Dr.M.G.R. EDUCATIONAL AND RESEARCH INSTITUTE UNIVERSITY
(Declared U/S 3 of the UGC Act 1956)

ELECTRONICS AND INSTRUMENTATION ENGINEERING DEPARTMENT

CURRICULUM AND SYLLABUS

2017 REGULATION

Semester : 3

Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BMA17006	Mathematics III for Electrical Engineers	4	3	1/0	0/0	Ty
BEI17001	Circuit Theory	4	3	1/0	0/0	Ty
BEI17002	Electrical Machines	4	3	1/0	0/0	Ty
BEI17003	Analytical Instruments	3	3	0/0	0/0	Ty
BME17I02	Thermodynamics and Fluid Mechanics	3	3	0/0	0/0	Ty

Practical:

BEI17ET1	Electron Devices & Circuits*	3	1	0/2	1/1	ETL
BEI17L01	Electrical Technology Laboratory	1	0	0/0	3/0	Lb
BEI17L02	Electric Circuits Laboratory	1	0	0/0	3/0	Lb
BME17IL1	Thermodynamics and Fluid Mechanics Laboratory	1	0	0/0	3/0	Lb

Credits Sub Total: 24

Semester: 4

Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BMA17011	Numerical Methods For Electrical Engineers	4	3	1/0	0/0	Ty
BEI17004	Digital Electronics	4	3	1/0	0/0	Ty
BEI17005	Computer Networks & Distributed Control System	4	3	1/0	0/0	Ty
BEI17006	Transducer Engineering	3	3	0/0	0/0	Ty
BCS17I06	Introduction to OOPS with C++ and JAVA	3	3	0/0	0/0	Ty

C : Credits L : Lecture T : Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab
* Internal evaluation (Departmental level Refer Annexure for evaluation methodology)

Practical:

BSK17ET1	Soft Skill 1	2	1	0/1	1/0	ETL
BEI17ET2	Measurements and Instruments*	3	1	0/2	1/1	ETL
BEI17L03	Transducer Laboratory	1	0	0/0	3/0	Lb
BEI17L04	Measurements Laboratory	1	0	0/0	3/0	Lb
BCS17IL6	Oops Lab Using C++	1	0	0/0	3/0	Lb
BEI17TSX	Technical Skill 1 (Evaluation)	1	0	0	2/0	Lb

Credits Sub Total: 27

Semester: 5
Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BEI17007	Control Engineering	4	3	1/0	0/0	Ty
BEI17008	Digital Signal Processing	4	3	1/0	0/0	Ty
BEI17009	Industrial Instrumentation – I	3	3	0/0	0/0	Ty
BEI17010	Fundamentals of Communication Engineering	3	3	0/0	0/0	Ty
BEE17I02	Microprocessor, Microcontroller & Its Applications	3	3	0/0	0/0	Ty

Practical:

BEI17ET3	Linear and Digital Integrated Circuits*	3	1	0/2	1/1	ETL
BEI17L05	Industrial Instrumentation Laboratory	1	0	0/0	3/0	Lb
BEI17L06	Digital Control Laboratory	**1**	0	0/0	3/0	Lb
BEE17IL3	Microprocessor, Microcontroller & Its Applications Laboratory	1	0	0/0	3/0	Lb
BEI17TS2	Technical Skill 2 (Evaluation)	1	0	0/0	2/0	Lb
BEI17L07	Inplant Training (Evaluation)	1	0	0/0	2/0	Lb

Credits Sub Total : 25

C: Credits L: Lecture T: Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research
Ty/Lb/ETL: Theory/Lab/Embedded Theory and Lab

* Internal evaluation (Departmental level Refer Annexure for evaluation methodology)

Semester: 6

Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BEI17011	Industrial instrumentation - II	4	3	1/0	0/0	Ty
BEI17012	Process Control	3	3	0/0	0/0	Ty
BEI17EXX	Elective 1	3	3	0/0	0/0	Ty
BEE17I03	Power Electronics	3	3	0/0	0/0	Ty
BEI17EOX	Open elective (Interdisciplinary)	3	3	0/0	0/0	Ty

Practical:

BSK17ET2	Soft skill 2	2	1	0/1	1/0	ETL
BEI17L08	Process Control Lab	1	0	0/0	3/0	Lb
BEI17L09	Design Project Laboratory	**1**	0	0/0	3/0	Lb
BEI17L10	Embedded System Laboratory	1	0	0/0	3/0	Lb
BEI17L11	Mini Project (Evaluation)	1	0	0/0	0/2	Lb
BEI17TSX	Technical Skill 3 (Evaluation)	1	0	0/0	2/0	Lb

Credits Sub Total: 23

Semester: 7

Theory:

Course Code	Course Title	C	L	T/SLr	P/R	Ty / Lb/ ETL
BEI17013	Computer control process	4	3	1/0	0/0	Ty
BEI17014	Virtual Instrumentation	4	3	1/0	0/0	Ty
BEI17EXX	Elective 2	3	3	0/0	0/0	Ty
BEI17EXX	Elective 3	3	3	0/0	0/0	Ty
BMG17002	Management concepts and organization Behaviour	3	3	0/0	0/0	Ty

C : Credits L : Lecture T : Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab

Practical:

BEI17ESX	Elective (Special - Based On Current Technology) *	3	1	0/2	1/1	ETL
BEI17L12	Virtual Instrumentation Laboratory	**1**	0	0/0	3/0	Lb
BEI17L13	Industrial Automation Laboratory	1	0	0/0	3/0	Lb
BEI17L14	Project Phase – 1	2	0	0/1	0/1	Lb
BFL17001	Foreign Language (Evaluation)	2	1	1		

Credits Sub Total: 26

Semester: 8
Theory:

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BEI17EXX	Elective 4	3	3	0/0	0/0	Ty
BEI17EXX	Elective 5	3	3	0/0	0/0	Ty
BMG17005	Entrepreneurship Development	3	3	0/0	0/0	Ty

Practical:

BEI17L15	Project (Phase – II)	10	0	0	10	Lb

Credits Sub Total: 19

C : Credits L : Lecture T : Tutorial S.Lr : Supervised Learning P : Problem / Practical R : Research
Ty/Lb/ETL : Theory/Lab/Embedded Theory and Lab
* Internal evaluation (Departmental level Refer Annexure for evaluation methodology)
4 Credit papers should compulsorily have either P/R component.

Credit Summary

Semester : 1 : 18
Semester : 2 : 23
Semester : 3 : 24
Semester : 4 : 27
Semester : 5 : 25
Semester : 6 : 23
Semester : 7 : 26
Semester : 8 : 19

Total Credits : 185

Elective 1

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BEI17E01	Embedded System	3	3	0/0	0/0	Ty
BEI17E02	Systems Theory	3	3	0/0	0/0	Ty
BEI17E03	System Identification and Adaptive control	3	3	0/0	0/0	Ty
BEI17E04	Neural and Fuzzy Logic Control	3	3	0/0	0/0	Ty

Elective 2

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BEI17E05	Power Plant Instrumentation	3	3	0/0	0/0	Ty
BEI17E06	PC Based Instrumentation	3	3	0/0	0/0	Ty
BEI17E07	Digital image processing	3	3	0/0	0/0	Ty
BEI17E08	Advanced process control	3	3	0/0	0/0	Ty

Elective 3

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BEI17E09	Instrumentation in Petrol Chemical Industry	3	3	0/0	0/0	Ty
BEI17E10	Intelligent Controllers	3	3	0/0	0/0	Ty
BEI17E11	Nano Technology	3	3	0/0	0/0	Ty
BEI17E12	Artificial Intelligence and Expert Systems	3	3	0/0	0/0	Ty

Elective 4

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BEI17E13	Biomedical instrumentation	3	3	0/0	0/0	Ty
BEI17E14	Digital Instrumentation	3	3	0/0	0/0	Ty
BEI17E15	Digital Control Systems	3	3	0/0	0/0	Ty
BEI17E16	Principles of Robotics	3	3	0/0	0/0	Ty

Elective 5

Course Code	Course Title	C	L	T/S Lr	P/R	Ty / Lb/ ETL
BEI17E17	Modern Control Systems	3	3	0/0	0/0	Ty
BEI17E18	Mechatronics	3	3	0/0	0/0	Ty
BEI17E19	Fibre Optics and Laser Instruments	3	3	0/0	0/0	Ty
BEI17E20	Control System Design	3	3	0/0	0/0	Ty

Subject Code:	**Subject Name : MATHEMATICS III FOR ELECTRICAL ENGINEERS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BMA17006	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To understand the basic concepts in Transformer

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the Basic concepts in Laplace Transforms
CO2	To understand the Applications of Laplace Transforms
CO3	To understand the Basic concepts in Fourier series
CO4	To understand the Basic concepts in Fourier Transforms
CO5	To understand the Basic concepts in Z Transforms

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	L	L	L	L	L	L	M	L	L	M
CO2	L	H	L	L	L	L	L	L	M	L	L	M
CO3	L	H	L	L	L	L	L	L	M	L	L	M
CO4	L	H	L	L	L	L	L	L	M	L	L	M
CO5	L	H	L	L	L	L	L	L	M	L	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	L	L	L			
CO2	M	M	L	L	L			
CO3	M	M	L	L	L			
CO4	M	M	L	L	L			
CO5	M	M	L	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
	✓											
Approval												

MATHEMATICS III FOR ELECTRICAL ENGINEERS

UNIT I LAPLACE TRANSFORMS **12 Hrs**

Transforms of simple functions – Properties of Transforms – Inverse Transforms – Transforms of Derivatives and Integrals.

UNIT II APPLICATIONS OF LAPLACE TRANSFORMS **12 Hrs**

Periodic functions – Initial and final value theorems – Convolution theorem – Applications of Laplace transforms for solving linear ordinary differential equations up to second order with constant coefficients and Linear simultaneous differential equations of first order with constant coefficients.

UNIT III FOURIER SERIES **12 Hrs**

Dirichlet's conditions – General Fourier series – Half range Sine & Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT IV FOURIER TRANSFORMS **12 Hrs**

Statement of Fourier integral theorem – Fourier transform pairs – Fourier Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's theorem.

UNIT V Z TRANSFORMS AND DIFFERENCE EQUATION **12 Hrs**

Z-transforms – Elementary properties – Inverse Z transforms – Partial fraction – Residue method – Convolution theorem – Solution of difference equation using Z transform (simple problems).

Total Number of hrs: 60 Hrs

Text Books:

1. Veerarajan T., Engineering Mathematics (for first year), Tata McGraw Hill Publishing Co., (2008)
2. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw Hill Publishing Co., (2005)
3. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012)

Reference Books:

1. Kreyszig E., Advanced Engineering Mathematics (9 th ed.), John Wiley & Sons, (2011)
2. Singaravelu, Transforms and Partial Differential Equations, Meenakshi Agency, (2017)

Subject Code: BEI17001	**Subject Name : CIRCUIT THEORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Enabling the students to acquire knowledge about the basic of circuit analysis, network theorems, ac circuits and transient analysis.
- The graduate will learn the analysis of complex circuits using mesh current and nodal voltage methods.
- Students to analyze complex circuits using network theorems.
- Understanding the concept of complex frequency & free and forced response of RL, RC & RLC circuits.
- Enabling to understand about different parameters of two networks.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands basics of circuit analysis, network theorems, ac circuits and transient analysis.
CO2	The graduate will be able to analysis complex circuits using mesh current and nodal voltage methods
CO3	Ability to analyze complex circuits using network theorems
CO4	Understands the concept of complex frequency & free and forced response of RL, RC & RLC circuits.
CO5	Acquire the knowledge about different parameters of two networks.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	H	L	M	H	M	L	H	H	M	L
CO2	M	H	H	L	M	M	H	H	L	L	H	M
CO3	M	H	H	L	M	M	H	H	L	M	H	M
CO4	H	H	M	M	H	H	L	H	H	M	L	L
CO5	H	H	M	M	H	H	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	L	L	L	M			
CO2	H	M	L	M	L			
CO3	H	M	M	L	L			
CO4	H	MM	L	L	M			
CO5	H	M	M	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

CIRCUIT THEORY

UNIT I BASICS OF CIRCUIT ANALYSIS **12 Hrs**

Kirchoff's Laws, DC and AC excitation, series and parallel circuits, sinusoidal steady state analysis, Mesh current and Node Voltage method of Analysis, Matrix method of Analysis.

UNIT II NETWORK THEOREMS AND RESONANCE CIRCUITS **12 Hrs**

Thevenin's and Norton's theorems, Superposition theorem, Compensation theorem, Reciprocity theorem, Maximum power transfer theorem, series and parallel resonance, Quality factor and Bandwidth.

UNIT III ANALYSIS OF NETWORKS IN 'S' DOMAIN **12 Hrs**

Network elements, Transient response of RL, RC and RLC Circuits to DC excitation, Natural and forced oscillations, Two-port Networks, Parameters and transfer function,Interconnection of two-ports.

UNIT IV ELEMENTS OF NETWORK SYNTHESIS **12 Hrs**

Network realizability, Hurwitz polynomials, Positive real functions, Properties of RL, RC and LC Networks, Foster and Cauer forms of Realization, Transmission Zeroes, synthesis of transfer functions.

UNIT V FILTER DESIGN **12 Hrs**

Butterworth and Chebyshev approximation, Normalized specifications, Lowpasss filter design, Frequency transformations, Frequency and Impedance denormalisation, Types of frequency selective filters, Linear phase filters, Active filter design concepts.

Total Number of Hours: 60 Hrs

Text Books:

1. A. Sudhakar, Shyammohan S. Palli, "Circuits and Networks Analysis and Synthesis", Second Edition, Tata McGraw-Hill, 2002. Unit (I – IV)
2. Vasudev. K, "Network Theory and Filter Design", Wiley – Eastern Ltd, Second Edition, 1993. (UnitV) .Aartre

Reference Books:

1. William H. Hayt and Jack E. Kermmerly, "Engineering Circuit Analysis", McGraw-Hill International Edition, 1993.
2. Joseph Edminister and MahmoodNahri, "Electric Circuits", Third Edition, Tata McGraw-Hill, New Delhi, 1999.
3. UmeshSinha, "Network Analysis", SatayaPrakasan, New Delhi, 1986.
4. Franklin. F. Kuo, "Network Analysis and Synthesis", John Wiley, 1996.
5. VanvalKenburg, "Network Analysis", Prentice Hall of India Pvt. Ltd, New Delhi, 1994.

Subject Code: BEI17002	**Subject Name : ELECTRICAL MACHINES**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Providing fair knowledge on the working of various electrical machines
- Understanding the construction, working, characteristics and applications of DC generators & DC motors.
- To learn about the construction, working, characteristics and testing of single phase transformers.
- Enabling the students to understand the principle of operation, construction and characteristics of 3 phase induction motor.
- To understand the construction and characteristics of single phase induction motor and some special motors

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the basic concepts of the rotating circuits.
CO2	Designing the DC machines and understands the working principle of the DC machine
CO3	Capable to draw the circle diagram of Induction machine
CO4	Graduate understands the principle of operation, construction and characteristics of 3 phase induction motor
CO5	Understands the construction and characteristics of single phase induction motor and some special motors

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	L	M	L	H	H	M	L
CO2	H	M	H	H	M	M	L	L	M	H	H	L
CO3	H	H	M	M	M	L	L	H	M	H	H	L
CO4	H	M	H	H	H	L	L	H	M	M	H	H
CO5	M	H	L	H	H	M	L	H	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	M	L	M			
CO2	H	H	M	H	M			
CO3	H	H	M	M	L			
CO4	H	H	M	L	M			
CO5	H	H	M	M	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

ELECTRICAL MACHINES

UNIT I D.C. MACHINES **12 Hrs**

Constructional details-EMF and Torque-Circuit model-Methods of Excitation- Characteristics of Generators- Characteristics of motors-Starting and speed control Methods-Testing and Efficiency-Losses in D.C machines-Applications.

UNIT II TRANSFORMER **12 Hrs**

Constructional details-Principle of operation-EMF equation-Equivalent circuit-Losses and efficiency-Voltage regulation-Auto transformers-Three phase transformers-Constructional details-Types of connections.

UNIT III INDUCTION MOTORS **12 Hrs**

Constructional details-types-Principle of operation-Torque equation-Equivalent circuit-Characteristics-Performance calculations-Starting methods-Speed control methods.

UNIT IV SYNCHRONOUS MACHINES **12 Hrs**

Construction of synchronous machines-Classification-Induced EMF equation-Voltage regulation-EMF method-Parallel operation-Synchronous motor-Principle of operation-Methods of starting-Hunting-Effect of change of excitation of a synchronous motor.

UNIT V SINGLE PHASE INDUCTION MOTORS & MACHINES **12 Hrs**

Single phase induction motors-Construction &Principle of working-Types-Universal motor-Reluctance motor-Stepper motor-Two phase servo motor-Tachogenerator-Linear induction motor (Qualitative Treatment

Total Number of Hours: 60 Hrs

Text Books:

1. Mulukutla.S.Sarma, "Electric Machines, Stead state theory and dynamic Performance", 2nd Edition Thomson Learning 1997
2. S.K Bhattacharya, "Electrical Machines", 3rd Edition Tata McGraw Hill Publications 2008.

Reference Books:

1. I.J. Nagrath& D.P. Kothari, "Electrical Machines", Tata McGraw Hill Publications, Second Edition 1997.
2. Nasar S.A, "Electrical Machines & Power Systems", TMH Publications
3. I cKenzie Smith ,"Hughes Electrical Technology", Revised Low price Edition, Pearson Education, Seventh edition.
4. Irving I.Kosow, "Electric Machinery and Transformers", PHI, Second Edition, 2001.

Dr.M.G.R Educational & Research Institute University

Department of ELECTRONICS AND INSTRUMENTATION ENGINEERING

Subject Code: BEI17003	**Subject Name : ANALYTICAL INSTRUMENTS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The capability to acquire knowledge on various techniques which occur in the various regions of the spectrum.
- The capability to acquire knowledge on various methods of analysis which occur in the various regions of the spectrum
- To understand Industrial Gas Analyzers And Pollution Monitoring Instruments
- To study important methods of analysis of industrial gases.
- Understanding the important radio chemical methods of analysis.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate gets knowledge on various techniques which occur in the various regions of the spectrum
CO2	The graduate gets knowledge on various methods of analysis which occur in the various regions of the spectrum
CO3	Understands Industrial Gas Analyzers And Pollution Monitoring Instruments
CO4	Students are capable of analysing important methods industrial gases analysis
CO5	Understands the important radio chemical methods of analysis.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	L	H	H	H	M	M	M	L	H
CO2	H	H	M	M	L	H	H	M	M	H	H	L
CO3	H	L	H	H	L	M	M	H	H	L	M	M
CO4	H	M	M	H	M	H	H	L	L	H	H	M
CO5	H	M	M	H	H	L	L	M	M	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H	L	H			
CO2	H	H	M	M	L			
CO3	L	M	M	H	H			
CO4	L	H	H	M	M			
CO5	H	H	M	H	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
		✓										
Approval												

ANALYTICAL INSTRUMENTS

UNIT I COLORIMETRY AND SPECTROPHOTOMETRY 9 Hrs

Special methods of analysis – Beer-Lambert law – Colorimeters – UV-Vis spectrophotometers – Single and double beam instruments – Sources and detectors – IR spectrophotometers – Types – Attenuated total reflectance flame photometers – Atomic absorption spectrophotometers – Sources and detectors – FTIR spectrophotometers – Flame emission photometers.

