleware principles, Middleware architecture, existing middleware. Operating System Design Issues, Examples of Operating Systems,TinyOS etc.	09
		45

Text Books:

1. "Wireless Sensor Networks: Technology, Protocols, and Applications", KazemSohraby, Daniel, Minoli, TaiebZnati, WIeyInterscience Publication, 2007
2. Morgan Kaufmann F. Zhao and L. Guibas, 'Wireless Sensor Networks', a Francisco, 2004.

Reference Books:

1 "Computer Networks" ,Andrew Tanenbaum, 4th ed., Pearson Education,2007
2. C. S. Raghavendra, Krishna M. Sivalingam, Taieb F. Znati , 'Wireless sensor networks', Edition: 2, Published by Springer, 2004 ISBN 1402078838, 9781402078835

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE04

Title of the Course : Fuzzy Logic & Neural Network (Core Elective-I)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Acquire* the concepts of biological neurons and its artificial models.
2. *Identify* neural network architectures and appropriate learning rules.
3. *Distinguish* between the crisp sets and fuzzy sets.
4. *Infer* the operations of fuzzy sets, fuzzification and defuzzification.
5. *Solve* the examples on fuzzy arithmetic.

Units	Contents	Hours
1	Introduction: Fuzzy Sets, Logic and Systems & Applications, Real Life Applications of Fuzzy Systems, Membership Functions and its types, Nomenclature Terms and Set Theoretic Operations used in Fuzzy Sets.	9
2	Set Theoretic Operations and Fuzzy Set Properties, Fuzzy Set Properties and Distance between Fuzzy Sets, Arithmetic Operations on Fuzzy Numbers, Complement, T-norm and S-norm for Fuzzy Sets.	9
3	Projection, Cylindrical Extension and Properties of Fuzzy Relation, Composition of Fuzzy Relations and Its Properties,Linguistic Hedges,Fuzzy Inference System: Mamdani Fuzzy Model and Examples.	10
4	Fundamental Concepts and Models of Artificial Neural Systems: Biological Neurons and Their Artificial Models, Models of Artificial Neural Networks, Learning and Adaptation, Neural Network Learning Rules, Single Layer ANN, Multi-layer ANN.	9
5	Perceptrons: Perceptron representation, perceptron learning, perceptron training algorithm. Back Propagation: Introduction to Back propagation and back propagation training algorithm.	8
		45

Text Books:

1. Bose & Liang, "Artificial Neural Networks ", Tata McGraw Hill, 1996
2. Kosco B, "Neural Networks and Fuzzy Systems: A Dynamic Approach to MachineIntelligence, Prentice Hall of India, New Delhi, 1992.
3. James A. Anderson, An introduction to neural networks, Prentice Hall of India, Private limited, New Delhi, 1999.
4. Jacek M. Zurada, Introduction to Artificial Neural System, Jaico Publishing Home, 2002.

Reference Books:

1. D. Drainkov, H. Hellendoorn and M. Reinfrank, An Introduction to Fuzzy Control, Narosa Publishing House, 1993.

2. T. J. Ross, Fuzzy Logic with Engineering Applications, McGraw Hill, Inc 1995.
3. Klir G.J. and Folger T.A., Fuzzy sets, “Uncertainty and Information”, Prentice Hall of India, New Delhi, 1994

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE04

Title of the Course : Engineering Optimization (Core Elective-I)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Distinguish* the modeling strategies used for physical and chemical systems.
2. *Solve* different types of algebraic equations using numerical methods.
3. *Determine* the solutions using linear programming techniques.
4. *Optimize* the linear and non-linear system with/without constraints
5. *Develop* the model of given chemical process.