UNIT II CHROMATOGRAPHY 9 Hrs

Different techniques – Gas chromatography – Detectors – Liquid chromatographs – Applications – High-pressure liquid chromatographs – Applications.

UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 9 Hrs

Types of gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

UNIT IV PH METERS AND DISSOLVED COMPONENT ANALYZERS 9 Hrs

Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors, dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer.

UNIT V RADIO CHEMICAL AND MAGNETIC RESONANCE TECHNIQUES 9 Hrs

Nuclear radiations – Detectors – GM counter – Proportional counter – Solid state detectors – Gamma cameras – X-ray spectroscopy – Detectors – Diffractometers – Absorption meters – Detectors.NMR – Basic principles – NMR spectrometer - Applications.Mass spectrometers – Different types – Applications

Total Number of Hours: 45 Hrs

Text Books:

1. R.S. Khandpur, ‘Handbook of Analytical Instruments’, Tata McGraw Hill publishing Co. Ltd., 2003.
2. H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, ‘Instrumental methods of analysis’, CBS publishing & distribution, 1995.

Reference Books:

1. Robert D. Braun, ‘Introduction to Instrumental Analysis’, McGraw Hill, Singapore, 1987.
2. G.W.Ewing, ‘Instrumental Methods of Analysis’, McGraw Hill, 1992.
3. DA Skoog and D.M.West, ‘Principles of Instrumental Analysis’, Holt, Saunders Publishing, 1985.
4. C.K. Mann, T.J Vickers & W.H. Gullick, ‘Instrumental Analysis’, Harper and Row publishers, 1974

Subject Code: BME17I02	Subject Name : THERMODYNAMICS AND FLUID MECHANICS	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To know the importance, application and inter relationship of various properties of fluid
- To study theories those explain the behaviour and performance of fluid when the fluid is flowing through the pipe
- To understand the utilization of dimensional analysis as a tool in solving problems in the field of fluid mechanics
- Fundamentals concepts and laws of thermodynamics.
- Various power cycles and their applications.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate understands performance of flow using various measuring instruments
CO2	The graduate will understand the Valve timing and port timing diagrams for IC Engines
CO3	The graduate will be able to analyze performance and Heat Balance Test and performance test on Refrigerator.
CO4	The graduate will understand Fundamentals concepts and laws of thermodynamics.
CO5	The graduate will be able to analyze Various power cycles and their applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M	M	L	H	H	L	M	L	H	H
CO2	M	M	L	H	H	M	M	L	H	M	M	H
CO3	L	L	H	M	M	H	H	H	M	L	M	M
CO4	H	H	M	M	M	H	H	H	L	L	M	L
CO5	H	L	M	H	H	HL	M	H	L	M	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	M	M	L			
CO2	M	H	M	L	H			
CO3	H	H	M	L	M			
CO4	M	H	L	M	H			
CO5	H	H	L	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

THERMODYNAMICS AND FLUID MECHANICS

UNIT I FLUID MECHANICS **9 Hrs**

Fluid properties; fluid statics, manometer, control-volume analysis of mass, momentum and energy; differential equations of continuity and momentum; Bernoulli's equation; viscous flow of incompressible fluids; boundary layer; elementary turbulent flow; flow through pipes, head losses in pipes, bends etc

UNIT II FLUID MACHINERY **9 Hrs**

Introduction, types of pumps – reciprocating pump – centrifugal pump - construction details – working principles.Pelton-wheel, Francis and Kaplan turbines – construction and working principles.

UNIT III THERMODYNAMICS **9 Hrs**

Zeroth, First and Second laws of thermodynamics; thermodynamic system and processes; Carnot cycle.Irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes.

UNIT IV HEAT-TRANSFER **9 Hrs**

Modes of heat transfer; one dimensional heat conduction plain wall and cylinder, resistance concept, electrical analogy. Free and forced convective heat transfer, various correlations for heat transfer in flow over flat plates and through pipes; thermal boundary layer; effect of turbulence. Radiative heat transfer, black and grey surfaces, shape factors.

UNIT V POWER ENGINEERING **9 Hrs**

Steam Tables, Rankine, Brayton cycles with regeneration and reheat.I.C. Engines: air-standard Otto, Diesel cycles. Refrigeration and air-conditioning: Heat pumps, gas refrigeration, vapour compression cycle; Moist air: psychrometric chart, basic psychrometric properties.

Total Number of Hours: 45 Hrs

Text Books:

1. Rudramoorthy R and Mayilsamy K., 'Heat Transfer', Pearson Education.
2. Sachdeva R.C., 'Fundamentals of Engineering Heat and mass Transfer', New Age International Publishers

Reference Books:

1. Rajput R.K., 'Fluid Mechanics and Hydraulic Machines', S.Chand and Co., India.
2. Bansal R.K., 'A Text Book of Fluid Mechanics and Hydraulic Machines',S.Chand and Co., India.
3. Nag P.K., Engineering Thermodynamics, Tata McGraw Hill Co. Ltd.,
4. Rajput R.K., 'Thermal Engineering. Lakshmi Publications Pvt. Ltd.
5. Sachdeva R.C., 'Fundamentals of Engineering Heat and mass Transfer', New Age International Publishers.

Subject Code: BEI17ET1	**Subject Name : ELECTRON DEVICES AND CIRCUITS ***	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	ETL	1	0/2	1/1	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The student will develop skills in the basics of the Electronic devices
- The student will develop skills in the basics of the Electronic Circuits
- The student will identify the components and design the circuits.
- Incorporate the circuits with the software like PSPICE
- Interpretation the results of the program.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable to develop skills in the basics of the Electronic devices
CO2	Capable to develop skills in the basics of the Electronic Circuits
CO3	Capable to identify the components and design the circuits.
CO4	Understands to Incorporate the circuits with the software like PSPICE
CO5	Understands the Interpretation the results of the program.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	L	M	M	H	L	M	H	H	M	L
CO2	M	H	H	H	L	M	H	L	H	M	H	L
CO3	H	M	H	H	L	M	H	L	H	M	H	M
CO4	H	M	H	L	H	H	M	L	H	M	H	M
CO5	H	M	H	L	H	M	H	L	M	H	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H	L	M			
CO2	H	M	H	L	H			
CO3	M	L	H	L	M			
CO4	M	H	M	L	H			
CO5	H	M	H	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

ELECTRON DEVICES AND CIRCUITS

UNIT I SEMICONDUCTOR DIODE **9 Hrs**

Theory of p-n junction – p-n junction as diode – p-n diode currents – Volt-ampere characteristics – Diode resistance – Temperature effect of p-n junction – Transition and diffusion capacitance of p-n diode – Diode switching times- Zener Diode- VI Characteristics.

UNIT II BIPOLAR TRANSISTOR **9 Hrs**

Junction transistor – Transistor construction – Detailed study of currents in transistor – Input and output characteristics of CE, CB and CC configurations – Transistor hybrid model for CE configuration – Analytical expressions for transistor characteristics – Transistor switching times – Voltage rating.

UNIT III FIELD EFFECT TRANSISTORS **9 Hrs**

Junction field effect transistor – Pinch off voltage – JFET volt-ampere characteristics – JFET small signal model – MOSFETS and their characteristics – FET as a variable resistor – Unijunction transistor.

UNIT IV OPTO ELECTRONIC DEVICES **9 Hrs**

Photo emissivity and photo Electric theory – Theory, construction and characteristics: light emitting diodes, liquid crystal cell, seven segment display, photo conductive cell, photodiode, solar cell, photo transistor.

UNIT V MISCELLANEOUS DEVICES **9 Hrs**

Theory, characteristics and application: SCR, TRIAC, DIAC, tunnel diode, thermistors, piezo electric devices, charge coupled devices, varactor diode and LDR.

Total Number of Hours: 45 Hrs

Text Books:

1. Jacob Millman, Christos, C. Halkias, (2003) Electronic Devices and Circuits. New Delhi: Tata McGraw Hill Publishing Limited.
2. David, A. Bell,(2003) Electronic Devices and Circuits. New Delhi: Prentice Hall of India Private Limited.

Reference Books:

1. Theodre, F. Boghert,(2003) Electronic Devices & Circuits.6th Ed. Pearson Education.
2. Ben G. Streetman, Sanjay Banerjee,(2002) Solid State Electronic Devices. Pearson Education.PHI.
3. Allen Mottershead, (2003) Electronic Devices and Circuits – An Introduction. New Delhi: Prentice Hall of India Private Limited

Subject Code: BEI17L01	**Subject Name : ELECTRICAL TECHNOLOGY LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Providing fair knowledge on the working of various electrical machines
- Understanding the construction, working, characteristics and applications of DC generators & DC motors.
- The graduate will learn the construction, working, characteristics and testing of single phase transformers.
- Enabling the students to understand the principle of operation, construction and characteristics of 3 phase induction motor.
- To understand the construction and characteristics of single phase induction motor and some special motors

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquires fair knowledge on the working of various electrical machines
CO2	The graduate understands the construction, working, characteristics and applications of DC generators & DC motors.
CO3	The graduate will learn the construction, working, characteristics and testing of single phase transformers.
CO4	Understands the principle of operation, construction and characteristics of 3 phase induction motor.
CO5	Understands the construction and characteristics of single phase induction

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	H	H	H	M	M	L	H	H
CO2	M	H	M	H	H	L	H	M	H	M	L	H
CO3	H	H	M	L	H	H	L	M	H	M	L	H
CO4	H	M	L	H	H	M	L	H	M	H	L	H
CO5	H	M	M	L	H	H	L	M	H	L	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	L	L			
CO2	M	H	H	M	M			
CO3	L	H	M	H	H			
CO4	M	H	H	M	L			
CO5	M	H	H	H	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

ELECTRICAL TECHNOLOGY LABORATORY

LIST OF EXPERIMENTS:

1. Verification of network theorems.
1. Determination of coupling coefficient.
2. Series and parallel resonance.
3. Power measurement in single phase and three phase circuits.
4. Open circuit characteristics of DC generators.
5. Load characteristic of DC motors.
6. Speed control of DC motors
7. Brake test of DC motors.
8. Regulation of three-phase alternator.
9. Open circuit and short circuits of transformer.
10. Brake test of induction motors.
11. V-curve of synchronous motor.

Total Number of Hours: 45 Hrs

Subject Code: BEI17L02	**Subject Name : ELECTRIC CIRCUITS LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Students will learn various network theorems
- Students will demonstrate the ability to Design and apply Hardware Implementation of what they have learnt theoretically in the field of Electronics, Electric circuits and network analysis using both analog techniques.
- Students will demonstrate the ability to Design and apply Hardware Implementation of what they have learnt theoretically in the field of Electronics, Electric circuits and network analysis using both digital techniques.
- To Design and implement the hardware of a voltage Regulator for AC inputs in hardware and Design a filter circuit for Active and passive components.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students Understands various network theorems
CO2	The graduate gets the ability to Design and apply Hardware Implementation of what they have learnt theoretically in the field of Electronics, Electric circuits and network analysis using both analog techniques.
CO3	The graduate gets the ability to Design and apply Hardware Implementation of what they have learnt theoretically in the field of Electronics, Electric circuits and network analysis using both digital techniques.
CO4	Students will be able to Design and implement the hardware of a voltage Regulator for AC inputs in hardware
CO5	Students will be able to Design a filter circuit for Active and passive components.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	L	M	H	H	M	L	M	H	M
CO2	H	M	H	M	H	M	L	H	H	L	M	H
CO3	M	H	H	H	M	H	M	L	H	H	M	L
CO4	M	H	H	M	L	H	M	L	H	H	M	M
CO5	H	H	M	M	M	L	M	M	H	H	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	H	L			
CO2	H	H	M	H	H			
CO3	M	H	H	M	L			
CO4	L	H	M	H	M			
CO5	H	L	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

ELECTRIC CIRCUITS LABORATORY

LIST OF EXPERIMENTS

1. Experimental verification of Kirchhoff's voltage and current laws
2. Experimental verification of Current and Voltage Division and Source Transformation
3. Experimental verification of network theorems (Thevenin, Norton, Superposition and maximum power transfer Theorem).
4. Determination of average value, rms value, form factor, peak factor of sinusoidal wave, square wave using hard ware and digital simulation.
5. Verification of Nodal and Mesh Analysis
6. Study of CRO and measurement of sinusoidal voltage, frequency and power factor
7. Experimental determination of time constant of series R-C electric circuits
8. Experimental determination of frequency response of RLC circuits.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonant circuits
11. Design and Simulation of Half wave and Full wave Rectifiers
12. Simulation of three phase balanced and unbalanced star, delta networks circuits
13. Experimental determination of power in three phase circuits by two-watt meter method
14. Calibration of single phase energy meter
15. Determination of two port network parameters
16. Design and Simulation of low pass and high pass passive filters
17. Design and Verification of Attenuators
18. Determination of self, mutual inductance and coefficient of coupling.

.

Total Number of Hours: 45 Hrs

Subject Code: BME17IL1	Subject Name : THERMODYNAMICS AND FLUID MECHANICS LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To analyze performance of flow using various measuring instruments.
- Providing fair knowledge on the working of various Pumps for testing their performance.
- To learn the Valve timing diagrams for IC Engines.
- To learn the port timing diagrams for IC Engines.
- To analyze performance and Heat Balance Test and performance test on Refrigerator.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate understands performance of flow using various measuring instruments.
CO2	Acquires knowledge on the working of various Pumps for testing their performance.
CO3	The graduate will understand the Valve timing and port timing diagrams for IC Engines.
CO4	The graduate will understand the port timing diagrams for IC Engines
CO5	The graduate will be able to analyze performance and Heat Balance Test and performance test on Refrigerator.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	H	H	M	M	H	M	L	H	L
CO2	H	M	M	L	H	M	H	H	M	L	M	H
CO3	M	H	H	M	L	H	M	H	M	M	H	L
CO4	H	M	H	M	H	M	H	M	L	M	H	L
CO5	H	H	H	M	M	M	H	L	M	H	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	L	H			
CO2	M	H	L	M	H			
CO3	H	H	M	L	H			
CO4	H	M	L	H	M			
CO5	M	H	L	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

THERMODYNAMICS AND FLUID MECHANICS LABORATORY

LIST OF EXPERIMENTS

FLUID MECHANICS

1. Measurement of flow using Orificemeter.
2. Measurement of flow using Venturimeter.
3. Measurement of flow using flow through pipes.
4. Measurement of flow using Flow meter.
5. Performance test on Reciprocating pump.
6. Performance test on Centrifugal pump.

THERMODYNAMICS

7. Valve timing and port timing diagrams for IC Engines.
8. Performance test on a Petrol Engine.
9. Performance test on a Diesel Engine.
10. Heat Balance test on an IC Engine.
11. Boiler – performance and Heat Balance Test.
12. Performance test on a Refrigerator (Determination of COP)

Total Number of Hours: 45 Hrs

Subject Code:	**Subject Name : NUMERICAL METHODS FOR ELECTRICAL ENGINEERS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
BMA17011	Prerequisite:	T	3	1	0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :
To develop the ability in Numerical Skills

COURSE OUTCOMES (COs) : (3- 5)

CO1	To understand the Basic concepts in Numerical Analysis
CO2	To understand the Basic concepts in System of Linear Equations
CO3	To understand the Basic concepts in Non Linear Equations
CO4	To understand the Basic concepts in Interpolation
CO5	To understand the Basic concepts in Numerical Differentiation and Integration

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	H	L	L	L	L	L	L	M	L	L	M
CO2	L	H	L	L	L	L	L	L	M	L	L	M
CO3	L	H	L	L	L	L	L	L	M	L	L	M
CO4	L	H	L	L	L	L	L	L	M	L	L	M
CO5	L	H	L	L	L	L	L	L	M	L	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	L	L	L			
CO2	M	M	L	L	L			
CO3	M	M	L	L	L			
CO4	M	M	L	L	L			
CO5	M	M	L	L	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

NUMERICAL METHODS FOR ELECTRICAL ENGINEERS

UNIT I BASICS OF NUMERICAL METHODS **12 Hrs**

Curve fitting-Method of group averages-Principle of least square-Method of moments-Finite differences-Operators (Forward, Backward & Shifting) -Relationship between the operators.

UNIT II SYSTEM OF LINEAR EQUATIONS **12 Hrs**

Gauss Elimination method – Gauss-Jordan method – Iterative methods – Gauss-Jacobi method – Gauss-Seidel method – Matrix Inversion by Gauss-Jordan method- Eigen value problem-Power method.

UNIT III NON LINEAR EQUATIONS **12 Hrs**

Solution of Algebraic and Transcendental equations – Method of false position -Fixed point iteration method (single and multi variables)- Newton-Raphson method (single and multi variables).

UNIT IV INTERPOLATION **12 Hrs**

Newton forward and backward differences – Central differences – Stirling's and Bessel's formulae – Interpolation with Newton's divided differences – Lagrange's method.

UNIT V NUMERICAL DIFFERENTIATION AND INTEGRATION **12 Hrs**

Numerical differentiation with interpolation polynomials – Numerical integration by Trapezoidal and Simpson's (both 1/3 rd & 3/8 th) rules – Two and three point Gaussian Quadrature formulae – Double integrals using Trapezoidal and Simpson's rules.