Units	Contents	Hours
1	**Mathematical Models of Chemical Systems :** Applications of mathematical models and principles of formulation, Fundamental laws: Continuity equations, Energy equation, Equations of motion, Examples of models: Modeling of CSTR's (isothermal, non-isothermal, constant holdup, variable holdup), Batch reactor, Ideal binary distillation column, Heat exchanger, Boiler, Field controlled and Armature controlled D.C. Motors.	10
2	**Numerical Methods for Solving Algebraic and Differential Equations :** Solution of algebraic equations: Interval halving method, Newton Raphson method Solution of differential equations: Euler method, Modified Euler method, Runge Kutta methods (2nd and 4th order), Adom Bashforth method.	10
3	**Development of Empirical Models and Computer Simulation of Chemical and Physical Systems :** Model development using linear or nonlinear regression, Fitting First and Second order models using step tests. Introduction to Genetic Algorithm, Gravity flow tank, three isothermal CSTR's in series, non-isothermal CSTR, Batch reactor, Ideal binary distillation column, First and second order electrical systems Armature controlled DC motor.	07
4	**Basic Concepts of Optimization and Unconstrained Optimization :** Continuity of functions, Concave and convex functions, Unimodal and Multimodal functions, Necessary and sufficiency condition for an extremum of an unconstrained function. Unconstrained single-variable optimization: scanning and bracketing procedures. Numerical methods: Newton, Quasi Newton and Secant methods. Unconstrained Multivariable optimization: Direct methods: Conjugate search directions, Powell's method. Indirect methods: Gradient methods, Conjugate gradient method, Newton's method	10
5	**Linear and Nonlinear Programming :** Linear programming: Degeneracies, Graphical method, Simplex method, Sensitivity analysis, Karmarkar algorithm. Nonlinear programming: Lagrange multiplier method, Quadratic programming	08
		45

Text Books:

1. W. L. Luyben, “Process, Modeling, Simulation and Control for Chemical Engineers”,
2. McGraw Hill Publications.
3. T. F. Edgar, D. M. Himmelblau, “Optimization of Chemical Processes”, McGraw Hill Publications .
4. Dale E. Seborg, Duncan A. Mellichamp, “Process Dynamics and Control”, 3rd Edition.

Reference Books:

1. B. Roffel, B. H. L. Betlem ,“Advanced Practical Process Control”, Springer.
2. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publications.
3. J. Malley, “Practical Process Instrumentation and Control”, McGraw Hill

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE04

Title of the Course : Biomedical Instrumentation-II (Core Elective-I)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Units	Contents	Hours
1	**Fundamentals of Biomedical Instrumentation:** Cell and its structure, Nervous Systems and its fundamentals, Basics components of biomedical systems, Biomechanics of bones, Biomaterials of soft tissues, Basics mechanics of spinal columns and limb.	09
2	**Nonelectric Parameters Measurements and Diagnostic:** Measurement of blood pressure, Pulmonary function measurement, Spirometer, Photo Plethysmography, Body Plethysmography, Blood gas analyzer, PH of blood, Measurement of blood PCO_2, PO_2, Finger tip oxymeter, ESR, GSR Measurements.	10
3	**Electrical Parameters Acquisition and Analysis:** Electrode-Limb electrode,floting electrode,Pregelled disposable electrode, Amplifier, preamplifier, isolation amplifier, EEG, EMG, ERG lead systems and recording methods	07
4	**Biomedical Measuring Equipments**: Ventilators, heart lungs machine, Hemodalysis, Lithotripsy, infant incubators, X-rays-Principle of generation, Uses of X-rays, Diagnostics still picture, Fluoroscopy, angiography, endoscopy, nuclear medicine systems, radiation therapy.	09
5	**Instruments for Clinical Laboratory:** Test on Blood Cell, Chemical test-Colorimeter, Flame Photometer, Introduction to telemedicine. **Electrical Safety:** Electrical safety in Medical Environment, Physiological effects of electric current, Shock hazards from electrical equipments, Methods of accident prevention.	10
		45

Text Books:

1. Leslie Chromwell, Biomedical Instrumentation and Measurements.
2. Joseph J. Carr and John M. Brown. Introduction to biomedical Equipments Technology.
3. Medical Instrumentation, Application and Design By J.G. Webster

Reference Books:

1. John G. Webster Medical Instrumentation Application and Design.
2. Duane Knudson, Fundaments of Biomechanics.
3. Various Instruments Manuals
4. Various internet resources

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE05

Title of the Course : Instrument System Design Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to:

1. *Identify* the suitable components for instrumentation system.
2. *Estimate* the tuning parameters of a PID controller for a given process.
3. *Verify* the characteristics of linear, quick opening and equal percentage control valve.
4. *Implement* signal conditioning circuits for conversion of process variables into standard signals.
5. *Design* an alarm annunciator system.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested list of experiments:

1. Design of signal conditioning for a K-type thermocouple
2. Design of signal conditioning for a RTD
3. Calibration and installation of flow, pressure, temperature and level transmitters
4. Configuration of D.P Transmitter and its application for flow
5. Calibration of I/P and P/I converter
6. Tuning of PID controller
7. Development of mathematical model of control valve
8. Study of control valve & plot the characteristics of control valve
9. Design of logic circuit for alarm and annunciator
10. A mini project which includes PCB design

Text Books:

1. Process Control and Instrumentation technology by C. D. Jonson.
2. Balaguruswamy E, “Reliability”, Tata McGraw-Hill Pub.co. New Delhi, 1999.
3. E. O. Doebline, Measurement Systems, McGraw-Hill, 2003.
4. John Bentley, Principles of Measurement Systems, Prentice Hall, 2004.
5. Anderson N.A., Instrumentation for Process Measurment and Control, 3/e, Routledge, 1997.

Reference Books:

1. Bela G. Liptak, “Instrument Engineer’s Hand Book – Process Control”, Chilton Company, 3rd Edition, 1995.
2. Andrew Williams, “Applied instrumentation in the process industries”, 2nd Edition, Vol. 1 &3, Gulf publishing company.

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE06

Title of the Course : Process Control Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to:

1. An ability to design and conduct simulation experiments for chemical process characteristics
2. Design and Selection of field instruments
3. An ability to identify, control loop in a given process and apply appropriate control strategy
4. Identify the pairing of controlled and manipulated variable for MIMO systems
5. Design the decoupler and controllers for MIMO systems

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested list of experiments:

1. Implement and Simulate Blending process in MATLAB
2. Implement and Simulate a Step test for chemical process
3. Selection of field instruments for Boiler, Heat Exchanger, Evaporator, Distillation Column, Spray Dryer
4. Designing of control valve for liquid/gas/vapour applications as per standard.
5. Design of orifice plates for liquid/gas/vapours as per ISO standard.
6. Design a Heat Exchanger for chemical process
7. Design and Implementation of cascade controller for a given application
8. Determine Relative Gain Array, Morari Resiliency Index and Niederlinsky index of MIMO system.
9. Design and Implement Decoupler for given 2x2 process transfer function matrix.

Text Books:

1. "Process, Modeling, Simulation and Control for Chemical Engineers", W. L. Luyben, McGraw Hill.
2. "Chemical Process Control", Stephanopoulos George, PHI.
3. Process Dynamics and Control, Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Francis J. Doyle, Willey

Reference Books:

1. B.A.Ogunnaike and W. H. Ray, Process dynamics, modeling, and control Oxford University Press.
2. "Process Control Modeling, Design, and Simulation", B. W. Bequette, PHI
3. "Process Control", F. G. Shinskey, McGraw Hill Book Company

VII Semester B.E. Instrumentation Engineering

Course Code : 7BEIE07

Title of the Course : Major Project Phase-I (Laboratory)

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	50	50	100

- The Major Project Phase – I- It includes seminar work, literature survey and minimal implementation of the project including software and Hardware, which is to be carried out in the institution/industry/research laboratory.
- The duration of project work should be a minimum of two semesters: Major Project Phase –I & II.
- Each student has to present a seminar, on any technical topic related to any subject not covered in the syllabus or preferably based on the project.
- The presentation time is of minimum 10 minutes followed by a 5 minutes session for discussion/question and answers.
- The seminar topic selected by the student must be approved by the project committee of the department at the beginning of the semester; the duplicity of the topics must be avoided.
- Each student/project group has to demonstrate the minimal implementation of the project work and should submit individual seminar report on the day of seminar to the department along with the project progress report.
- The seminar presentation & submission of the report will carry 50% weightage and demonstration and submission of project progress report will carry 50% weightage for final evaluation. The evaluation is to be carried out by department project committee including guide.

VIII Semester

Instrumentation Engineering

VIII Semester B.E. Instrumentation Engineering

Course Code : 8BEIE01

Title of the Course : Analytical and Environmental Instrumentation

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Acquire* the concept of qualitative and quantitative methods of analysis.
2. *Identify* the components of optical instruments.
3. *Infer* the working principles of analytical instruments.
4. *Examine* the pollution level using appropriate gas analyzer.
5. *Classify* chromatographic methods.