Total Number of Hours: 60 Hrs

Text Books:

1. Veerarajan T., Numerical Methods, Tata McGraw Hill Publishing Co., (2007)
2. Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall of India, (2012)

Reference Books:

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, (2012)
2. Kandasamy P., Thilagavathy, Gunavathy K., Numerical Methods (Vol.IV), S.Chand & Co., (2008)

Subject Code: BEI17004	**Subject Name : DIGITAL ELECTRONICS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Understanding logic and analyzing the logical processes
- Familiarity to common forms of number representation in digital electronic circuits and to be able to convert between different representations
- Understanding the logical operation of simple arithmetic and other MSI circuits (Medium Scale Integrated Circuits)
- To impart the concepts of sequential circuits enabling them to analyze sequential systems in terms of state machines

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate can tell the history and development of digital electronics.
CO2	Students can describe and demonstrate the use digital test equipment and its operating characteristic
CO3	Examine purpose of PAL, PLA and FPGA
CO4	Understand and recognize the various logic families like RTL, DTL, TTL, ECL.
CO5	Identify and describe flip-flop circuits.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M	H	L	H	L	M	M	H	M	L
CO2	M	H	L	H	H	M	M	L	H	M	H	M
CO3	M	H	H	L	M	H	H	M	H	M	H	M
CO4	H	H	H	L	M	H	M	H	M	H	H	M
CO5	M	H	M	H	H	H	M	H	M	H	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	M	L	H			
CO2	H	M	M	M	H			
CO3	H	M	H	M	H			
CO4	H	H	M	M	L			
CO5	M	L	H	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

DIGITAL ELECTRONICS

UNIT I NUMBER SYSTEMS **12 Hrs**

Review of binary, octal and hexadecimal number systems – Conversions; Binary Arithmetic– signed magnitude form – 1's, 2's Complement representation. Codes: - BCD, Excess-3, Grey codes, ASCII Codes, Error detecting codes (Hamming code)-Applications of Error Detecting Codes**.**

UNIT II BOOLEAN ALGEBRA **12 Hrs**

Boolean algebra – De Morgan's law - Simplifications of Boolean expression – Sum of products and product of sums – KarnaughMap(upto 5 variables) – Quince McClusky method of simplification (Including Don't care conditions)

UNIT III COMBINATIONAL LOGIC **12 Hrs**

Logic gates – AND, OR, NOT, NOR, NAND and EX-OR – combinational logic- Arithmetic circuits – Half adder – Full adder, Half Subtractor - Decimal Adder – Excess 3 adder – Code converters – Multiplexer – Demultiplexer- Encoder – decoder – Design of general combinational logic circuit. PAL, PLA and FPGA.

UNIT IV SEQUENTIAL LOGIC DESIGN **12 Hrs**

Building blocks of sequential logic-RS, JK, Master-Slave, D and T flip-flop, Asynchronous and synchronous counters - Binary and BCD counters - Shift registers –Basic models of sequential machines – concept of state diagram - State table – State reduction - Design and implementation of synchronous sequential circuits

UNIT V LOGIC FAMILIES **12 Hrs**

Characteristics of RTL, DTL, TTL, families – Schottky, clamped TTL, ECL, IIL – Mos Inverters – complementary Mosinverters.IC based Full adder ,IC based Magnitude Comparator.

Total Number of Hours: 60 Hrs

Text Books:

1. Charles H. Roth, "Fundamentals of Logic Design", Thompson Learning ,5th Edition.
2. John. M. Yarbrough, "Digital Logic: Application and design", Thomson Learning

Reference Books:

1. FLOYD:" Digital Fundamentals",10th Edition Universal Book Stall, New Delhi.1993.
2. Morris Mano, "Digital Electronics and Design", Prentice Hall of India, 2000.
3. ALBERT PAUL, MALVINO AND DONALD P LEACH: "Digital Principles and Applications" Tata McGraw Hill publications.

Subject Code: BEI17005	**Subject Name : COMPUTER NETWORKS AND DISTRIBUTED CONTROL SYSTEM**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introduction about the concept, terminologies and technologies associated with instrumentation buses and data network.
- Focus on the basic concept of communication buses.
- Providing an idea about various data networks.
- Enabling the student to get familiarized with different protocols and network components.
- The graduate can understand the application of DCS in industrial.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate understands terminologies and technologies associated with instrumentation buses and data network.
CO2	The student knows the basic concept of communication buses.
CO3	The student will be able to know about various data networks.
CO4	Enable the student to get familiarized with different protocols and network components.
CO5	The graduate understands the application of DCS in industrial

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	H	H	L	H	M	H	M	L
CO2	M	H	H	M	L	H	M	L	M	H	L	M
CO3	L	M	H	H	L	M	H	L	M	H	H	M
CO4	M	H	H	M	H	M	H	L	L	H	M	H
CO5	H	M	H	M	H	H	L	M	M	H	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	M	M	L			
CO2	M	H	L	M	H			
CO3	H	M	M	H	H			
CO4	M	H	H	M	L			
CO5	M	L	H	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

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COMPUTER NETWORKS AND DISTRIBUTED CONTROL SYSTEM

UNIT I DATA NETWORK FUNDAMENTALS **12 Hrs**

Network hierarchy and switching – open system interconnection model of ISO – Data link control protocol – BISYNC – SLDC – HLDC – media access protocol – Command – response – Token passing – CSMA/CD, TCIP/IP. .

UNIT II INTER NETWORKING **12 Hrs**

Bridges – Routers – Gateways – open system with bridge configuration – open system with gateway configuration – Standard ETHERNET and ARCNET configuration – Special requirement for networks used for control.

UNIT III DISTRIBUTED CONTROL SYSTEMS **12 Hrs**

Evolution – Different architecture – local control unit – Operator interface – Displays – Engineering interface.

UNIT IV APPLICATIONS OF DCS **12 Hrs**

DCS applications in Power plants, Iron and Steel plants, Chemical plants, Cement plants and Pulp and Paper plants.

UNIT V HART AND FIELD BUS **12 Hrs**

Introduction – Evolution of signal standards – HART communication protocol – communication modes – HART networks – Control system interface – HART commands – HART field controller implementation – HART and OSI model – Field bus – Introduction – General field bus architecture – basic requirements of field bus standard – field bus topology – interoperability – interchangeability

Total Number of Hours: 60 Hrs

Text Books:

1. A.S.Tanenbaum, Computer Networks, Third Edition, Prentice Hall of India, 1996
2. Michal P.Lucas, Distributed control systems, Van nostrand Reinhold Co., 1986

Reference Books:

1. Romily Bowden, HART application guide and the OSI communication foundation., 1999
2. G.K.McMillan, Process/ Industrial instrument and handnook, McGraw-Hill, New york, 1999.
3. Popovic D. and Bhatkar V.P., Distributed Computer Control for industrial automation, Marcel Dekkar Inc., 1990 (for Unit 4)
4. Buchanan W., Computer Busses, Arnold Publishers, London, 2000.

Subject Code: BEI17006	**Subject Name : TRANSDUCER ENGINEERING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Understanding how physical quantities are measured and converted to electrical or other forms.
- To have an adequate knowledge of different transducers, resistance.
- Developing the knowledge in inductance and capacitance transducers.
- Studying the operation, characteristics, applications of various types of transducers.
- Studying the advantages and disadvantages of various types of transducers.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The student understands the dynamics of the transducer.
CO2	The student will be able to select a suitable transducer for a given application.
CO3	The student can design a transducer as per the requirement
CO4	Understands the operation, characteristics, applications of various types of transduc
CO5	Understands the advantages and disadvantages of various types of transducers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	L	M	H	M	H	H	M	L	H
CO2	M	H	H	M	M	H	L	L	H	H	M	H
CO3	H	H	H	M	L	H	M	L	H	H	M	H
CO4	M	H	H	M	L	H	M	L	H	M	H	L
CO5	H	H	H	M	L	H	M	H	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H	M	L			
CO2	H	M	H	M	L			
CO3	L	H	M	M	H			
CO4	M	H	H	L	M			
CO5	H	L	M	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

TRANSDUCER ENGINEERING

UNIT I SCIENCE OF MEASUREMENT **9 Hrs**

Units and standards – calibration methods – static calibration – classification of errors – error analysis – statistical methods – odds and uncertainty. .

UNIT II CHARACTERISTICS OF TRANSDUCERS **9 Hrs**

Static characteristics – accuracy, precision, sensitivity, linearity etc. – mathematical model of transducers – zero, first-order and second-order transducers – response to impulse, step, ramp and sinusoidal inputs

UNIT III VARIABLE RESISTANCE TRANSDUCERS **9 Hrs**

Principle of operation, construction details, characteristics and applications of resistance potentiometers, strain gauges, resistance thermometers, thermistors, hot-wire anemometer, piezoresistive sensors and humidity sensors.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS **9 Hrs**

Induction potentiometer – variable reluctance transducers – EI pick up – LVDT – capacitive transducers – variable air gap type – variable area type – variable permittivity type – capacitor microphone.

UNIT V OTHER TRANSDUCERS **9 Hrs**

Piezoelectric transducer – magnetostrictive transducer – IC sensor – digital transducers – smart sensor – fiber optic transducers.

Total Number of Hours: 45 Hrs

Text Books:

1. Neubert, H.K.P. Instrument Transducers, Clarenden Press, Oxford, 1988.
2. Patranabis, D, Sensors and Transducers, Wheeler Publishing Co., Ltd. New Delhi, 1997

Reference Books:

1. Doebelin, E.O., Measurement Systems, McGraw-Hill Book Co., 1998.
2. Neubert, H.K.P. Instrument Transducers, Clarenden Press, Oxford, 1988.
3. Patranabis, D, Sensors and Transducers, Wheeler Publishing Co., Ltd. New Delhi, 1997.
4. Murthy, D.V.s., Transducers and Instrumentation, Prentice Hall of India Pvt. Ltd., New Delhi, 1995.
5. Renganathan, S., Transducer Engineering, Allied Publishers, Chennai, 1999.

Subject Code: BCS17I06	**Subject Name : INTRODUCTION TO OOPS WITH C++ AND JAVA**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To be able to distinguish OOPS features with procedural Oriented and
- To Analyze OOPS features to a real world object,
- To analyze generic data type for the data type independent programming which relate it to reusability.
- To understand the concepts of Java programs
- To develop basic networking programs using Java.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will be able to distinguish OOPS features with procedural Oriented and analyze these features to a real world object,
CO2	Analyze OOPS features to a real world object,
CO3	Understands the analysis of generic data type for the data type independent programming which relate it to reusability.
CO4	Understands the concepts of Java programs
CO5	Develops basic networking programs using Java

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	L	M	H	H	L	H	H	M	H
CO2	L	M	H	M	H	M	H	L	L	M	H	H
CO3	M	H	H	M	L	H	M	H	L	H	L	H
CO4	H	H	M	H	L	H	M	H	H	L	M	M
CO5	L	H	H	M	H	M	H	L	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	M	L			
CO2	L	H	M	M	H			
CO3	M	L	H	M	H			
CO4	H	H	M	M	L			
CO5	H	M	L	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

INTRODUCTION TO OOPS WITH C++ AND JAVA

UNIT I BASICS OF OOPS **9 Hrs**

Programming methodologies -Object Oriented concepts-Definition-Data members-Function members-Access specifiers-Constructors-Default constructors-Copy constructors-Destructors-Static members-Control statements, Basics of C++environment. .

UNIT II INHERITANCE AND POLYMORPHISM **9 Hrs**

Overloading operators-Functions-Friends-Class derivation-Virtual functions-Abstract base classes-Multiple inheritance.

UNIT III TEMPLATES **9 Hrs**

Class templates-Function templates-Exception handling-Streams.

UNIT IV JAVA PROGRAMMING **9 Hrs**

Java environment-Classes-Definition-Fields-Methods-Object creation-Constructors-Overloading methods-Static members-This keyword-Nested classes-Extending classes.

UNIT V INHERITANCE AND EXCEPTION **9 Hrs**

Inheritance-member accessibility-Overriding methods-Abstract classes-Interfaces. Exceptions And Threads: Exception and errors -Exception classes - Runtime Exception - Uncompact Exception - Finally block – User defined Exceptions. Creating Threads -Controlling Threads

Total Number of Hours: 45 Hrs

Text Books:

1. Stanley B.Lippman, "The C++ Primer" Addison Wesley, 5/e, 2012.
2. H.Schildt , Java 2 : The Complete Reference,6/e, Tata McGraw Hill-2008

Reference Books:

1. Deitel and Deitel, "C++ How to Program" Prentice Hall, 8/e, 2011
2. Programming in java –E.Balagurusamy-Tata McGraw Hill,4/e, 2009
3. Ken Arnold and James Gosling, "The Java Programming Language", Pearson Education, 3/e, Reprint 2009.
4. B.Stroustrup,"The C++ Programming Language", 3/e, Pearson Education, 2004.
5. E.Balagurusamy "Object Oriented Programming with C++"- 4/e. "Tata Mcgraw Hill", 2008.

Subject Code: BSK17ET1	Subject Name :SOFT SKILLS – I CAREER & CONFIDENCE BUILDING	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: None	T	1	0	1	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To create awareness in students, various top companies helping them improve their skill set matrix, leading to develop a positive frame of mind.
- To help students be aware of various techniques of candidate recruitment and help them prepare CV's and resume.
- To help student how to face various types of interview, preparing for HR, technical interviews.
- To help students improve their verbal reading, narration and presentation skills by performs various mock sessions.

COURSE OUTCOMES (COs) : (3- 5)

Students will be able to

CO1	Be aware of various top companies leading to improvement in skills amongst them.
CO2	Be aware of various candidate recruitment techniques like group discussion, interviews and be able to prepare CV's and resumes.
CO3	Prepare for different types of interviews and be prepared for HR and technical interviews.
CO4	Improve their verbal, written and other skills by performing mock sessions.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	L	L	L	L	L	M	M	H	M	H	M	H
CO2	L	L	L	L	L	M	M	H	M	H	M	H
CO3	L	L	L	L	L	M	M	H	M	H	M	H
CO4	L	L	L	L	L	M	M	H	M	H	M	H

COs / PSOs	PSO1	PSO2	PSO3
CO1	L	L	H
CO2	L	L	H
CO3	L	L	H
CO4	L	L	H

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
			✓						✓			
Approval												

SOFT SKILLS – I CAREER & CONFIDENCE BUILDING

UNIT I **6 Hrs**

Creation of awareness of top companies / improving skill set matrix / Development of positive frame of mind / Creation of self-awareness.

UNIT II **6 Hrs**

Group discussions / Do's and don'ts – handling group discussions / what evaluators look for interpersonal relationships / Preparation of Curriculum Vitae / Resume.

UNIT III **6 Hrs**

Interview – awareness of facing questions – Do's and don'ts of personal interview / group interview, enabling students to prepare for different proce3dures such as HR interviews and Technical Interviews / self-introductions.

UNIT IV **6 Hrs**

Verbal aptitude, Reading comprehension / narration / presentation / Mock Interviews.

UNIT V **6 Hrs**

Practical session on Group Discussion and written tests on vocabulary and reading comprehension

Total Number of Hours: 30 Hrs

Subject Code: BEI17ET2	**Subject Name : MEASUREMENTS AND INSTRUMENTS ***	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	ETL	1	0/2	1/1	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Developing adequate knowledge of the instruments, relevant circuits and their working
- Introduction to electrical instruments and
- Introduction to measurements techniques.
- To Emphasis Knowledge on analog techniques used to measure voltage, current, power etc
- To Emphasis Knowledge on digital techniques used to measure voltage, current, power etc

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate will get adequate knowledge of the instruments, relevant circuits and their working
CO2	Capable of describing various electrical instruments
CO3	Capable of describing various measurements techniques.
CO4	Knowledge on analog techniques used to measure voltage, current, power etc. gets enhanced
CO5	Knowledge on digital techniques used to measure voltage, current, power etc. gets enhanced

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	H	L	H	M	M	H	M	H	L	H
CO2	H	H	M	H	M	H	H	L	H	M	H	L
CO3	M	H	L	M	H	M	L	M	H	M	H	L
CO4	H	M	L	M	H	M	L	H	H	H	M	M
CO5	L	H	M	H	H	M	L	H	H	H	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H	M	L			
CO2	L	M	H	M	H			
CO3	H	H	M	L	L			
CO4	M	H	H	M	L			
CO5	H	M	M	L	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

MEASUREMENTS AND INSTRUMENTS

UNIT I INTRODUCTION **9 Hrs**

Units, Dimensions and standards-measurement errors PMMC, moving iron instruments – Galvanometer – construction -Principle of operation- Types of Ammeter & voltmeter- Rectifier type voltmeter and ammeter. .

UNIT II RESISTANCE, INDUCTANCE & CAPACITANCE MEASUREMENTS **9 Hrs**

Resistance measurement – wheat stone bridge & Kelvin double bridge measurement of inductance and capacitance– Maxwell bridge& Hay's bridge measurement of capacitance – Schering bridge, student type potentiometer- precision potentiometer – AC potentiometer, polar and co-ordinate type – application.

UNIT III WATT METER AND ENERGY METER CALIBRATION **9 Hrs**

Electro dynamic Instruments, wattmeter – theory and its error – methods of correction – LPF wattmeter – induction type wattmeter – theory and adjustment – calibration of wattmeter and energy meter, Instrument transformer – construction and theory of current Transformer & potential Transformer..

UNIT IV ANALOG & DIGITAL INSTRUMENTS **9 Hrs**

CRO – operation – measurement of voltage, frequency and phase-Analog storage oscilloscope, sampling oscilloscope -DSO – operation, signal & function generation – Digital voltmeter and mutimeter. Q-meter.

UNIT V DIGITAL DISPLAY AND RECORDING DEVICES **9 Hrs**

Bar graph display – seven segment and dot matrix display – signal recorders – XY recorders – magnetic tape recorders – digital recording and data loggers.

Total Number of Hours: 45 Hrs

Text Books :

1. Rangan C.S. "Instrumentation Devices and Systems", Tata McGraw Hill, 1998.
2. Cooper, "Electronic Instrumentation and Measurement Techniques", Prentice Hall of India, 1988.
3. A. K. Shawney "Electronics and Electrical Instrumentation" Tata McGraw Hill, 1975.

Reference Books:

1. Bouwels A.J., "Digital Instrumentation", McGraw Hill, 1986.
2. Barney .C, "Intelligent Instrumentation ", Prentice Hall of India, 1985.
3. Oliver and Cage, "Electronic Measurements and Instruments and Instrumentation", McGraw Hill, 1975.
4. Deobelin, "Measurements Systems", McGraw Hill, 1990.

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Subject Code: BEI17L03	**Subject Name : TRANSDUCER LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To learn practically about transducers and about the types of Transducers
- To study various transducers used for the measurement of various physical Quantities
- To identify suitable instruments to meet the requirements of industrial applications
- To measure Resistive, Capacitive and Inductive transducers
- To calibrate various transducers

COURSE OUTCOMES (COs) : (3- 5)

CO1	Enables the students to practically know about transducers and about the types of Transducers
CO2	various transducers used for the measurement of various physical Quantities
CO3	The student can identify suitable instruments to meet the requirements of industrial applications
CO4	The graduate can measure Resistive, Capacitive and Inductive transducers
CO5	Graduate can calibrate various transducers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M	H	H	M	M	L	H	M	H	M
CO2	H	H	H	H	M	M	L	L	M	H	M	L
CO3	H	M	M	M	M	L	M	M	H	H	M	L
CO4	M	H	H	M	H	M	H	H	H	M	L	M
CO5	H	H	H	M	L	M	L	M	H	H	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H	H	L			
CO2	H	H	H	M	M			
CO3	M	H	H	M	L			
CO4	H	H	M	H	L			
CO5	M	M	H	L	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

TRANSDUCER LABORATORY

LIST OF EXPERIMENTS

1. Displacement versus output voltage characteristics of a Potentiometric transducer.
2. Strain gauge characteristics.
3. Load cell characteristics.
4. Photoelectric tachometer.
5. Hall effect transducer.
6. Characteristics of LVDT.
7. Characteristic of LDR, Thermistor and thermocouple.
8. Ramp response characteristic of filled in system thermometer.
9. Step response characteristic of RTD and thermocouple.
10. Flapper nozzle system.
11. P/I and I/P converters.
12. Study of smart transducers

Total Number of Hours: 45 Hrs

Subject Code: BEI17L04	**Subject Name :MEASUREMENTS LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Developing adequate knowledge of the compensating circuits
- Introduction to synchronous motor
- Introduction to measurements techniques.
- To Emphasis Knowledge on control system
- To Emphasis Knowledge on digital techniques used to measure voltage, current, power etc

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate will get adequate knowledge of the compensating circuits
CO2	Capable of describing synchronous motor
CO3	Capable of describing various measurements techniques.
CO4	Knowledge on control system
CO5	Knowledge on digital techniques used to measure voltage, current, power etc. gets enhanced

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	L	H	H	M	M	L	L	M
CO2	M	H	H	M	L	M	H	H	H	L	M	M
CO3	M	H	H	H	H	L	M	L	M	L	H	H
CO4	H	H	H	M	M	M	H	M	H	L	H	M
CO5	M	H	H	L	L	M	H	H	H	M	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	H	M			
CO2	H	H	M	L	H			
CO3	H	M	H	L	L			
CO4	L	H	H	L	M			
CO5	M	M	H	L	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

MEASUREMENTS LABORATORY

LIST OF EXPERIMENTS:

1. Compensating Networks
2. Study of synchronous Motor
3. DC stepper Motor
4. DC Position control system
5. AC position control system
6. Digital control (P & PI) of I order system
7. Digital control (state variable feedback) of II order liquid level system
8. Study of transducers
9. Use of Wheatstone bridge as a resistance to voltage converter and to determine its sensitivity for various ratios
10. Kelvin double bridge

Total Number of Hours: 45 Hrs

Subject Code: BCS17IL6	**Subject Name : OOPS LABORATORY USING C++**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To be able to understand and apply various object oriented features like inheritance, data abstraction, encapsulation and polymorphism
- To solve various computing problems using C++ language.
- To be able to create a program that measures or simulates performance and use it
- To be analyze the behavior of the performance of the program
- The students will be able to an object-oriented program design into the class and template model of C++.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Able to understand and apply various object oriented features like inheritance, data abstraction, encapsulation and polymorphism to solve various computing problems using C++ language.
CO2	To solve various computing problems using C++ language
CO3	Students will be able to create a program that measures or simulates performance and use it
CO4	Analyze the behavior of the performance of the program
CO5	The graduates can map an object-oriented program design into the class and template model of C++.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M	H	H	H	M	M	L	H	H	M	M
CO2	M	H	H	M	M	L	H	M	H	L	H	M
CO3	H	H	H	M	M	L	M	H	M	L	H	M
CO4	M	M	H	M	H	M	H	H	M	L	H	M
CO5	H	M	H	L	L	M	H	M	L	H	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H	H	L			
CO2	H	H	M	M	L			
CO3	M	H	H	M	M			
CO4	H	H	M	M	M			
CO5	L	L	M	L	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

OOPS LABORATORY USING C++

LIST OF EXPERIMENTS

- To implement the following list of programs.

1. Write a C++ program for Simple Interest. And adding two numbers
2. Write a C++ program for Control Structure.
3. Write a C++ program for Inline Function.
4. Write a C++ program for Function Overloading.
5. Using Class concept write a C++ program for Constructor and Destructor.
6. Using Class concept write a C++ program for Overloading Unary Operator, Binary operator.
7. Using Class concept write a C++ program for Single Inheritance.
8. Using Class concept write a C++ program for Multiple Inheritance.
9. Using Class concept write a C++ program for Multilevel Inheritance.

USING JAVA

1. Write a JAVA program Find the length of array.
2. Write a JAVA program to Prime number checking and sum of digit
3. Write a program for example of try and catch block. In this check whether the given array size is negative or not.
4. Write the programs using the concept of Generic class, Inheritance, Interface and Package
5. Write a program to create a file and write data into it using the methods Output Stream class.
6. Write a program that uses the concept of Applet and Exception Handling
7. Write a program to give example for multiple inheritance in Java
8. Write an application to simulate traffic lights and calculator using GridbagLayout
9. Write the program which creates the Frame and implements MouseListener

Total Number of Hours: 45 Hrs

Subject Code: BEI17TSX	**Subject Name : TECHNICAL SKILL I**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
		L	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

Approval	

Subject Code: BEI17007	**Subject Name : CONTROL ENGINEERING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To provide strong foundation in basic science and mathematics necessary to formulate, solve and analyse control and instrumentation problems.
- To understand and apply differential equation, integrals, matrix theory, probability theory, etc..
- To provide good knowledge of instrumentation systems and their applications.
- To provide necessary foundation on computational platforms and software applications related to the respective field of engineering.
- To provide an opportunity to work in inter-disciplinary groups.

COURSE OUTCOMES (Cos) : (3- 5)

CO1	The graduate gets Strong foundation in basic science and mathematics necessary to formulate, solve and analyze control and instrumentation problems.
CO2	Understands and applies differential equation, integrals, matrix theory, probability theory, etc.
CO3	Gets good knowledge of instrumentation systems and their applications.
CO4	Gets necessary foundation on computational platforms and software applications related to the respective field of engineering
CO5	Gets an opportunity to work in inter-disciplinary groups.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	M	H	M	H	M	L	L	H	M
CO2	M	M	H	H	H	L	L	M	H	M	H	M
CO3	M	H	M	L	H	M	L	L	H	H	M	H
CO4	H	M	L	M	H	M	L	H	M	L	M	H
CO5	H	L	L	M	H	H	M	H	M	H	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H	M	L			
CO2	H	M	M	H	L			
CO3	L	H	M	M	H			
CO4	H	L	L	H	M			
CO5	H	M	H	L	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

CONTROL ENGINEERING

UNIT I SYSTEMS AND THEIR REPRESENTATION **12 Hrs**

Basic elements in control systems-open and closed loop systems – Mathematical modeling of Mechanical Translational system and Rotational system - Electrical analogy of physical systems – transfer function – AC and DC servomotors – block diagram reduction techniques – signal flow graph. .

UNIT II TIME RESPONSE **12 Hrs**

Time response – time domain specifications – types of test inputs – I and II order system response – error coefficients – generalised error series – steady state error – PID controller response with and without I order system.

UNIT III FREQUENCY RESPONSE **12 Hrs**

Frequency response – definition – Bode plot – polar plot – constant M and N circles – Nichols chart – determinate of closed loop response from open loop response..

UNIT IV STABILITY OF CONTROL SYSTEM **12 Hrs**

Characteristic equation – location of roots in s-plane for stability – Routh Hurwitz criterion – root locus techniques – construction – gain margin and phase margin – Nyquist stability criterion.

UNIT V CONTROL SYSTEM DESIGN **12 Hrs**

Performance criteria – selection of controller modes – lag, lead, and lag-lead networks – compensator design for desired response. PI, PD and PID Controllers – Feedback compensation.

Total Number of Hours: 60 Hrs

Text Books:

1. Ogata K., Modern Control Engineering, Prentice Hall of India Ltd., New Delhi, 1995.
2. I.Gopal, and M.Nagrath, Control Systems, Wiley Eastern, Ltd., New Delhi, 1985
3. A. NagoorKani, control systems, R.B.A publications, Chennai

Reference Books:

1. Kuo B.C., Automatic Control Systems, Prentice Hall of India Ltd., New Delhi, 1995.
2. M.Gopal, Control Systems, Principles and Design, Tata McGraw-Hill Publishing Co., New Delhi, 1997.

Subject Code: BEI17008	**Subject Name : DIGITAL SIGNAL PROCESSING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introduction to periodic & pulse signals, various systems and time domain analysis.
- Graduates to understand the properties of Z-transform and they able solve the Fourier series.
- Overview of FFT and problems in the fast Fourier transform.
- Students to design IIR and FIR filters with Fourier series method.
- Architecture and features of various signal processing chips.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students understand about discrete time signals and system.
CO2	Understand the properties of Z-transform and they able solve the Fourier series.
CO3	Students learn the overview of Fourier transform, FIR and IIR filters.
CO4	Capable to design IIR and FIR filters with Fourier series method
CO5	Acquire knowledge about Architecture and features of various signal processing chips

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	H	M	H	M	H	H	M	M	L	M
CO2	M	M	M	H	H	H	H	M	M	H	L	H
CO3	H	H	M	L	H	M	H	H	M	H	M	H
CO4	H	L	M	H	M	H	M	L	H	M	H	H
CO5	H	H	M	M	H	M	H	H	H	L	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	M	L			
CO2	M	M	H	L	H			
CO3	H	M	M	L	M			
CO4	L	H	M	M	M			
CO5	M	L	M	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

DIGITAL SIGNAL PROCESSING

UNIT I DISCRETE TIME SIGNALS AND SYSTEMS **12 Hrs**

Periodic and pulse signals – examples of sequences – pulse step, impulse, ramp, sine and exponential – differential equations – linear time invariant – stability, causality – DT systems – time domain analysis

UNIT II Z- TRANSFORM **12 Hrs**

Z-transform and its properties – convolution – inverse Z-transform – discrete Fourier series – properties – sampling the Z-transform – discrete Fourier transform – properties for frequency domain analysis – linear convolution using discrete Fourier transform – overlap add method, overlap save method.

UNIT III FAST FOURIER TRANSFORM (FFT) **12 Hrs**

Introduction to Radix 2 FFT's – decimation in time FFT algorithm – decimation in frequency FFT algorithm – computing inverse DFT using FFT – mixed radix FFT algorithm – periodogram technique.

UNIT IV IIR AND FIR FILTER DESIGN **12 Hrs**

Classification – reliability constrains – IIR design – bilinear transform method – impulse invariant method – step – invariance method – FIR design – Fourier series method – window function method.

UNIT V PROGRAMMABLE DSP CHIPS **12 Hrs**

Architecture and features of TMS 320C50 and ADSP 2181signal processing chips

Total Number of Hours: 60 Hrs

Text Books:

1. Openheim A.V., and Schafer R.W., Discrete Time Signal Processing, Prentice Hall of India, New Delhi, 1992

2. Proakis J.G. and Manolakis, D.G., Digital Signal Processing Principles, Algorithms and Applications, Prentice Hall of India, New Delhi, 1997.

Reference Books:

1. Antonian A., Digital Filters analysis and Design, Tata McGraw-Hill Publishing Co., New Delhi, 1988.

2. Stanley W.D., Digital Signal Processing, Restion Publishing House, 1989.

3.ADSP2181 DATASHEET http://www.analog.com/UploadedFiles/Datasheets/505104853ADSP2181_d.pdf

4. TMS320C50 DATASHEET http://www.ti.com/sc/ds/smq320c50.pdf

Subject Code: BEI17009	**Subject Name : INDUSTRIAL INSTRUMENTATION – I**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To acquire familiarity about various industrial instrumentation types, their parameters and different types of measurement techniques.
- To understand the basics in measurement techniques of force, torque and speed and
- To learn about techniques of acceleration, Vibration and density
- To gain knowledge about pressure measurement techniques.
- To gain extensive knowledge about temperature measurement techniques.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students acquire familiarity about various industrial instrumentation types, their parameters and different types of measurement techniques.
CO2	Students understand the basics in measurement techniques of force, torque and speed
CO3	Acquires knowledge on techniques of acceleration, Vibration and density
CO4	Acquire extensive knowledge about pressure measurement techniques
CO5	Acquire extensive knowledge about temperature measurement techniques

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	L	M	H	M	L	M	H	M	L
CO2	H	M	H	M	H	M	H	M	L	H	M	H
CO3	M	H	L	M	H	M	H	L	H	M	H	L
CO4	M	M	H	M	H	M	H	L	L	M	M	H
CO5	L	L	H	M	H	M	H	L	L	H	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	L	H	M	L			
CO2	M	L	H	H	M			
CO3	M	H	M	H	L			
CO4	M	H	H	M	L			
CO5	L	M	M	L	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

INDUSTRIAL INSTRUMENTATION – I

UNIT I MEASUREMENT OF FORCE, TORQUE AND VELOCITY 9 Hrs

Electric balance – Different types of load cells – Magnets – Elastic load cells - Strain gauge load cell – Different methods of torque measurement – Strain gauge, relative regular twist – Speed measurement – Revolution counter – Capacitive tacho-drag cup type tacho – D.C and A.C tacho generators – Stroboscope.

UNIT II MEASUREMENT OF ACCELERATION, VIBRATION, DENSITY AND VISCOSITY 9 Hrs

Accelerometers – LVDT, piezoelectric, strain gauge and variable reluctance type accelerometers – Mechanical type vibration instruments – Seismic instrument as an accelerometer and vibrometer – Calibration of vibration pick-ups – Units of density, specific gravity and viscosity used in industries – Baume scale, API scale – Pressure head type densitometer – Float type densitometer – Ultrasonic densitometer – Bridge type gas densitometer – Viscosity terms – Saybolt viscometer – Rotameter type.

UNIT III PRESSURE MEASUREMENT 9 Hrs

Units of pressure - Manometers – Different types – Elastic type pressure gauges – Bourdon type bellows – Diaphragms – Electrical methods – Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor – Resonator pressure sensor – Measurement of vacuum – McLeod gauge – Thermal conductivity gauges – Ionization gauge, cold cathode and hot cathode types – Testing and calibration of pressure gauges – Dead weight tester.

UNIT IV TEMPERATURE MEASUREMENT 9 Hrs

Definitions and standards – Primary and secondary fixed points – Calibration of thermometer, different types of filled in system thermometer – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – Electrical methods of temperature measurement – Signal conditioning of industrial RTDs and their characteristics – Three lead and four lead RTDs.

UNIT V THERMOCOUPLES AND PYROMETERS 9 Hrs

Thermocouples – Laws of thermocouple – Fabrication of industrial thermocouples – Signal conditioning of thermocouples output – Thermal block reference functions – Commercial circuits for cold junction compensation – Response of thermocouple – Special techniques for measuring high temperature using thermocouples – Radiation methods of temperature measurement – Radiation fundamentals – Total radiation & selective radiation pyrometers – Optical pyrometer – Two colour radiation pyrometers.

Total Number of Hours: 45 Hrs

Text Books:

1. E.O. Doebelin, ‘Measurement Systems – Application and Design’, Tata McGraw Hill publishing company, 2003.
2. R.K. Jain, ‘Mechanical and Industrial Measurements’, Khanna Publishers, New Delhi,1999.

Reference Books:

1. D. Patranabis, ‘Principles of Industrial Instrumentation’, Tata McGraw Hill Publishing Company Ltd, 1996.
2. A.K. Sawhney and P. Sawhney, ‘A Course on Mechanical Measurements, Instrumentation and Control’, DhanpathRai and Co, 2004.
3. B.C. Nakra&K.K.Chaudary, ‘Instrumentation Measurement & Analysis’, Tata McGraw Hill Publishing Ltd, 2004.
4. S.K. Singh, ‘Industrial Instrumentation and Control’, Tata McGraw Hill, 2003.
5. D.P. Eckman’, Industrial Instrumentation’, Wiley Eastern Ltd

Subject Code: BEI17010	**Subject Name : FUNDAMENTALS OF COMMUNICATION ENGINEERING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Analysing the frequencies of radio communication system.
- Graduates to understand the various modulation schemes.
- Overview of data transmission through FSK, PSK, etc..
- Able to recognise the cables, optical fibres and concepts of FDM &TDM transmission.
- Ability to understand the scanning methods, picture tubes, and synchronization of communication.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable of understanding the concepts of Analog and Digital communication circuits
CO2	Gain knowledge about the Communication conversion methods
CO3	Gain knowledge about the different concepts of modulation techniques
CO4	Develop knowledge about the various digital communication media
CO5	Ability to understand and incorporate the concepts of IOT in different fields.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	M	H	H	L	H	M	H	M	H
CO2	M	H	H	M	L	L	M	H	H	M	M	L
CO3	M	M	M	H	H	M	H	L	H	M	H	M
CO4	H	H	H	M	M	L	L	M	H	M	L	H
CO5	M	M	M	M	H	H	H	L	L	H	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	M	M	L			
CO2	M	M	H	H	M			
CO3	L	L	H	M	H			
CO4	H	M	L	H	H			
CO5	M	H	M	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

FUNDAMENTALS OF COMMUNICATION ENGINEERING

UNIT I RADIO COMMUNICATION SYSTEMS **9 Hrs**

Frequency Spectrum – Principle of AM and FM – AM and FM transmitters and receivers – introduction to microwave communication systems – Principles of Satellite communication.

UNIT II PULSE COMMUNICATION SYSTEMS **9 Hrs**

PAM, PPM, PDM, PCM – Delta Modulation – Differential PCM – Merit and demerits – comparison of pulse modulation schemes

UNIT III DATA TRANSMISSION **9 Hrs**

Base Band Signal Receiver – error probability – optimum and matched filter techniques. Coherent Reception – Digital modulations systems – FSK, PSK – comparison of Data Transmission Systems.

UNIT IV TRANSMISSION MEDIUM **9 Hrs**

Characteristics of cables – optical fibers – Effects of EM Radiation – Bandwidth and Noise Restrictions – Statistical measurements of Random Noise – Concept of Multiplexing FDM and TDM.

UNIT V TELEVISION **9 Hrs**

Scanning methods - B/W and colour systems – camera and picture tubes – synchronization – Transmitters and Receivers.

Total Number of Hours: 45 Hrs

Text Books:

1. Kennedy, Electronic Communication systems 1987 McGraw Hill.
2. Simon Haykins, Communication Systems 1995 Wiley
3. Roddy and Coolen, Electronic Communication 1999, PHI

Reference Books:

1. Dr.J.S.Chitode, Principles Of communication, technical publications, 2009

Subject Code: BEE17I02	**Subject Name: MICROPROCESSOR, MICROCONTROLLER, AND ITS APPLICATIONS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr: Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To develop an in-depth understanding of the operation of microprocessor and microcontroller, machine language programming and interfacing techniques.
- The graduate will learn some the internal organization of some popular microprocessor and microcontroller.
- To learn hardware and software interaction and integration.
- The graduate will learn the design of microprocessor and microcontroller based system.
- Understand the application of microcontroller.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Familiarize with operation of microprocessor and microcontroller, machine language programming and interfacing techniques
CO2	Acquire the knowledge on internal organization of some popular microprocessor and microcontroller
CO3	Capable of understanding the hardware and software interaction and integration
CO4	Understand the design of microprocessor and microcontroller based system
CO5	Understand the applications of microcontroller

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	L	H	M	H	M
CO2	H	H	H	H	H	H	M	M	H	M	H	M
C03	H	H	H	M	M	L	L	L	M	L	M	L
CO4	H	H	H	H	H	M	M	M	H	M	H	M
CO5	H	H	H	H	H	M	M	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	H	M	M			
CO2	M	H	H	H	M			
CO3	L	H	H	M	L			
C04	L	M	M	M	L			
CO5	M	H	H	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

MICROPROCESSOR, MICROCONTROLLER, AND ITS APPLICATIONS

UNIT I ARCHITECTURE **9 Hrs**

General 8-bit microprocessor and its architecture – 8085 functional block diagram – architecture functions of different sections – architecture of 8086 CPU.