Units	Contents	Hours
1	**Colorimetry And Spectrophotometry:** Methods of analysis, Beer-Lambert law, Colorimeters, Single and double beam instruments, Sources and detectors, UV-Visible spectrophotometers, IR Spectrophotometers, Flame photometers, Atomic absorption spectrophotometers, Sources and detectors, Atomic Emission Spectroscopy,	9
2	**Chromatography:** Chromatography, basic definition, gas chromatography, basic parts of gas chromatography, applications, Liquid chromatographs, types of Liquid chromatographs, High-pressure liquid chromatographs, Applications.	9
3	**Nuclear Magnetic Resonance And Microscopic Techniques:** NMR**:** Basic principles, NMR spectrometer and Applications, Electron spin Resonance spectroscopy: Basic principles, Instrumentation and applications. Scanning Electron Microscope (SEM): Basic principles, Instrumentation and applications.	9
4	**Industrial Gas Analyzers:** Types of gas analyzers, Oxygen, NO_2 and H_2S types, IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. **Environmental Pollution Monitoring Instruments:** Air pollution monitoring instruments, air pollution monitoring stations, carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation.	9
5	**Environmental Pollution Monitoring Instruments:** Water pollution monitoring instruments, Types of pollutants and Techniques, conductivity, dissolved oxygen, temperature turbidity **pH Measurement And Dissolved Component Analyzers:** Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors,	9
		45

Text Books:

1. R.S. Khandpur, Handbook of Analytical Instruments, Tata McGraw Hill publishing Co. Ltd., 2edition, 2006
2. G.W. Ewing, Instrumental Methods of Analysis, Mc Graw Hill, 2004.
3. Liptak, B.G., Process Measurement and Analysis, CRC Press, 2005.
4. H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, Instrumental methods of analysis, CBSpublishing & distribution, 1995.

.Reference Books:

1. Braun, R.D., Introduction to Instrumental Analysis, Mc Graw – Hill, Singapore, 2006.
2. James keeler , Understanding NMR Spectroscopy, Second Edition John Wiley & Sons, 2010.
3. John H.Nelson , Nuclear Magnetic Resonance Spectroscopy, Prentice Hall/Pearson Education,2003.
4. Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and francis group, 2007.

VIII Semester B.E. Instrumentation Engineering

Course Code : 8BEIE02

Title of the Course : Project Planning Estimation and Assessment

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
3	1	0	3	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. Understand the instrumentation project & its implementation in the real world
2. Select particular standards for the specific items, need of documentation & drawings, and the process of installation & commissioning
3. Understand project structure, its management, planning & scheduling
4. Initiate and execute procurement process
5. understand the control room, panel arrangement & layouts

Units	Contents	Hours
1	**Introduction to Project Engineering**: Project, Project Management & project Report, Project Planning and Scheduling techniques, network techniques CPM, PERT etc. **Standards used in instrumentation project:** different symbols, ISA, ANSI, ASME, NFPA, NEMA, DIN, PIP, IEEE, ISO, SAMA Standard & safety standards	10
2	**Project Documentation and drawings:** Introduction, Types of Project documents, preliminary schedule of events., Need for Engineering Documents, General Guidelines for Development of Documents, Process Flow Diagram, Piping and Instrumentation diagrams (P&ID),process data sheet ,material balance sheet, Instrument Index Sheet, specification data sheet, Instrument project schedule sheet, Loop wiring diagram, Instrument hook-up diagrams, Junction box Schedule, Cable Schedule, MIMIC diagram, Factors influencing the project, GA drawing, Importance of plant layout and GA drawing.	9
3	**Procurement, contracting and estimation:** Introduction ,Vendor liaison, Types of Tenders, bids, technical bid evaluation, steps in purchasing, PO format, Vendor documents and vendor drawings Site selection and layout of a factory, Bid analysis and Contracting, **Estimation:**Types of Estimates, pricing process, salary overheads, labour hours, material and support costs,	10
4	**Installation and Commissioning:** Typical Installation details, Installation standards, installation sketches, installation details of instruments like pressure, flow, temperature, etc., cable laying, Networking protocols, instrument installation guidelines. **Commissioning:** Pre-commissioning Procedures, Hot and cold commissioning, bill of material Factory acceptance test (FAT), Site acceptance test (SAT) & Customer Acceptance Test (CAT),.loop & hardware check out procedures, Duties of project engineer, calibration, testing of instruments, operation and maintenance manual, commissioning Procedures, process start-up.	08
5	**Control Centers and Panels:** Control room layout, control room engineering, engineering aspects and design criteria, Control panels types, panel layout, panel piping and tubing, panel wiring, nameplate, tags and graphics display, panel bid specifications. Panel Inspection Significance of control center and its design objectives, Intelligent Operator Interface.	08
		45