UNIT II INSTRUCTION SETS **9 Hrs**

Instruction format-addressing addressing modes – instruction set of 8085 CPU – instruction cycle – timing diagrams – different machine cycles – fetch and execute operations – estimation of execution time.

UNIT III ASSEMBLY LANGUAGE PROGRAMMING **9 Hrs**

Assembly format of 8085 – assembly directions – multiple precision arithmetic operations – binary to BCD and BCD to binary code conversion – ALU programming using look up table – stack and subroutines

UNIT IV DATA TRANSFER AND INTERFACING **9 Hrs**

Data transfer schemes – program I/O û interrupt structure of 8085 – interrupt driven I/O – DMA serial I/O – input/output ports – latches and buffers – peripheral interface IC's – 8212, 8255, 8251, 8279, 8259 – interfacing of A/D and D/A converters – RAM and ROM – memory devices – display devices – applications.

UNIT V MICROCONTROLLERS **9 Hrs**

Architecture of 8-bit micro controller (8051) – bus configuration – reset circuitry – power down considerations – instruction sets - programming exercises and micro controllers software design - development and troubleshooting tools – applications.

Total Number of Hours: 45 Hrs

Text Books:

1. Gaonkarr.s.,Microprocessor architecture programming and application, wiley eastern ltd., new delhi, 1995.
2. Kenneth hint, and danieltabak, microcontrollers, architecture, implementation and programming, mcgraw hill international, usa, 1992.

Reference Books:

1. Mathur A.P., Introduction of Microprocessors, Tata McGraw-Hill Publishing Co.Ltd., New Delhi, 1989.
2. John B.Peatman, Design with Microcontrollers, McGraw Hill International, USA, 1988.

Subject Code: BEI17ET3	**Subject Name : LINEAR AND DIGITAL INTEGRATED CIRCUITS***	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	ETL	1	0/2	1/1	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The purpose of this course is to enable the students to understand the fundamentals of integrated circuits and designing electronic circuits using it.
- Implementing various circuits using Op-Amps.
- The graduate can understand & Design waveforms Generating circuits and Multivibrators.
- Design simple filter circuits for specific engineering application
- Design combinational logic circuits using digital IC's.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The students will be able to understand the fundamentals of integrated circuits and designing electronic circuits using it.
CO2	Acquires knowledge on Implementing various circuits using Op-Amps
CO3	The graduate can understand & Design waveforms Generating circuits and Multivibrators.
CO4	Students can be able to design simple filter circuits for specific engineering application
CO5	The graduate will be able to Design combinational logic circuits using digital IC's.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	H	M	H	H	M	M	L	L	H
CO2	M	H	H	H	M	M	L	L	M	H	H	L
CO3	M	H	H	M	H	M	H	H	M	H	L	H
CO4	H	M	H	L	H	L	M	H	L	M	H	M
CO5	H	M	L	L	H	M	M	H	L	H	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	M	H	L			
CO2	H	M	M	H	M			
CO3	M	H	H	M	L			
CO4	M	H	M	L	H			
CO5	L	M	H	L	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

LINEAR AND DIGITAL INTEGRATED CIRCUITS*

UNIT I FABRICATION OF INTEGRATED CIRCUITS 9 Hrs

Silicon Wafer Preparation – Epitaxial growth –Photolithography – Etching – Diffusion: - Thermal Diffusion and Ion implantation – Metallization – Packaging – Realization of passive and active devices- Resistor, Capacitor, diode, BJT, FET and MOS transistors. .

UNIT II LINEAR INTEGRATED CIRCUITS 9 Hrs

Introduction to Linear IC – Operational amplifiers – DC characteristics:- bias, offset and drift –AC characteristics:- bandwidth, slew rate and noise - Inverting and non inverting amplifiers - Zero crossing detector with hysteresis – Arithmetic Circuits.

UNIT III APPLICATIONS OF OP-AMP 9 Hrs

Precision rectifiers – Active filters – Butterworth low-pass filter and Butterworth highpass filter - Waveform generators: - Square, triangular and sine wave – V to I converter and I to V converter- Instrumentation Amplifier - Log and antilog amplifiers..

UNIT IV TIMER AND PHASE-LOCKED LOOP 9 Hrs

Basic functional block diagram - Characteristics and applications of ICs:- 555, 565,566, LM 723 voltage regulator and current regulator**.**

UNIT V -SPECIAL FUNCTIONS ICs 9 Hrs

Functional Block diagram of ADC and DAC – Sample and Hold circuit – Successive Approximation ADC - Integrating ADC – Sigma Delta ADC – Study of successive approximation ADC IC – Study of Integrating ADC IC – Study of Sigma Delta ADC IC – Study of 8 bit DAC IC – Temperature Sensor IC - Piezoelectric Pressure Sensor IC – Hall-Effect sensor IC and Level sensor IC.

Total Number of Hours: 45 Hrs

Text Books:

1. Gayakwad, R.A, "OP-Amps and Linear Integrated Circuits", Prentice Hall of India, New Delhi, 4th Edition, Pearson Education, 2003.
2. Choudhury, R. and Jain, S., "Linear Integrated Circuits", 3rd Edition, New Age Pub., 2007.

Reference Books:

1. Botkar, K.R., "Integrated circuits", Khanna Publishers, New Delhi, 2003.
2. Millman, J., and Halkias, C. C., "Integrated Electronics - Analog and Digital circuits System", Tata McGraw-Hill, 2003.
3. Coughlin, R.F., Driscoll, F. F., "Operational Amplifiers and Linear Integrated Circuits", Pearson Education (P) Ltd, 6th Edition, 2006.
4. Franco, S., "Design with Operational and Analog Integrated Circuits", Tata McGraw- Hill Publishing Co., 3rd Edition, 2002.
5. Bell, D.A, "Op-amp & Linear ICs", Prentice Hall of India, 2nd Edition, 2007.

Subject Code: BEI17L05	**Subject Name : INDUSTRIAL INSTRUMENTATION LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0 /0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To enable the students to understand the fundamentals of orifice plate.
- The graduate can understand calibration and measurement.
- Overview about the practical knowledge about the spectrophotometer

COURSE OUTCOMES (COs) : (3- 5)

CO1	Enable the students to understand the fundamentals of orifice plate.
CO2	The graduate can understand calibration and measurement.
CO3	Understands the Overview about the practical knowledge about the spectrophotometer

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	H	M	M	H	L	H	L
CO2	L	H	M	M	L	H	L	M	H	L	M	H
CO3	H	H	H	M	M	M	L	L	L	H	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	H	M			
CO2	M	H	M	H	M			
CO3	H	M	M	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

INDUSTRIAL INSTRUMENTATION LABORATORY

LIST OF EXPERIMENTS:

1. Discharge coefficient of orifice plate
2. Measurement of Force using Proving Ring Calibration of pressure gauge
3. Calibration of Thermocouple
4. Measurement of Flow using Wheel Flow Meter
5. Measurement of Viscosity
6. Vacuum Pressure Measurement
7. Level measurement using d/p transmitter
8. UV – Visible spectrophotometer
9. Calibration of Pressure Gauge using Dead Weight Tester
10. pH Meter standardisation and Measurement of pH values of solutions
11. Conductivity meter calibration and measurements of conductivity of test solutions.
12. Measurement of Temperature using Radiation Pyrometer.
13. Capacitance measurement using Capacitive Pickup.

Total Number of Hours: 45 Hrs

Subject Code: BEI17L06	**Subject Name :DIGITAL CONTROL LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To study various signals.
- To enable the students to understand the various response of the system .
- To Study about the various types of sequential circuits
- To study the PLC & application of PLC.
- To Design and verify compensator using bode plot.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Graduates should study various signals.
CO2	Students can understand the various responses of the system
CO3	The various types of sequential circuits can be analyzed
CO4	The graduate becomes familiar with the PLC & application of PLC.
CO5	The students will be able to Design and verify compensator using bode plot

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	L	L	H	H	M	H	M	H
CO2	M	H	H	M	L	H	M	H	M	H	L	L
CO3	L	M	M	L	H	M	H	L	H	M	L	H
CO4	H	H	M	L	H	H	M	L	H	M	H	L
CO5	H	M	H	M	L	H	M	L	L	H	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	M	L	H			
CO2	H	H	M	L	H			
CO3	M	L	H	M	H			
CO4	L	L	H	L	M			
CO5	M	H	L	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

DIGITAL CONTROL LABORATORY

LIST OF EXPERIMENTS:

1. standard test signal
2. response for the first order system
3. response for the second order system
4. bode plot for a given system
5. root locus for the given system
6. polar plot for the given system
7. design of lead compensator using bode plot
8. design of lag compensator using bode plot
9. Study of programmable logic controller (PLC)
10. Verification of logic gates using PLC
11. Application of PLC

Total Number of Hours: 45 Hrs

Subject Code: BEE17IL3	**Subject Name: MICROPROCESSOR, MICROCONTROLLER AND ITS APPLICATIONS LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The students understand to do basic programming in microprocessors and Interfacing.
- Basic concept to understand code conversion.
- Logical calculations to carry out basic arithmetic.
- Graduates to understand the programming concepts of microprocessor.
- To understand the programming concepts of microcontroller.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable of programming in microprocessors and Interfacing.
CO2	Familiar with code conversion.
CO3	Capable of performing Logical calculations to carry out basic arithmetic
CO4	Capable of understand the programming concepts of microprocessor.
CO5	Understand the programming concepts of microcontroller.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	L	H	M	H	M
CO2	H	H	H	M	M	L	L	L	M	L	M	L
CO3	H	H	H	H	H	H	M	M	H	M	H	M
CO4	H	H	H	H	H	M	M	M	H	M	H	M
CO5	H	H	H	H	H	M	M	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	L	M	M	L	M			
CO2	M	M	M	M	H			
CO3	M	M	M	M	H			
CO4	M	M	M	L	H			
CO5	L	M	M	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

MICROPROCESSOR, MICROCONTROLLER AND ITS APPLICATIONS LABORATORY

LIST OF EXPERIMENTS:

1. Familiarisation of 8085 Microprocessor kit
2. Familiarisation of 8051 Microcontroller kit
3. 8085 and 8051 assembly language programming exercises
4. Interfacing of switches and display devices
5. Interfacing of D/A and A/D Converters
6. Interface of key board and display using programmable controllers
7. Interface of programmable Timer
8. Stepper motor control using microprocessor
9. Simple 8086 assembly language programming exercises
10. Study of MASM and DEBUG utilities

Total Number of Hours: 45 Hrs

Subject Code: BEI17TSX	Subject Name : TECHNICAL SKILL II	T / L/ ETL	L	T / S.Lr	P/ R	C
		L	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

Approval	

Subject Code: BEI17L07	**Subject Name : INPLANT TRAINING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
		0	0	0	1	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective of the Inplant training is to provide a short-term work experience in an Industry/ Company/ Organization

COURSE OUTCOMES (COs) : (3- 5)

CO1	To get an insight of an industry / organization/company pertaining to the domain of study.
CO2	To acquire skills and knowledge for a smooth transition into the career.
CO3	To gain field experience and get linked with the professional network.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L	L	L	L	H	H	H	H	H	H	H
CO2	H	M	H	H	M	H	H	H	H	H	H	M
CO3	H	H	H	H	M	H	H	H	H	H	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1								
CO2								

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

Approval	

Subject Code: BEI17011	Subject Name : INDUSTRIAL INSTRUMENTATION-II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Understanding variable head type flow meters , quantity meters ,
- Understanding air flow meters and mass flow meters
- Introduction to electrical type flow meters
- Developing knowledge on the level measurement techniques
- Capability to study the properties of Viscosity, Humidity and Moisture content

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students can analyze about variable head type flow meters , quantity meters ,
CO2	Students can analyze about air flow meters and mass flow meters
CO3	Students can analyze electrical type flow meters
CO4	Students acquire knowledge on various level measurement techniques
CO5	The graduate understands the properties of Viscosity, Humidity and Moisture content.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	M	H	L	L	H	H	M	L	H
CO2	M	H	M	H	M	H	H	M	L	H	M	L
CO3	H	M	M	M	H	H	M	L	H	M	H	H
CO4	M	H	M	H	H	M	H	M	H	H	L	H
CO5	M	H	L	H	H	M	H	M	H	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	H	M			
CO2	M	H	M	H	M			
CO3	H	H	M	H	L			
CO4	M	H	H	M	H			
CO5	M	H	M	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

INDUSTRIAL INSTRUMENTATION-II

UNIT I MEASUREMENT OF HUMIDITY & MOISTURE 12 Hrs

Humidity terms – Dry and wet bulb psychrometers – Hot wire electrode type hygrometer – Dew cell Electrolysis type hygrometer – Commercial type dew point meter – Moisture terms – Different methods of moisture measurement – Moisture measurement in granular materials, solid penetrable materials like wood, web type material. .

UNIT II MECHANICAL TYPE FLOW METERS 12 Hrs

Theory of fixed restriction valuable head type flow meters – Orifice plate – Venturi tube – Flow nozzle – Dall tube – installation of head flow meters – Piping arrangement for different fluids – Pitot tube.

UNIT III QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS 12 Hrs

Positive displacement flow meters – Constructional details and theory of operation of mutating disc, reciprocating piston, oval gear and helix type flow meters – Inferential meter – Turbine flow meter – Rotameter – Theory and installation – Angular momentum mass flow meter – Coriolis mass flow meters – Thermal mass flow meters – Volume flow meter plus density measurement – Calibration of flow meters – Dynamic weighing method.

UNIT IV ELECTRICAL TYPE FLOW METER 12 Hrs

Principle and constructional details of electromagnetic flow meter – Different types of excitation schemes used – Different types of ultrasonic flow meters – Laser Doppler anemometer systems – Vortex shedding flow meter – Target flow meter – Solid flow rate measurement – Guidelines for selection of flow meter.

UNIT V LEVEL MEASUREMENT 12 Hrs

Gauge glass techniques coupled with photoelectric readout system – Float type level indication – Different schemes – Level switches, level measurement using displacer and torque tube – Bubble system. Boiler drum level measurement – Differential pressure method – Hydra step systems –Electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors.

Total Number of Hours: 60 Hrs

Text Books:

1. D.Patranabis, Principles of Industrial Instrumentation Tata McGraw-Hill Publishing Co., New Delhi, 1999
2. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi 1999.

Reference Books:

1. Ernest O.Doebelin, Measurement systems application and design international student Edition, Tata McGraw Hill Publishing Co., New Delhi, 1999.
2. Patranabis, Principles of Industrial Instrumentation Tata McGraw-Hill Publishing Co., New Delhi, 1999
3. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi 1999.
4. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation – Dhanpat Rai and Sons, New Delhi, 1999.
5. Eckman D.P.M Industrial Instrumentation – Wiley Eastern Limited, 1990.
6. Liptak B.G. Instrument Engineers Handbook (Measurement), Chilton Book Co., 1994.

Subject Code: BEI17012	**Subject Name: PROCESS CONTROL**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The introduction of need for process control and over all view of self- regulation.
- The overview of control action and pneumatic and electronic controllers with practical form of PID.
- The analysis of various process reaction curve method.
- The graduate will learn the design of multi loop control and examples of distillation column and boiler system.
- The brief view of various controller actions, control valve sizing and control valve positioning.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students learn the necessity of process control, the mathematical modeling of different processes and characteristics of different controllers.
CO2	Understands the need for process control and over all view of self- regulation
CO3	Capable to design of multi loop control and examples of distillation column and boiler system
CO4	Students learn different control actions and controllers like ON-OFF, P,P+I+D and also about tuning methods for setting optimum value and various multi-loop controlling methods.
CO5	Students acquire the knowledge of final control elements

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1								
CO2								

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

PROCESS CONTROL

UNIT I INTRODUCTION **9 Hrs**

Need for process control – mathematical model of first – order level, pressure and thermal processes – higher order process – interacting and non-interacting systems – continuous and batch process – self-regulation – servo and regulator operation-Heat Exchanger-CSTR. .

UNIT II CONTROL ACTIONS AND CONTROLLERS **9 Hrs**

Basic control actions – characteristics of on-off, proportional, single-speed floating, integral and derivative control modes – P+I, P+D and P+I+D control modes – pneumatic and electronic controllers –Practical form of PID Controller.

UNIT III OPTIMUM CONTROLLER SETTINGS **9 Hrs**

Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – determination of optimum settings for mathematically described processes using time response and frequency response – tuning – process reaction curve method – Ziegler Nichols method – damped oscillation method..

UNIT IV MULTILOOP CONTROL **9 Hrs**

Feed forward control – ratio control- cascade control – inferential control – split range control – introduction to multivariable control – Model Predictive control-Plant wide control-Adaptive control-examples from distillation column and boiler systems.

UNIT V FINAL CONTROL ELEMENT **9 Hrs**

I/P converter – pneumatic and electric actuators – valve positioner – control values – characteristics of control valves – inherent and installed characteristics – valve body – commercial valve bodies – control valve sizing – cavitation and flashing – selection criteria.

Total Number of Hours: 45 Hrs

Text Books:

1. Stephanopoulis, G, Chemical Process Control, Prentice Hall of India, New Delhi, 1990.
2. Eckman. D.P., Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993.

Reference Books:

1. Pollard A.Process Control, Heinemann educational books, London, 1971.
2. Harriott. P., Process Control, Tata McGraw-Hill Publishing Co., New Delhi, 1991.
3. Curtis.D.Johnson, Process control Instrumentation Technology, PHI Learning ,2009

Subject Code: BEE17I03	**Subject Name: POWER ELECTRONICS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The purpose of this course is to develop basic understanding of power semi conductor devices its construction, V-I and switching characteristic and implementation in various power converter applications.
- Detailed overview about operation of power semi conductor devices.
- The purpose to design protection circuits for power semiconductor devices used in power converters.
- Overview about the basics of industrial drives.
- Understand the implementation of power semi conductor devices in industrial drives applications.
  To know the design and selection of drives in industrial application

COURSE OUTCOMES (COs) : (3- 5)

CO1	Acquires knowledge about fundamental concepts and techniques used in power electronics.
CO2	Ability to analyze various single phase and three phase power converter circuits and understand their applications.
CO3	Ability to identify basic requirements for power electronics based design application.
CO4	Develops skills to build, and troubleshoot power electronics circuits.
CO5	Foster ability to understand the use of power converters in commercial and industrial applications.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	H	L	H	M	L	H	H
CO2	M	H	M	H	M	L	L	H	M	H	M	L
CO3	H	H	H	H	M	M	M	L	L	H	M	H
CO4	M	H	L	H	M	H	M	L	H	M	H	M
CO5	H	M	M	H	M	L	H	M	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	M	L			
CO2	L	M	H	M	H			
CO3	H	M	L	H	M			
CO4	H	L	M	H	M			
CO5	H	M	L	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								
Approval												

POWER ELECTRONICS

UNIT I POWER SEMICONDUCTOR DEVICES **9 Hrs**

Power diodes – power transistor – characteristics of SCR, Triac, power MOSFET – IGBT – MCT – LASCR – SCR turn on, turn off characteristics – thyristor specifications – thyristor protection circuits. .

UNIT II COMMUNICATION CIRCUITS **9 Hrs**

Thyristor trigger circuits – R, RL, RC triggering – Single pulse and train of pulses – triggering with microprocessor – forced commutation – different techniques – series and parallel operation of SCRs.

UNIT III CONVERTERS **9 Hrs**

Natural commutation – single phase – three phase – half controlled and fully controlled rectifiers – effect of source and load inductance – dual converters – cyclo converter.

UNIT IV INVERTERS AND CHOPPERS **9 Hrs**

Voltage source inverters – series, parallel and bridge inverters – current source inverters – PWM inverters – DC chopper – step up and step down chopper – AC chopper.

UNIT V TYPICAL APPLICATION **9 Hrs**

Control of DC and AC drives – stepper and switched reluctance motor drive – AC voltage regulators – SMPS – uninterrupted power supply – induction heating.

Total Number of Hours: 45 Hrs

Text Books:

1. P.S.Bimbhra, 'Power Electronics', Khanna Publishers, New Delhi, 2002
2. G.K.Dubey, Doradia, S.R. Joshi and R.M.Sinha, Thyristorised Power Controllers, New Age International Publishers, New Delhi, 1996.

Reference Books:

1. M.H.Rashid, Power Electronics circuits, devices and applications, PHI, New Delhi, 1995.
2. Joseph Vithyathi, Power Electronics, McGraw-Hill, USA, 1995.
3. Mohan, Undeland and Robbins, Power Electronics, John Wiley and Sons, New York, 1995.
4. P.C.Sen, Modern Power Electronics, Wheeler Publishers, New Delhi, 1998.

Subject Code:	Subject Name : SOFT SKILLS – II	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: Soft Skills - I	ETL	1	0/1	1/0	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The main objective is to strengthen the logical and arithmetic reasoning skills of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Recognize and apply arithmetic knowledge in a variety of contexts.
CO2	Ability to identify and critically evaluate philosophical arguments and defend them from criticism.
CO3	Define data and interpret information from graphs.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	L	L	H	M	H	H
CO2	M	M	M	H	L	H	L	H	H	H	H	L
CO3	H	H	H	H	H	H	M	M	H	H	H	H
COs / PSOs	PSO1		PSO2		PSO3		PSO4		PSO5			
CO1												
CO2												

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
									✓			

Approval	

SOFT SKILLS II

UNIT I LOGICAL REASONING I
Logical Statements – Arguments – Assumptions – Courses of Action.

UNIT II LOGICAL REASONING II
Logical conclusions – Deriving conclusions from passages – Theme detection.

UNIT III ARITHMETICAL REASONING I
Number system – H.C.F & L.C.M – Problem on ages – Percentage – Profit & Loss – Ratio & Proportion – Partnership.

UNIT IV ARITHMETICAL REASONING II
Time & Work – Time & Distance – Clocks – Permutations & Combinations – Heights & Distances – Odd man out and Series.

UNIT V DATA INTERPRETATION
Tabulation – Bar graphs – Pie graphs – Line graphs.

Reference Book:
1. R.S.Agarwal, A modern approach to Logical Reasoning, S.Chand & Co., (2017).
2. R.S.Agarwal, A modern approach to Verbal and Non verbal Reasoning, S.Chand & Co., (2017).
3. R.S.Agarwal, Quantitative Aptitude for Competitive Examinations, S.Chand & Co., (2017).
4. A.K.Gupta, Logical and Analytical Reasoning, Ramesh Publishing House, (2014).
5. B.S.Sijwali, Indu sijwali, A new approach to Reasoning (Verbal and Non verbal), Arihant Publishers, (2014).

Subject Code: BEI17L08	Subject Name: PROCESS CONTROL LABORATORY	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To enable the students to understand the fundamentals of process control, types of processes, characteristics of different types of controllers for controlling a process and process automation.
- Control of processes using PID and ON-OFF controllers
- Automation of process
- Design and Tuning of controllers
- Control of a process using personal computer.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Enable the students to understand the fundamentals of process control, types of processes, characteristics of different types of controllers for controlling a process and process automation.
CO2	Control of processes using PID and ON-OFF controllers can be performed
CO3	Understands Automation of process
CO4	The graduate will be able to Design and Tune controllers
CO5	Understands the Control of a process using personal computer.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	H	L	M	H	M	H	M	H	M
CO2	M	H	M	H	L	H	M	L	M	H	H	M
CO3	H	L	H	M	H	H	L	H	H	L	M	M
CO4	H	M	H	M	L	H	M	H	L	M	H	H
CO5	M	H	L	M	H	H	L	H	M	H	L	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	H	M			
CO2	M	H	M	H	L			
CO3	M	H	M	L	M			
CO4	H	H	M	L	H			
CO5	L	H	M	M	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

PROCESS CONTROL LABORATORY

LIST OF EXPERIMENTS:

1. Operation of Interacting and Non-Interacting systems
2. Responses of different order processes with and without transportation lag
3. Response of ON-OFF controller
4. Response of P+I+D controller
5. Characteristics of Equal Percentage Control Viscosity Valve
6. Characteristics of Control Valve with Positioner.
7. Operation of ON-OFF controller Using Simple Thermal System.
8. Closed loop response of Flow Control Loop
9. Closed loop response of Level Control Loop
10. Closed loop response of Temperature Control Loop
11. Closed loop response of pressure control loop
12. Tuning of Controllers
13. Study of complex control system (ratio / cascade / feed forward)
14. Analysis of Non-Linear Systems(Conical Tanks)

Total Number of Hours: 45 Hrs

Subject Code: BEI17L09	**Subject Name: DESIGN PROJECT LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

To learn about filters
To study about converters
To design about valves, controllers
To gain knowledge on P&I Diagram
To study about instrumentation documentation

COURSE OUTCOMES (COs) : (3- 5)

CO1	Graduate understands the concept of filters
CO2	Understands the converters
CO3	Capable of analyzing valves, controllrs
CO4	Understands P&I Diagram
CO5	Capable to analyse instrumentation documentation

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	M	H	M	H	M	L	L	M
CO2	M	H	M	M	H	M	H	M	L	L	H	M
CO3	H	M	H	M	H	M	H	H	M	L	M	H
CO4	H	H	M	H	H	H	M	M	M	L	L	M
CO5	M	H	M	H	H	M	L	M	H	L	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	M	H	L			
CO2	L	H	L	H	M			
CO3	M	H	L	M	H			
CO4	M	H	H	L	M			
CO5	L	H	M	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

DESIGN PROJECT LABORATORY

LIST OF EXPERIMENTS:

1. Design of Instrumentation Amplifier
2. Design of active filters
3. Design of regulated power supply
4. Design of v/I converter
5. Design of I /V converter
6. Design of compensation circuit for thermocouples
7. Design of signal conditioning circuit for strain gauge & RTD
8. Design of orifice plate & rotameter
9. Design of Control Valve
10. Design of PID Controller
11. Piping & Instrumentaton Diagram- Case Study
12. Preparation of document of instrumentation project
13. Preparation of project scheduling

Total Number of Hours: 45 Hrs

Subject Code: BEI17L10	**Subject Name: EMBEDDED SYSTEM LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To design and simulate combitional circuits and sequential circuits
- To design toggle, Bitwise, Arithmetic, Delay

COURSE OUTCOMES (COs) : (3- 5)

CO1	Students will be able to design and simulate combitional circuits and sequential circuits
CO2	Graduate capable to design toggle, Bitwise, Arithmetic, Delay
CO3	

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	L	L	H	M	M	H	M	L	H
CO2	M	H	M	H	L	H	M	H	M	H	L	M

Cos / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	H	M			
CO2	M	H	M	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

EMBEDDED SYSTEM LABORATORY

LIST OF EXPERIMENTS

Design and Simulate Using Keil Version

1. Design of Logic Gates
2. Design of Multiplexer and De-multiplexer
3. Design of Encoder and Decoders
4. Flip Flops
5. Counters
6. Toggle a port bit in Keil
7. Bitwise operators
8. Arithmetic Operators
9. Delay Operations
10. ADC Interfacing with ARM Processor

Total Number of Hours: 45 Hrs

Subject Code: BEI17L11	**Subject Name : MINI PROJECT**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite: NIL	L	0	0/0	0/2	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : To acquire hands-on experience in converting a novel idea / technique into a working model / prototype involving multi-disciplinary skills and / or knowledge and working in at team.

COURSE OUTCOMES (COs) : (3- 5)

CO1	To conceptualize a novel idea / technique into a product
CO2	To develop a multi-disciplinary thinking and enable teamwork
CO3	Ideate and develop a prototype

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	M	M	H	H	H	M	L	H	M
CO2	H	H	H	M	H	M	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	H	H	M	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1								
CO2								

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

Department of ELECTRONICS AND INSTRUMENTATION ENGINEERING

Subject Code:	Subject Name : Technical Skill III	T / L/	L	T /	P/ R	C

BEI17TSX		ETL		S.Lr		
		L	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

Approval	

Subject Code: BEI17TSX	Subject Name : Technical Skill III	T / L/ ETL	L	T / S.Lr	P/ R	C
		L	0	0/0	2/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits

T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective is to develop the technical skill of the students.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Develop the technical skills required in the field of study
CO2	Bridge the gap between the skill requirements of the employer or industry and the competency of the students.
CO3	Enhance the employability of the students.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	M	M	H	M	H	M
CO2	H	H	M	H	H	H	M	M	H	H	H	H
CO3	H	H	H	H	H	H	M	M	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
								✓				

Approval	

Subject Code: BEI17013	**Subject Name: COMPUTER CONTROL PROCESS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Capability to analyze discrete data systems , sampling process and z-transform.
- Ability to design of dead beat, dahlin, pole placement and predictive controllers
- To understand the basic systems to make computer as a controller.
- Overview of PLC's architectures, programs, logic & their functional blocks.
- Communications in PLC's and case study of bottle filling plant.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capability to analyze discrete data systems, sampling process and z-transform.
CO2	Ability to design dead beat, dahlin, pole placement and predictive controllers
CO3	Understands the basic systems to make computer as a controller.
CO4	Understands the Overview of PLC's architectures, programs, logic & their functional blocks.
CO5	Understands Communications in PLC's and case study of bottle filling plant.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	M	H	L	M	H	M	H	L
CO2	M	H	H	M	H	M	H	M	L	L	H	M
CO3	M	H	M	H	L	M	H	M	H	M	L	H
CO4	M	H	M	L	H	M	H	L	H	M	H	L
CO5	M	H	L	H	M	H	M	H	L	H	M	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H	L	H			
CO2	M	H	L	M	H			
CO3	H	M	H	M	H			
CO4	H	M	H	M	M			
CO5	L	H	M	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

COMPUTER CONTROL PROCESS

UNIT I ANALYSIS OF DISCRETE DATA SYSTEM **12 Hrs**

Z-Transform- Selection of sampling process – Selection of Sampling period – pulse transfer function – modified Z-transform – Stability of Discrete Data System. .

UNIT II DESIGN OF DIGITAL CONTROLLER **12 Hrs**

Digital PID – Dead beat – Dahlin algorithms – pole placement controller Design of feed forward controller – predictive controller.

UNIT III COMPUTER AS A CONTROLLER **12 Hrs**

Basic building blocks of computer control system – SCADA – Direct Digital Control – AI and expert control systems – Case studies on computer control for Industrial process..

UNIT IV PLC **12 Hrs**

Evolution of PLC's – Sequential and programmable controllers – Architecture- Relay logic – Ladder logic – Programming Timers & Counters

UNIT V PROGRAMMING & APPLICATIONS OF PLC'S **12 Hrs**

Instructions in PLC-Program control instructions, math instructions, and sequencer instructions-use of PC as PLC-Application of PLC-Bottle filling system application.

Total Number of Hours: 60 Hrs

Text Books:

1. Despande and R.H.Ash, Computer process control, ISA Publication, USA 1995.
2. Shanthisasidharan, Computer control of Process

Reference Books:

1. Stephanopoulous, Chemical Process control, Prentice Hall of India, New Delhi.
2. Chidambaram, Computer control of Process

Subject Code: BEI17014	**Subject Name: VIRTUAL INSTRUMENTATION**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	1/0	0/0	4

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The graduate can understand the fundamental of virtual instrumentation.
- To understand programming and data flow in virtual instrumentation.
- Overview about the interfacing of external instruments to pc and detailed information about the different protocols.
- To study about the graphical programming environment in virtual instrumentation.
- Analysis tools and simple application used in virtual instrumentation.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate can understand the fundamental of virtual instrumentation.
CO2	Understands programming and data flow in virtual instrumentation.
CO3	Understands the Overview about the interfacing of external instruments to pc and detailed information about the different protocols
CO4	The graduate can provide graphical programming environment in virtual instrumentation.
CO5	The student will get capability to analyse tools and simple applications used in virtual instrumentation.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	M	H	H	M	H	M	H	L
CO2	M	H	M	H	H	H	M	H	M	H	M	H
CO3	M	H	M	H	M	M	H	L	M	H	H	M
CO4	H	H	M	H	M	H	L	H	M	H	M	L
CO5	H	M	H	M	H	M	H	L	H	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	M	H			
CO2	M	H	M	H	L			
CO3	L	H	M	M	H			
CO4	M	M	H	M	H			
CO5	L	H	H	M	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
				✓								

Approval	

VIRTUAL INSTRUMENTATION

UNIT I REVIEW OF DIGITAL INSTRUMENTATION 12 Hrs

Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

UNIT II FUNDAMENTALS OF VIRTUAL INSTRUMENTATION 12 Hrs

Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT III CLUSTER OF INSTRUMENTS IN VI SYSTEM 12 Hrs

Interfacing of external instruments to a PC – RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – ISO-OSI model for serial bus – Introduction to bus protocols of MOD bus and CAN bus..

UNIT IV GRAPHICAL PROGRAMMING ENVIRONMENT IN VI 12 Hrs

Concepts of graphical programming – Lab-view software – Concept of VIs and sub VI - Display types – Digital – Analog – Chart – Oscilloscopic types – Loops – Case and sequence structures - Types of data – Arrays – Formulae nodes –Local and global variables – String and file I/O.

UNIT V ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI 12 Hrs

Fourier transform - Power spectrum - Correlation – Windowing and filtering tools – Simple temperature indicator – ON/OFF controller – P-I-D controller - CRO emulation - Simulation of a simple second order system – Generation of HTML page.

Total Number of Hours: 60 Hrs

Textbooks

1. S. Gupta and J.P Gupta, 'PC Interfacing for Data Acquisition and Process Control',
2. Instrument society of America, 1994.
3. Peter W. Gofton, 'Understanding Serial Communications', Sybex International.
4. Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.

Reference Books:

1. Kevin James, 'PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control', Newness, 2000.
2. Gary W. Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.

Subject Code: BMG17002	**Subject Name : MANAGEMENT CONCEPTS AND ORGANISATION BEHAVIOUR**	**T / L/ ETL**	**L**	**T**	**P**	**C**
	Prerequisite: Basic Knowledge as Statistical Techniques and Probability Theory	T	3	0/0	0/0	3

L : Lecture T : Tutorial P : Project C: Credits

OBJECTIVE:

The student will learn:

- This course is aimed at addressing the contemporary issues, which fall under the broad title of management, and its functions.
- There will also be an attempt to analyze the behavior of individuals within an organization and the issues of working with other group or teams.

COURSE OUTCOMES (COs) :

CO1	Effective leadership skills
CO2	Accommodating with co workers and at Work environment
CO3	Enhanced leadership skills
CO4	Understanding and implementing good policies for the welfare of management and workers

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	H		M		M		L		M		L	
CO2	M	M				M		H	M	M	L	H
CO3	L		H	H	M		M	H	M	L	M	
CO4	M	L				M			M			M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Management Science		
										✓		
Approval												

MANAGEMENT CONCEPTS AND ORGANISATION BEHAVIOUR

UNIT I INTRODUCTION **9 Hrs**

Management – definition, evolution – nature of management – distinction between administration and management, MBO, Management functions – planning, organization, motivating, control and functions Areas -operations – marketing, finance, HR

UNIT II ORGANIZING **9 Hrs**

Organizing definitions – process of organization – importance of organization – organization structure – organizational chart - and managing HR and communicating- types of communication – formal communication – features of formal communication , motivating and leading

UNIT III INDIVIDUAL AND GROUP BEHAVIOUR **9 Hrs**

Behavior of an individual in an organization – attitude, value, job satisfaction, personality, perception, concepts of learning, motivation, theories and application. Group behavior – structure process, decision making, work team – different from group.

UNIT IV POWER AND POLITICS **9 Hrs**

Power and politics, directing – characteristics of directing – importance of directing – principles of directing – techniques of directing, organizational culture, organizational work culture and work design

UNIT V HR POLICIES AND PRACTICES **9 Hrs**

HR policies and practices, Definitions of supervision – qualities of a good supervisor- responsibilities or functions of a supervisor, appraisal of performance – span of supervision managing the future – new worker / new organization etc.