Text Books:

1. Andrew Williams, Applied instrumentation in the process industries, 2nd Edition, Vol. 1 & 2, Gulf publishing company.
2. Management systems, “John Bacon”, (ISA).
3. Instrument installation project management, “John Bacon”, (ISA).
4. H. H. Shah, Project: Engineering, Planning & Management, Chinttan Publication

.Reference Books:

1. Bela Liptak, Instrumentation engineering handbook, Vol-1,2
2. Michael D. Whitt, Successful Instrumentation and Control Systems Design, ISA Publication.
3. Installation of Instrumentation & Process control systems- EEUA Handbook.
4. Instrumentation engineering handbook by Considine

VIII Semester B.E. Instrumentation Engineering

Course Code : 8BEIE03

Title of the Course : Biomedical Instrumentation (Open Elective)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Units	Contents	Hours
1	**Patient Monitoring System:** Measurement of Heart Rate, Pulse rate, Blood pressure, Temperature and Respiration rate, Apnea Detector. Electrical Safety in Biophysical Measurements	10
2	**Pulmonary Function Analyzer and Ventilator:** Respiration measurement technique: Lung volume and capacities. Spirometry, Pulmonary function measurement and analyser, Oximetry, Ventilators and Anesthesia Equipment. Mechanical Ventilation in Covid-19,Use of ventilator in Covid-19.	9
3	**Physiotherapy, Electrotherapy Equipments:** Basic principle, working and technical specifications of Shortwave Diathermy, Ultrasonic therapy unit, Infrared and UV lamps, Nerve and Muscle Stimulator.	10
4	**Alimentary System**: All organs of the Digestive System, other secretions and main Functions, Deglutition and Defecation. **Urinary System**: Structure of Nephron, Function of Kidney, Urinary Bladder, Urethra, Internal/External Sphincters, Formation of Urine, Micturition	08
5	**Laser Applications in Biomedical Engineering:** Laser classifications, Types of Lasers, Medical Applications, Laser delivery Systems and safety.	08
		45

Text Books:

1. Handbook of Biomedical Engineering By R.S. Khandpur (TMH Pub).
2. Handbook of Analytical Instruments By R.S. Khandpur (TMH Pub).
3. Medical Instrumentation, Application and Design By J.G. Webster

.Reference Books:

1. Introduction to Biomedical Equipment Technology By Carr.-Brown (Pearson Education Pub)
2. Introduction to Biomedical Engineering – Joseph Bronzino (CRC Press)
3. Various Instruments Manuals
4. Various internet resources

VIII Semester B.E. Instrumentation Engineering

Course Code : 8BEIE04

Title of the Course : Building Automation (Core Elective-II)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. Articulate the purpose and operation of HVAC system components, the operation of HVAC systems.
2. Understanding thermal comfort conditions with respect to temperature and humidity and human clothing and activities and its impact on human comfort, productivity, and health.
3. Understanding of the needs and requirements for ventilation and its impact on design and energy and its impact on human comfort, productivity, and health.
4. Understand the way in which a large fire alarm system would be connected and zoned.
5. Understand the fundamental elements that make up an Access Control System.

Units	Contents	Hours
1	**Introduction to Building Automation systems :** • Intelligent building and its architecture • Evolution of intelligent buildings & Lifecycle of buildings • Different systems in BAS which includes HVAC, security, fire, lighting systems. Importance of each system in BAS. • BAS System Hierarchy –Field level components, Direct Digital Control (DDC), Supervisory Controller, Server, Operator Workstation (OWS) • Different communication protocol and addressing concepts • Open Protocols -BACnet, LON, Profibus, Modbus, M-bus, • Proprietary Protocols- N2, CBUS,	8
2	**Comfort parameters for human being and measurement in BAS system** • Comfort parameters for human being- temperature, humidity, flow, pressure, clean air, CO_2%. • Heat Transfer - Conduction, Convection, Radiation. Specific Heat, Sensitive Heat & Latent Heat, Enthalpy, Entropy • Working Principle, Characteristics of different types of temperature sensors- RTD, Thermistor, Thermocouple, Bimetallic strip • Humidity, Specific Humidity, Relative Humidity, Dew point, Saturation point • Dry bulb & Wet bulb temperature, Working principle of Psychrometer • Pressure and Flow measurements in HVAC for air-side and water-side applications	10