Total Number of Hours: 45 Hrs

Reference Books:

1. Stephen P Robbins, Organizational Behavior, PHI, 15th edition, 2012 ISBN 10: 0132834871/0-13-283487-1 ISBN 13: 9780132834872
2. Koontz O'Dannel, Principles of Management – Mc Graw Hill Publishing Co.LTD, 5th edition, 2008
3. Peter Drunker, The practice of management – Allied Publications. 2010, ISBN: 0062005448, 9780062005441
4. L M Prasad, Principles and Practice of Management, Sultan Chand & Sons., 7th edition, 2007, ISBN: 818054575X, 9788180545757
5. Steward Black & Lyman W Porter, Management – Meeting new challenges, Prentice Hall, October 1st 2004, ISBN: 0131430084 (ISBN13: 9780131430082)

Subject Code: BEI17L12	**Subject Name: VIRTUAL INSTRUMENTATION LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To get practical knowledge in programming techniques, data acquisition and interfacing Techniques of virtual instrumentation and to use VI for different applications.
- Familiarize with the VI software and learn programming in VI.
- Experiment various functions available in Lab VIEW.
- To check various analysis tools and develop programs for Process control applications.
- Using various Instrument Interfacing and data acquisition methods

COURSE OUTCOMES (COs) : (3- 5)

CO1	➢ Gets practical knowledge in programming techniques, data acquisition and interfacing Techniques of virtual instrumentation and to use VI for different applications.
CO2	➢ Familiarize with the VI software and learn programming in VI.
CO3	➢ Can perform Experiments on various functions available in Lab VIEW.
CO4	➢ Capable to understand various analysis tools and develop programs for Process control applications
CO5	➢ Capable of Using various Instrument Interfacing and data acquisition methods

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	L	H	M	H	M	H	M	L	M
CO2	M	M	M	M	H	H	H	M	L	L	H	L
CO3	H	H	H	M	L	H	M	L	M	H	H	M
CO4	M	L	M	H	M	M	H	L	M	H	M	L
CO5	H	M	H	M	L	M	H	H	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H	M	H			
CO2	L	H	M	H	M			
CO3	M	M	L	H	H			
CO4	M	H	M	H	M			
CO5	L	M	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

VIRTUAL INSTRUMENTATION LABORATORY

LIST OF EXPERIMENTS:

1. Basic LabVIEW programming
2. Simulation of a level measurement process system.
3. Log File writing and reading on TDMS and LVM files.
4. Creating S-transfer functions and observes its Frequency response using control design toolkit.
5. Creating Discrete-time Z- Transfer Functions and state space models.
6. Series and feedback connections using control design toolkit.
7. Calculating Transfer Functions from state space models.
8. Discretizing Continuous time models.
9. A complete control system simulation and analysis using PID Controller.
10. Temperature alarm system using cDAQ 9172 module.
11. Designing Filters using NI ELVIS.
12. Manual Testing and Control of Two- Way Stoplight intersection with NI ELVIS.
13. RF wireless Communication using NI ELVIS.
14. Signal Processing with Speedy 33(speech recording and analysis).
15. Image processing techniques and applications using vision assistant.
16. Filtered response of images, corrupted with salt and pepper noise.
17. Temperature control using cFP-2020.
18. DFT/IDFT identification of a given DT signal.
19. Implementation of low pass FIR and IIR filters for a given sequence using speedy 33.
20. Implementation of high pass FIR and IIR filters for a given sequence using speedy 33.
21. Virtual instrument with a digital signal processing to identify parameters of signals.

Total Number of Hours: 45 Hrs

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Department of ELECTRONICS AND INSTRUMENTATION ENGINEERING

Subject Code: BEI17L13	**Subject Name: INDUSTRIAL AUTOMATION LABORATORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	L	0	0/0	3/0	1

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To Calibrate the Pressure gauge using Dead weight Tester, manometers, Control valves, I to P and P to I converters, Pressure Switch, RTD and Thermocouple.
- To Study the basic programming of PLC, Analog operation in PLC, Arithmetic operation, Timer, Counter operation using PLC, Annunciator design using PLC
- To Study the Application using PLC and PC based programming (Level control, Temperature control, Speed Control).
- To Analyze various Faults Using SCADA
- To study and analyze transmission mode, Distribution mode using SCADA.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable to Calibrate the Pressure gauge using Dead weight Tester, manometers, Control valves, I to P and P to I converters, Pressure Switch, RTD and Thermocouple.
CO2	Understands the basic programming of PLC, Analog operation in PLC, Arithmetic operation, Timer, Counter operation using PLC, Annunciator design using PLC
CO3	Understands the Application using PLC and PC based programming (Level control, Temperature control, Speed Control) .
CO4	Capable to Analyze various Faults Using SCADA
CO5	Capable to study and analyze transmission mode, Distribution mode using SCADA.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	H	M	L	L	H	M	M	H
CO2	M	M	M	H	M	H	L	H	M	H	M	L
CO3	M	H	M	L	H	M	H	M	H	L	H	M
CO4	H	L	H	M	L	H	M	L	H	M	L	H
CO5	H	H	M	M	H	M	H	L	M	H	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	M	H	M			
CO2	H	H	H	M	M			
CO3	H	M	H	H	L			
CO4	L	M	H	M	L			
CO5	M	H	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

INDUSTRIAL AUTOMATION LABORATORY

LIST OF EXPERIMENTS:

1. Study of PLC
2. Batch Process Reactor Control using PLC
3. PF Control/Voltage Regulation
4. Lift Control using PLC
5. Speed Control of Motor Using Digital Signal Processor
6. Bottle filling plant using PLC
7. Trafiic light control using PLC
8. Study of SCADA
9. Automation of Level Process using SCADA
10. Automation of Pressure Process using SCADA
11. Automation of Temperature Process using SCADA
12. Study of DCS
13. Automation of Pressure process using DCS
14. Automation of Level process using DCS
15. Automation of Temperature process using DCS
16. Study of CCS

Total Number of Hours: 45 Hrs

Subject Code: BEI17L14	Subject Name : PROJECT PHASE - 1	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: NIL	L	0	0/1	0/1	2

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE : The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue , address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	M	H	H	L	M	M	H	H
CO2	H	H	H	H	H	H	H	M	M	M	H	H
CO3	H	H	H	H	H	H	H	M	M	H	H	M
CO4	H	M	H	H	H	H	M	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					
Approval												

Subject Code:	**Subject Name ENTREPRENUERSHIP DEVELOPMENT**	**T / L/ ETL**	**L**	**T**	**P**	**C**
BMG17005	Prerequisite: Basic Knowledge as Management Concepts	T	3	0	0	3

L : Lecture T : Tutorial P : Project C: Credits

OBJECTIVE: The student will learn:

- The course aims to acquaint the students with challenges of starting new ventures and enable then to investigate, understand and internalize the process of setting up a business

COURSE OUTCOMES (COs) :

CO1	Understand the basics of entrepreneurial development
CO2	Explain the requisites of starting a small scale industry
CO3	Propose a plan for new venture
CO4	Comprehend role of government in entrepreneurship

Mapping of Course Outcomes (COs) with Program Outcomes (POs) & Program Specific Outcomes (PSOs)

COs/POs	**PO1**	**PO2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	M	M	H			M	L	H	L	H	H	H
CO2		H			L			M		M	H	M
CO3	H	H	H			M		M	M	H	M	M
CO4		M		M	L		H			M	L	M

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills	Management Science		
										✓		
Approval												

ENTREPRENUERSHIP DEVELOPMENT

UNIT I INTRODUCTION 9 Hrs

Nature and Development of Entrepreneurship; Entrepreneurial Decision Process; Role of entrepreneurship in economic development; Entrepreneurial process; managerial vs. entrepreneurial approach and emergence of entrepreneurship. Entrepreneurial background; Skills and characteristics of successful entrepreneurs; Motivation; Role Models and Support Systems

UNIT II BUSINESS IDEA 9 Hrs

Generating business idea – sources of new ideas, methods of generating ideas, creative problem solving, opportunity recognition; Environmental scanning, competitor and industry analysis; Feasibility study – market feasibility, technical/operational feasibility, financial feasibility; Drawing a business plan; Using and Implementing the Business plan.

UNIT III MARKETING PLAN 9 Hrs

Marketing plan – Marketing research for the new venture; Steps in preparing marketing plan; Contingency planning; Organizational plan – Forms of Business; Designing the organization; Building management team and Successful Organizational Culture; Role of Board of Directors; Board of Advisors; Financial plan – Operating and capital Budgets; Pro forma income statements; Pro forma cash flow; Pro forma balance sheet; Break even analysis; Pro forma Sources and Applications of Funds.

UNIT IV ASSESSMENT OF RISK 9 Hrs

Assessment of Risk; Sources of finance – Debt or Equity Financing, Internal or External Funds; Personal Funds, Family and Friends; Commercial Banks – types of loans, Cash flow financing, Bank lending decisions; Venture Capital – Nature, overview, process, locating and approaching Venture Capitalists.

UNIT V ENTREPRENEURIAL STRATEGY FOR GENERATING AND EXPLOITING NEW ENTRIES; STRATEGIES FOR GROWING THE VENTURE 9 Hrs

Entrepreneurial strategy for generating and exploiting new entries; Strategies for growing the venture; Growth implications on Economy, Firm and Entrepreneur. Other routes for growth – Franchising, Joint Ventures, Acquisitions and Mergers: Going Public – Advantages & Disadvantages, Alternatives to Going Public.

Total Number of Hours: 45 Hrs

Reference Books:

1. Hisrich, Robert D., Michael Peters and Dean Shephered, Entrepreneurship, Tata McGraw Hill, New Delhi., 9th Edition, 2012, ISBN-13: 978-0078029196, ISBN-10: 0078029198
2. Vasant Desai, The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House., 11th Edition, 2005, ISBN: 8178660598
3. Prasana Chandra, Projects – planning, analysis selection, Implementation and reviews, Tata McGraw-Hill Publishing Company, 7th Edition, 2009, ISBN-10: 0070077932, ISBN-13, 9780070077935
4. Charantimath, Poornima, Entrepreneurship Development and Small Business Enterprises, Pearson Education, New Delhi, 5th Edition, 2009, ISBN: 978-81-7758-260-4
5. K.Ramachandran, Essentials of Business Communication, McGraw Hill Education (India) Private Limited, 9th Edition, 2013, ISBN-13: 978-1-111-82122-7, ISBN-10: 1-111-82122-4

Subject Code: BEI17L15	Subject Name : PROJECT PHASE - 2	T / L/ ETL	L	T / S.Lr	P/ R	C
	Prerequisite: NIL	L	0	0/1	0/1	10

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE: The objective of the Main Project is to culminate the academic study and provide an opportunity to explore a problem or issue, address through focused and applied research under the direction of a faculty mentor. The project demonstrates the student's ability to synthesize and apply the knowledge and skills acquired to real-world issues and problems. This project affirms the students to think critically and creatively, find an optimal solution, make ethical decisions and to present effectively.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Apply the knowledge and skills acquired in the course of study addressing a specific problem or issue.
CO2	To encourage students to think critically and creatively about societal issues and develop user friendly and reachable solutions
CO3	To refine research skills and demonstrate their proficiency in communication skills.
CO4	To take on the challenges of teamwork, prepare a presentation and demonstrate the innate talents.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	`PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	H	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H	H	H	H	H	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	H	H	H	H			
CO2	H	H	H	H	H			
CO3	H	H	H	H	H			
CO4	H	H	H	H	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
							✓					

Approval	

Subject Code: BEI17E01	**Subject Name : EMBEDDED SYSTEM**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The brief view of real time and embedded system.
- The graduates can understand the embedded system components and interface.
- Detailed overview about embedded system design and development.
- Analysis of real time system performance, language and their features.
- The case studies of safety, aerospace ,automobile, medical and industrial application.
-

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable to get brief view of real time and embedded system.
CO2	Understands embedded system components and interface.
CO3	The graduates understands embedded system design and development .
CO4	The graduates Analysis of real time system performance, language and their features
CO5	The graduate will be capable to perform case study on safety, aerospace ,automobile, medical and industrial application.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	H	M	L	H	M	H	L	L	M
CO2	M	M	H	M	L	H	M	L	H	M	L	H
CO3	H	H	H	M	H	M	H	L	H	M	H	M
CO4	H	H	M	L	H	M	L	H	M	L	H	M
CO5	M	H	M	L	H	M	L	H	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	M	L	H			
CO2	H	M	H	M	L			
CO3	M	M	L	H	M			
CO4	H	L	M	H	L			
CO5	L	M	M	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

EMBEDDED SYSTEM

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9 Hrs

Brief overview of real time systems and embedded systems - Classification of embedded systems - Embedded system definitions - Functional and non-functional requirements - Architectures and standards - Typical applications.

UNIT II EMBEDDED SYSTEM COMPONENTS AND INTERFACE 9 Hrs

Device choices - Selection criteria and characteristics of Processors and memory systems for embedded applications - Interface and Peripherals - Power sources and management.

UNIT III EMBEDDED SYSTEM DESIGN AND DEVELOPMENT 9 Hrs

Design methods and techniques - Classification of need - Need analysis -Requirement and specification - Conceptual design - Models and languages – State machine model - State machine tables - Verification – Validation - Simulation and emulation.

UNIT IV REAL TIME SYSTEMS AND MODELS 9 Hrs

Characteristics and classification of real time systems - Real time specifications and Design techniques - Event based - Process based and graph based models – Real time kernel - Hierarchy services and design strategy - Real time system performance and analysis - Typical real time systems - Their languages and features.

UNIT V CASE STUDIES 9 Hrs

Case studies of safety-critical and time-critical embedded systems with reference to Aerospace, automobile, Medical and Industrial applications.

Total Number of Hours: 45 Hrs

Text Books:

1. Noergaard, T., “Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers”, Elsevier Publications, 2005.
2. Berger, A.S., “Embedded System Design: An Introduction to Process, Tools and Techniques”, CMP Books, 2002.

Reference Books:

1. David, S., “An Embedded Software Primer”, Addison-Wesley, 1999.
2. Liv, J.W.S., “Real-Time Systems”, Pearson Education, 2001.
3. Vahid and Givargis, T., “Embedded System Design: A Unified Hardware/ Software Introduction”, John Wiley and Sons, 2002.
4. Peatman, J.B., “Design with Microcontrollers”, McGraw-Hill International Ltd.,Singapore, 1989.
5. Kang, C.M.K., and Shin, G., “Real Time Systems”, McGraw Hill, 1997.

Subject Code: BEI17E02	**Subject Name : SYSTEMS THEORY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Analysis of various frequency domain descriptions.
- The review of state model of a system and its properties.
- To design in state space systems and control.
- The brief view of various types of non -linear systems and their phase plane analysis with examples.
- The graduate will have the complete impact of stability and applications related to non linear problems.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Capable to analyse of various frequency domain descriptions.
CO2	Understands review of state model of a system and its properties
CO3	The graduates design state space systems and control.
CO4	The student understands brief view of various types of non -linear systems and their phase plane analysis with examples.
CO5	The graduate will have the complete impact of stability and applications related to non linear problems.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	H	M	L	H	M	H	L	L	M
CO2	M	M	H	M	L	H	M	L	H	M	L	H
CO3	H	H	H	M	H	M	H	L	H	M	H	M
CO4	H	H	M	L	H	M	L	H	M	L	H	M
CO5	M	H	M	L	H	M	L	H	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	M	L	H			
CO2	H	M	H	M	L			
CO3	M	M	L	H	M			
CO4	H	L	M	H	L			
CO5	L	M	M	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

SYSTEMS THEORY

UNIT I FREQUENCY DOMAIN DESCRIPTIONS 9 Hrs

Properties of transfer functions – Impulse response matrices – Poles and zeros of transfer function matrices – Critical frequencies – Resonance – Steady state and dynamic response – Bandwidth. .

UNIT II STATE SPACE DESCRIPTION 9 Hrs

Review of state model for systems – State transition matrix and its properties - Free and forced responses – Controllability and observability – Kalman decomposition – Minimal realisation – Balanced realisation

UNIT III DESIGN IN STATE SPACE SYSTEMS 9 Hrs

State feedback – Output feedback – Design methods – Pole assignment – Full order and reduced order observers – Deadbeat control – Deadbeat observers – Introduction to optimal control..

UNIT IV NON-LINEAR SYSTEMS 9 Hrs

Typesof non-linearity – Typical examples – Phase plane analysis – Limit cycles -Equivalent linearization – Describing functions – Chaotic behaviour. Need for model reduction – Aggregation techniques – Dominant pole concept – Model reduction via partial realisation – Time moment matching and pade approximation – Hankel norm model reduction – Comparative merits of various methods.

UNIT V STABILITY 9 Hrs

Stability concepts – Equilibrium points – BIBO and asymptotic stability – Direct method of Lyapunov – Application to non-linear problems – Frequency domain stability criteria – Popov's method and its extensions.

Total Number of Hours: 45 Hrs

Text Books:

1. M.Gopal, "Modern Control Engineering", Wiley, 1996.
2. Theodore E. Djaferis , Irvin c.schick, System Theory: Modeling, Analysis and Control, springer science, 2000.

Reference Books:

1. Ogatta, "Modern Control Engineering", PHI, 3rd Edition, 1997.
2. G.J.Thaler, "Automatic control systems", Jaico publishers, Chennai, 1993.

Subject Code: BEI17E03	**Subject Name : SYSTEM IDENTIFICATION & ADAPTIVE CONTROL**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Providing theoretical and practical knowledge on methods to develop mathematical models from experimental data, adaptive control system.
- Designing and implement system identification experiments.
- To use input/output experimental data for identification of mathematical dynamical models.
- Equipping the students with designing methods of adaptive control.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate understands theoretical and practical knowledge on methods to develop mathematical models from experimental data, adaptive control system.
CO2	Capable of Designing and implement system identification experiments.
CO3	The students are capable of designing methods of adaptive control.
CO4	Capable to use input/output experimental data for identification of mathematical dynamical models
CO5	Capable to design various methods of adaptive control.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	H	M	L	H	M	M	H	L
CO2	H	L	M	H	L	M	H	M	L	M	M	H
CO3	L	M	H	L	M	H	M	L	H	M	L	H
CO4	H	H	M	L	H	M	L	H	M	L	H	M
CO5	M	H	M	L	H	M	H	L	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	L	M	M			
CO2	H	H	M	L	M			
CO3	H	H	M	L	H			
CO4	M	M	H	M	L			
CO5	M	H	H	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

SYSTEM IDENTIFICATION & ADAPTIVE CONTROL

UNIT I NON PARAMETRIC METHODS **9 Hrs**

Non parametric methods: Transient analysis – frequency analysis – correlation analysis spectral analysis .

UNIT II PARAMETRIC METHODS **9 Hrs**

Linear Regression: The least square estimate – best linear unbiased estimation under linear constraints – updating the parameter estimates for linear regression models – prediction error methods: description of prediction error methods – optimal prediction – relationships between prediction error methods and other identification methods – theoretical analysis.

Instrumental variable methods: Description of instrumental variable methods – theortical analysis – covariance matrix of IV estimates – comparison of optimal IV and prediction error estimates.

UNIT III RECURSIVE IDENTIFICATION METHODS **9 Hrs**

The recursive least squares method – the recursive instrumental variable method – the recursive prediction error method – model validation and model structure determination. Identification of systems operating in closed loop: identifiability considerations – direct identification – indirect identification – joint input – output identification.

UNIT IV ADAPTIVE CONTROL SCHEMES **9 Hrs**

Introduction – uses – definitions – auto tuning – types of adaptive control – gain scheduling controller – model reference adaptive control schemes –self-tuning controller.

UNIT V MRAC AND STC **9 Hrs**

Approaches – the gradient approach –liapunov functions – passivity theory – pole placement method – minimum variance control – predictive control-Stability – convergence – robustness – application of adaptive control.