	• Measurement of CO_2 level in air, Air filtration techniques, ozonisation and UV • Other Parameters affecting building operation- Building load for Chilled water and hot water system, Working principal of BTU meter, BTU meter mounting.	
3	**HVAC Basic Concepts- Systems (Air Side)- Air handling unit** • Concept of Air handling unit. Design, working of different components in AHU- damper, filter, cooling coil, heating coil, fan, heat recovery wheel, humidifier. • Design and working of different types of AHU with combination of- 100% outdoor air, mixed air, constant volume, variable volume, dual duct, single duct • Operation of different modes in AHU- humidification, dehumidification, static pressure control, volume matching, warm up mode, night purge mode, cooling, heating, economiser mode. • Heat recovery techniques- plate heat exchanger, heat recovery wheel and glycol heat recovery loop. • Concept of Variable Air Volume (VAV) system-Design, working, use of different types of VAV- CAV, cooling only, with reheat, series fan powered, parallel fan powered, pressure dependent, supply-exhaust VAV, and dual duct VAV.	9
4	**Introduction to Fire Alarm System & Fire Detection** • What is Fire? Fire alarm System-The History • FAS architecture & operation • Classification of Fire Alarm System, Conventional and Addressable Fire Alarm System • Important Codes-NFPA72, IS 2189, BS 5839 • Critical fire & safety parameters in Facility Environment • FAS Loops-Classification of Loops and Examples • Power Supply Requirement and its designing parameters • Battery Calculations and Its Requirement and design Network terminology for Fire Systems, Classification of Cables, Class of Cables- Types and distance Supported specific to fire alarm system • Working Principles of Fire Alarm devices and its working Application in building safety • Components of fire detection system • SLC wiring and its classification • Concepts of Water leak detection system & Concepts of VESDA (Very early smoke detection system)	9
5	**Introduction to Building Security – Access Control & CCTV** • Basic Concepts of Access Control System & it's components • Benefits of Access Control System & it's architecture • Access Control System Devices –Its features and Working principles. Antipassback, Forgiveness, Two man Rule, Time and Attendance, Guard Tour, Elevator Control	9

	• Secure and Non Secure Concept • Card Technology Overview –Smartcard, Proximity Card, MI fare Cards • System Architecture of Access Control System • Basic of CCTV system, System Architecture of CCTV System • Types of Camera –Fixed, PTZ, Analog, Digital • Video Analytics, Camera Connectivity, Video Management System: DVR, DVM, NVR.	
		45

Text Books:

1. HVAC Systems Design Handbook, Fifth Edition by Roger W. Haines
2. HVAC Fundamentals, volume 1 to 3 by James E. Brumbaugh
3. Basics of Air Conditioning by ISHRAE. Indian Society of Heating, RefrigerConditioning Engineers (product code: B0004 for online shopping)

.Reference Books:

1. All About AHU's by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0005 for onlineshopping)
2. Chillers Basics by ISHRAE. Indian Society of Heating, Refrigerating & Air Conditioning Engineers (product code: B0009 for online shopping)
3. Handbook-Industrial Ventilation Application 2004 by Indian SocietyHeating, Refrigerating & Air Conditioning Engineers
4. Fundamentals Of Refrigeration by Indian Society of Heating, Refrigerating & Air Conditioning Engineers
5. HVAC Handbook Part-1 by Indian Society of Heating, Refrigerating & Air Conditioning Engineers

VIII Semester B.E. Instrumentation Engineering

Course Code : 8BEIE04

Title of the Course : Embedded System for Instrumentation (Core Elective-II)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. Use of Embedded System for different applications.
2. Verify the architecture of AVR Microcontroller with assembly language program.
3. Verify various on chip peripherals of AVR microcontroller.
4. Design interfacing with on chip peripherals.
5. Use RTOS for Embedded system design

Units	Contents	Hours
1	**Embedded system Introduction:** Introduction to Embedded System, History, Design challenges, optimizing design metrics, time to market, applications of embedded systems and recent trends in embedded systems, embedded design concepts and definitions, memory management, hardware and software design and testing.	09
2	**System Architecture:** Introduction to AVR Microcontroller: History and Features, AVR architecture and Assembly language Programming.	09
3	**Study of on Chip Peripherals:** Study of on-chip peripherals like I / O ports, timers, interrupts, on-chip ADC, DAC, Watch-Dog Timer, Power down Modes.	09
4	**Interfacing and Programming in Assembly Language:** Programming on-chip peripherals: Timer, Interrupts, Serial Port, PWM, SPI	09
5	**Real Time Operating System :** Introduction to Real – Time Operating Systems: OS services, Process Management, Tasks and Task States, Tasks and Data, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Memory Management, Interrupt Routines in an RTOS Environment.	09
		45

Text Books:

1. The AVR Microcontroller and Embedded Systems, Muhammad Ali Mazidi, Pearson Publication
2. Rajkamal - Embedded Systems, TMH.

.Reference Books:

1. DR.K.V.K. K. Prasad - Embedded / real time system, Dreamtech
2. Steve Heath - Embedded System Design , Neuwans
3. David Simon - Embedded systems software primer, Pearson

VIII Semester B.E. Instrumentation Engineering

Course Code : 8BEIE04

Title of the Course : Robotic System and Control (Core Elective-II)

Course Scheme					Evaluation Scheme (Theory)				
Lecture	Tutorial	Practical	Periods/week	Credits	Duration of paper, hrs	MSE	IE	ESE	Total
4	0	0	4	4	3	10	10	80	100

Course Outcomes: After completion of the course, the student will be able to:

1. *Enlist* the components and structures of robots.
2. *Formulate* the feed forward, computed torque and PD control strategies for robotic motion.
3. *Derive* the kinematic and dynamical model of robotic manipulators.
4. *Exemplify* the usage of feedback linearization techniques for '*n*' link robots.
5. *Apply* the concepts of robotics in industrial automations and societal applications.

Units	Contents	Hours
1	**Introduction:** Introduction to robotics, History, growth; Robot applications, Laws of Robotics, Components and Structure of Robots, Common Kinematic arrangements, Rotations, Composition of Rotations, Properties, Homogeneous Transformation.	09
2	**Forward and Velocity Kinematics:** Kinematic Chains, Denavit-Hartenberg Representation, Derivation of the Jacobian, Examples, Singularities, Inverse Velocity and acceleration.	12
3	**Dynamics:** Euler-Lagrange Equations, Expressions for kinetic and potential energy, Equation of Motions, Common configurations.	11
4	**Controls:** Introduction, Actuator dynamics, Set-Point Tracking, Drive Train Dynamics, Trajectory Interpolation/Planning, PD/PID, Feed forward Control and Computed Torque.	05
5	**Feedback Linearization Based Control:** The Frobenius theorem, Single-Input Systems, Feedback Linearization for N-Link Robots, Introduction to outer loop design-Lyapunov's Second Method, Introduction to sliding mode control for robotic applications.	08
		45

Text Books:

1. Mark W. Spong& M. Vidyasagar. "Robot Dynamics and Control", Willey India Publisher,2009. ISBN: 978-81-265-1780-0.
2. Lee, K.S. Fu, R.C. Gonzalez & C.S.G - Robotics, McGraw Hill.
3. Bruno Sicilian (1996) - Modelling and controlling of Robot manipulations, Lorenzo Seivicco, TMH.

.Reference Books:

1. Wolfram Stadler (1995) - Analytical robotics and Mechatronics, TMH.
2. Robert J. Schilling (1996) - Fundamentals of Robotics Analysis and control, PHI.

VIII Semester B.E. Instrumentation Engineering

Course Code : 8BEIE05

Title of the Course : Analytical Environmental Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to:

1. *Recognize* the importance of wavelength/emission spectrum in analytical instruments.
2. *Examine* the properties of the sample tested on Colorimeter.
3. *Determine* concentration of sample using UV-VIS spectrophotometer.
4. *Compare* the results of given sample with standard sample using analytical instruments.
5. *Follow* the safety procedures and precautions for handling analytical instruments.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested list of experiments:

1. Study of filter photometer.
2. Study of flame photometer.
3. Study of optical densitometer.
4. Study of UV visible spectrophotometer.
5. Study of refractrometer.
6. Study of Gas Chromatograph.
7. Study of interferometer.
8. Study of Atomic Absorption Spectrophotometer.
9. Study of turbidity meter.
10. Study of ESR.
11. Measurement of pH of given sample
12. Study of colorimeter.

Text Books:

1. R.S. Khandpur, Handbook of Analytical Instruments, Tata McGraw Hill publishing Co. Ltd., 2edition, 2006
2. G.W. Ewing, Instrumental Methods of Analysis, Mc Graw Hill, 2004.
3. Liptak, B.G., Process Measurement and Analysis, CRC Press, 2005.
4. H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, Instrumental methods of analysis, CBS publishing & distribution, 1995.

Reference Books:

1. Braun, R.D., Introduction to Instrumental Analysis, Mc Graw – Hill, Singapore, 2006.
2. James keeler , Understanding NMR Spectroscopy, Second Edition John Wiley & Sons, 2010.
3. John H.Nelson , Nuclear Magnetic Resonance Spectroscopy, Prentice Hall/Pearson Education,2003.
4. Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and francis group, 2007.

VIII Semester B.E. Instrumentation Engineering

Course Code : 8BEIE06

Title of the Course : Project Planning Estimation and Assessment Laboratory

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	2	1	25	25	50

Course Outcomes: After completion of the course, the student will be able to:

1. Develop & draw the project report format on drawing sheet.
2. Develop & draw the Piping & Instrumentation Diagrams (P & ID).
3. Develop & draw the Process Flow Sheet.
4. Develop & draw the Instrumentation Index Sheet, Specification Sheet.
5. Develop & draw the Loop Wiring Diagrams, Control Room layouts.

Term Work (TW) & POE:

Term work and practical/Oral examination shall consist of at least eight experiments based on contents of syllabi in the form of a journal and necessary documentation.

Suggested list of experiments:

1. Develop & draw the structure of Project Management.
2. Develop & draw the project report format on drawing sheet.
3. Develop & draw the Piping & Instrumentation Diagrams (P & ID).
4. Develop & draw the Process Flow Sheet.
5. Develop & draw the Instrumentation Index Sheet.
6. Develop & draw the Instrumentation Specification Sheet.
7. Develop & draw the Loop Wiring Diagrams.
8. Develop & draw the purchase requisition note & purchase order form.
9. Develop & draw the installation diagram of typical level switch, in-line transmitting rotameter and DP sensing instrument in liquid service.
10. Develop & draw classification of cables & network topology.
11. Develop & draw the Control Room layouts.
12. Develop & draw the various Control Panels.

Text Books:

1. Andrew Williams, Applied instrumentation in the process industries, 2nd Edition, Vol. 1 & 2, Gulf publishing company
2. H. H. Shah, Project: Engineering, Planning & Management, Chinttan Publication

Reference Books:

1. Bela Liptak, Instrumentation engineering handbook, Vol-1,2
2. Michael D. Whitt, Successful Instrumentation and Control Systems Design, ISA Publication.

VIII Semester B.E. Instrumentation Engineering

Course Code : 8BEIE07

Title of the Course : Major Project Phase-II (Laboratory)

Course Scheme				Evaluation Scheme (Laboratory)		
Lecture	Tutorial	Practical	Credits	TW	POE	Total
0	0	12	6	75	75	150

- The Major Project work Phase-II is to be conducted in continuation of the project work Phase-I which is to be carried out in the institution/industry/research laboratory.
- The duration of project work should be a minimum of two semesters (Project Phase –I & II).
- There will be a mid-semester evaluation of the project work done after about two months. An interim project report is to be submitted to the department during the mid-semester evaluation. The mid-semester evaluation will be done by the department project committee/project guide; this will carry weightage in final evaluation.
- Each student / project group has to submit to the department a project report in the prescribed format after completion of the project work. The final evaluation and viva-voce will be conducted by the project committee/Guide on the stipulated date at the end of the semester.
- Each student / project group has to make a demonstration on the work carried out, before the project committee for project evaluation. The end semester evaluation will be done by the project committee including the guide.