Total Number of Hours: 45 Hrs

Text Books:

1. Soderstorm, T. and PetreStoica, System Identification, Prentice Hall International (UK)Ltd., 1989.
2. Sastry S. and Bodson M., Adaptive control – stability, convergence and Robustness, Prentice Hall inc., New Jersey, 1989.

Reference Books:

1. Ljung L, system identification: Theory for the user, Prentice Hall, Englewood Cliffs, 1987

Subject Code: BEI17E04	**Subject Name : NEURAL AND FUZZY LOGIC CONTROL**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- The graduates can understand what is neural network ,maps and theories.
- To overview of control case study for neural network.
- Detailed overview about fuzzy sets,fuzzyrules, fuzzy relation and fuzzy algorithm.
- To understand about the design of fuzzy logic controller.
- Analysis of fuzzy algorithm and case study.

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduates understand neural network, maps and theories
CO2	Understands overview of control case study for neural network.
CO3	The student will be able to give Detailed overview about fuzzy sets, fuzzyrules, fuzzy relation and fuzzy algorithm.
CO4	The student understands about the design of fuzzy logic controller.
CO5	Capable to Analyse of fuzzy algorithm and case study.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	M	H	L	H	M	L	H	M	H
CO2	M	H	L	H	M	L	H	M	M	H	L	M
CO3	H	H	H	M	L	H	M	L	M	L	H	M
CO4	L	L	M	H	L	H	M	L	M	H	M	H
CO5	M	H	M	L	H	M	L	H	M	H	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	H	M			
CO2	H	L	M	H	M			
CO3	M	L	H	M	L			
CO4	H	M	L	H	H			
CO5	M	M	H	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

NEURAL AND FUZZY LOGIC CONTROL

UNIT I INTRODUCTION AND DIFFERENT ARCHITECTURES OF NEURAL NETWORKS **9 Hrs**

Artificial neuron – MLP – Back propagation – Hope field networks – Kohonenself- organising maps – adaptive resonance theory. .

UNIT II NEURAL NETWORKS FOR CONTROL **9 Hrs**

Schemes of neuro-control – identification and control of dynamical systems – adaptive neuro controller – case study.

UNIT III INTRODUCTION TO FUZZY LOGIC **9 Hrs**

Fuzzy sets – fuzzy relations – fuzzy conditional statements – fuzzy rules – fuzzy algorithm. Fuzzy logic controller – fuzzification interface – knowledge base –

UNIT IV FUZZY LOGIC **9 Hrs**

decision making logic – defuzzification interface – design of fuzzy logic controller – case study.

UNIT V NEURO-FUZZY LOGIC CONTROL **9 Hrs**

Optimisation of membership function and rules base of fuzzy logic controller using neural networks – genetic algorithm – fuzzy neuron – adaptive fuzzy systems – case study.

Total Number of Hours: 45 Hrs

Text Books:

1. LauranceFausett, Fundamentals of Neural Networks, Prentice Hall, Englewood cliffs, N.J, 1992.
2. Zimmermann H.J., Fuzzy set theory and its applications, Allied Publication Ltd., 1996.

Reference Books:

1. Tsoukalas L.H, and Robert E.Uhrig, Fuzzy and Neural approach in Engineerin,John Wiley and Sons, 1997.
2. JacekM.Zurada, Introduction to artificial Neural Systems, Jaico Publishing House Mumbai, 1997.
3. KlirG.J.and Yuan B.B, Fuzzy sets and fuzzy logic, Prentice Hall of India, New Delhi, 1997.
4. Driankov D., Hellendron. H. Reinfrank M., An Introduction to Fuzzy control, Narosa publishing House, New Delhi, 1996.
5. Millon W.T., Sutton R.S.andWebrose P.J., Neural Networks for control, MIT Press, 1992.

Subject Code: BEI17E05	**Subject Name: POWER PLANT INSTRUMENTATION**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To provide an overview on power generation through various methods.
- Acquiring knowledge on the various types of power plants and the measurement devices.
- Educating on the basic and advanced boiler control techniques.
- Gaining knowledge about different analysers in power plant.
- Studying about different control loops used in boilers.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the power generation through various methods.
CO2	Acquires knowledge on the various types of power plants and the measurement devices
CO3	Understands the basic and advanced boiler control techniques.
CO4	Capable to get knowledge about different analyzers in power plant
CO5	Understands different control loops used in boilers.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	H	M	H	L	L	M	H	H
CO2	L	M	L	H	M	L	H	M	M	H	M	H
CO3	M	L	H	L	H	M	L	H	M	L	M	H
CO4	H	H	H	H	L	M	M	L	M	H	H	M
CO5	M	H	L	M	H	L	H	M	L	H	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	M	M	H	H	L		
CO2	L	M	H	M	L		
CO3	H	H	M	L	H		
CO4	M	M	H	L	H		
CO5	H	M	M	L	H		

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

POWER PLANT INSTRUMENTATION

UNIT I OVERVIEW OF POWER GENERATION 9 Hrs

Brief survey of methods of power generation – hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants – building blocks – details of boiler processes UP&I diagram of boiler – cogeneration. .

UNIT II MEASUREMENTS IN POWER PLANTS 9 Hrs

Electrical measurements – current, voltage, power, frequency, power – factor etc. – non electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement – radiation detector – smoke density measurement – dust monitor

UNIT III ANALYZERS IN POWER PLANTS 9 Hrs

Flue gas oxygen analyser – analysis of impurities in feed water and steam – dissolved oxygen analyser – chromatography – PH meter – fuel analyser – pollution monitoring instruments..

UNIT IV CONTROL LOOPS IN BOILER 9 Hrs

Combustion control – air/fuel ratio control – furnace draft control – drum level control – main stem and reheat steam temperature control – superheater control – attemperator – deaerator control – distributed control system in power plants – interlocks in boiler operation.

UNIT V TURBINE – MONITORING AND CONTROL 9 Hrs

Speed, vibration, shell temperature monitoring and control – steam pressure control – lubricant oil temperature control – cooling system

Total Number of Hours: 45 Hrs

Text Books:

1. Sam G. Dukelow, The control of Boilers, instrument Society of America, 1991.
2. Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.

Reference Books:

1. Elonka,S.M. and Kohal, A.L., Standard Boiler Operations, McGraw-Hill, New Delhi, 1994.
2. R.K.Jain, Mechanical and industrial Measurements, Khanna Publishers, Delhi ,1995.

Subject Code: BEI17E06	**Subject Name :PC BASED INSTRUMENTATION**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introduction to the measurement and analyzing techniques of digital computer power and performance
- Exposure to the various types of interfacing systems and components
- Developing the knowledge of real-time systems and case studies in instrumentation
- To have the Capability to analyze PC based data
- To develop instrumentation systems on various processes of industrial measurements.

COURSE OUTCOMES (Cos) : (3- 5)

CO1	Understands measurement and analyzing techniques of digital computer power and performance
CO2	Understands the various types of interfacing systems and components
CO3	Develops the knowledge of real-time systems and case studies in instrumentation
CO4	Capability to analyze PC based data
CO5	Capable to develop instrumentation systems on various processes of industrial measurements

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	H	M	H	H	M	L	M	H
CO2	H	H	L	H	M	H	H	L	H	H	H	L
CO3	M	M	H	M	H	M	M	M	M	M	M	M
CO4	H	H	M	L	M	L	L	H	H	L	H	H
CO5	M	M	M	H	L	H	M	M	M	H	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	H	L	H			
CO2	M	H	M	L	H			
CO3	M	H	M	L	H			
CO4	M	H	L	M	H			
CO5	H	L	M	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

PC BASED INSTRUMENTATION

UNIT I INTRODUCTION **9 Hrs**

Review of microprocessors, microcomputers, micro processing systems - Input-output structures - Measurement of digital computer power and performance. .

UNIT II INTERFACING **9 Hrs**

Analogue signal conversion – Interface components and techniques - Signal processing - Interface systems and standards – Communications.

UNIT III SOFTWARE **9 Hrs**

Real time languages – Programming real time systems - Discrete PID algorithms -Real time operating systems - Case studies in instrumentation..

UNIT IV MEASUREMENT AND CONTROL **9 Hrs**

PC based data - Acquisition systems – Data Acquisition- Data Gathering

UNIT V APPLICATION EXAMPLES **9 Hrs**

Industrial process measurements, like flow temperature, pressure, and level PC based instruments development system.

Total Number of Hours: 45 Hrs

Text Books:

1. Krishna Khan, “Computer based industrial control”, Prentice Hall, 1997.

Reference Books:

1. Ahson, S.I., “Microprocessors with applications in process control”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1984.
2. George Barney C., “Intelligent Instrumentation”, Prentice Hall of India Pvt. Ltd., New Delhi, 1998.

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Subject Code: BEI17E07	**Subject Name : DIGITAL IMAGE PROCESSING**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introduction to the basic theory and algorithms that are widely used in digital image processing
- Exposure to current technologies and issues that are specific to image processing systems
- To develop an hands-on experience in using computers to process image
- To familiarize with MATLAB Image Processing Toolbox
- Developing critical thinking about shortcomings of the state of the art in image processing

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the basic theory and algorithms that are widely used in digital image processing
CO2	Gets Exposure to current technologies and issues that are specific to image processing systems
CO3	Develops hands-on experience in using computers to process image
CO4	Familiarized with MATLAB Image Processing Toolbox
CO5	Develops critical thinking about shortcomings of the state of the art in image processing

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	H	M	H	L	L	M	H	M
CO2	H	H	M	H	M	M	H	H	M	H	H	H
CO3	M	M	H	H	L	M	M	H	H	L	M	M
CO4	L	L	L	M	M	M	L	M	H	M	L	L
CO5	M	M	M	L	H	L	M	L	H	H	M	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	M	L			
CO2	H	H	H	H	H			
CO3	H	M	M	M	M			
CO4	M	H	L	L	H			
CO5	L	L	M	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

DIGITAL IMAGE PROCESSING

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9 Hrs

Introduction – Steps in image processing systems – Image acquisition – Sampling and Quantization – Pixel relationships – Color fundamentals and models, File formats, Image operations – Arithmetic, Geometric and Morphological. .

UNIT II IMAGE ENHANCEMENT 9 Hrs

Spatial Domain: Gray level Transformations – Histogram processing – Spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain – DFT, FFT, DCT – Smoothing and sharpening filters – Homomorphic Filtering.

UNIT III IMAGE SEGMENTATION AND FEATURE ANALYSIS 9 Hrs

Detection of Discontinuities – Edge operators – Edge linking and Boundary Detection – Thresholding – Region based segmentation – Morphological Watersheds – Motion Segmentation, Feature Analysis and Extraction.

UNIT IV MULTI RESOLUTION ANALYSIS AND COMPRESSIONS 9 Hrs

Multi Resolution Analysis: Image Pyramids – Multi resolution expansion – Wavelet Transforms, Image compression: Fundamentals – Models – Elements of Information Theory – Error free compression – Lossy Compression – Compression Standards.

UNIT V APPLICATION OF IMAGE PROCESSING 9 Hrs

Image classification – Image recognition – Image understanding – Video motion analysis – Image fusion – Steganography – Digital compositing Mosaics – Colour Image Processing.

Total Number of Hours: 45 Hrs

Text Books:

1. Anil K.Jain, “Fundamentals of Digital Image Processing”. Pearson Education, 2003
2. Anil K.Jain, “Fundamentals of Digital Image Processing”. Pearson Education, 2003.

Reference Books:

1. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing”, 2ndEdition, Pearson Education, 2003.
2. Milan Sonka, ValclavHalavac and Roger Boyle, “Image Processing, Analysis and Machine Vision”, 2nd Edition, Thomson Learning, 2001.

Subject Code: BEI17E08	**Subject Name : ADVANCED PROCESS CONTROL**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introducing some of the techniques of nonlinear control.
- Developing an in-depth understanding of generalized predictive control [GPC] as a vehicle for explaining the principles of modern predictive control [MPC].
- To become familiar with the minimum variance methods as a basis for studying the techniques of self-tuning and adaptive control.
- Providing a basis for applying these techniques in an industrial context.
- To appreciate the functionality of commercially available packages for realizing model predictive control.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands some of the techniques of nonlinear control
CO2	Develops an in-depth understanding of generalized predictive control [GPC] for explaining the principles of modern predictive control[MPC].
CO3	Gets familiarized with the minimum variance methods as a basis for studying the techniques of self-tuning and adaptive control.
CO4	Understands the basis for applying these techniques in an industrial context
CO5	Develops the functionality of commercially available packages for realizing model predictive control.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	H	M	H	M	L	M	H	M
CO2	M	H	M	H	M	H	L	M	H	L	H	M
CO3	M	H	M	L	M	H	M	L	H	M	H	M
CO4	M	H	L	H	H	M	L	H	M	L	H	H
CO5	M	L	H	M	L	H	M	L	M	H	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	M	L	H			
CO2	H	M	L	H	M			
CO3	H	L	M	L	H			
CO4	H	M	L	L	H			
CO5	M	L	H	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

ADVANCED PROCESS CONTROL

UNIT I MULTIVARIABLE SYSTEMS **9 Hrs**

Multivariable Systems – Transfer Matrix Representation – State Space Representation – Poles and Zeros of MIMO System - Multivariable frequency response analysis - Directions in multivariable systems - Singular value decomposition.

UNIT II MULTI-LOOP REGULATORY CONTROL **9 Hrs**

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs -The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method - Decoupling Control – LQG Control – RGA for Non-square Plant

UNIT III MULTIVARIABLE REGULATORY CONTROL **9 Hrs**

Introduction to Multivariable control –Multivariable PID Controller -Multivariable IMC– Multivariable Dynamic Matrix Controller -Multivariable Model Predictive Control –Generalized Predictive Controller – Multiple Model based Predictive Controller – Constrained Model Predictive Controller - Implementation Issues.

UNIT IV CONTROL OF TIME-VARYING AND NONLINEAR SYSTEMS **9 Hrs**

Models for Time-varying and Nonlinear systems – Input signal design for Identification –Real-time parameter estimation - Types of Adaptive Control - Gain scheduling - Adaptive Control - Deterministic Self-tuning Controller and Model Reference Adaptive Controller – Nonlinear PID Controller - Control of Hammerstein and Wiener Systems

UNIT V CASE STUDIES **9 Hrs**

Control Schemes for Distillation Column, CSTR, Bioreactor, Three-tank hybrid system, Four-tank system, pH, and polymerization reactor

Total Number of Hours: 45 Hrs

Text Books:

1. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.
2. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.
3. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons, 2nd Edition, 2003.
4. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw -Hill International Edition, 2004.

Reference Books:

1. E. Ikonen and K. Najim, “Advanced Process Identification and Control”, Marcel Dekker, Inc. Newyork, 2002
2. P. Albertos and S. Antonio, “Multivariable Control Systems An Engineering Approach”, Springer Verlag, 2004
3. Sigurd Skogestad, Ian Postlethwaite, “Multivariable Feedback Control: Aalysis and Design”, John Wiley and Sons, 2004

Subject Code: BEI17E09	**Subject Name : INSTRUMENTATION IN PETRO CHEMICAL INDUSTRY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introduction to the methods of crude oil extraction, processing and refining
- The study of Unit operations in petroleum refinery and petrochemical industry
- Understanding the production routes of important petrochemicals.
- Gaining familiarity in Control of selected petrochemicals production processes
- Gaining familiarity safety in instrumentation systems

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate will be able to know the methods of crude oil extraction, processing and refining
CO2	Understands the operations in petroleum refinery and petrochemical industry
CO3	Understands the production routes of important petrochemicals
CO4	Capable to Control selected petrochemicals production processes
CO5	Familiarized with safety in instrumentation systems

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	L	M	H	M	L	H	M	L
CO2	M	H	L	M	H	L	H	M	L	H	M	L
CO3	H	H	H	M	L	M	L	H	M	H	L	M
CO4	M	M	L	H	M	L	M	H	L	M	H	L
CO5	H	M	L	H	L	M	H	M	L	M	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	H	M	H			
CO2	M	H	M	H	L			
CO3	H	M	H	M	M			
CO4	L	H	M	H	H			
CO5	M	M	H	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

INSTRUMENTATION IN PETRO CHEMICAL INDUSTRY

UNIT I PETROLEUM PROCESSING **9 Hrs**

Petroleum exploration – recovery techniques – oil – gas separation processing wet gases – refining of crude oil.

UNIT II OPERATIONS IN PETROLEUM INDUSTRY **9 Hrs**

Thermal cracking – catalytic cracking – catalytic reforming – polymerization – alkylation – isomerization - production of ethylene, acetylene and propylene from petroleum

UNIT III CHEMICALS FROM PETROLEUM PRODUCTS **9 Hrs**

Chemical from petroleum – methane derivatives – acetylene derivatives – ethylene derivatives – propylene derivatives – other products.

UNIT IV MEASUREMENT IN PETROCHEMICAL INDUSTRY **9 Hrs**

Parameters to be measured in refinery and petrochemical industry – selection and maintenance of measuring instruments – intrinsic safety of instruments

UNIT V CONTROL LOOPS IN PETROCHEMICAL INDUSTRY **9 Hrs**

Process control in refinery and petrochemical industry-control of distillation column control of catalytic crackers and pyrolysis unit-automatic control of polyethylene production-control of vinyl chloride and PVC production

Total Number of Hours: 45 Hrs

Text Books:

1. Waddams A.L, Chemical from petroleum, Butter and Janner Ltd., 1968
2. Balchan.J.G. and Mumme K.I., Process Control Structures and Applications, Van Nostrand Reinhold Company, New York, 1988.

Reference Books:

1. Austin G.T.Shreeves, Chemical Process Industries, McGraw-Hill International student edition, Singapore, 1985.
2. Liptak B.G. Instrumentation in Process Industries, Chilton Book Company, 1994.

Subject Code: BEI17E10	**Subject Name : INTELLIGENT CONTROLLERS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Graduates to understand difference between conventional and expert system.
- Providing the ideas of knowledge Acquisition.
- Learning about expert system tool.
- Enabling the students to understand about Fuzzy modeling.
- Enabling the students to understand control with Neural Controllers.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Graduates can understand difference between conventional and expert system
CO2	Understands the ideas of knowledge Acquisition.
CO3	Understands expert system tool
CO4	Understand about Fuzzy modeling
CO5	Understands about control with Neural Controllers.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	H	M	H	M	L	M	H	H	M	H
CO2	M	H	M	L	M	H	L	M	H	M	L	M
CO3	M	H	M	H	M	L	H	M	L	H	M	H
CO4	L	M	H	M	L	H	M	H	L	M	H	L
CO5	H	L	H	L	H	L	M	H	L	M	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	L	M	H			
CO2	H	M	L	M	H			
CO3	H	M	L	H	M			
CO4	M	L	H	M	H			
CO5	M	L	H	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

INTELLIGENT CONTROLLERS

UNIT I INTRODUCTION **9 Hrs**

Definition – architecture – difference between conventional and expert system.

UNIT II KNOWLEDGE ACQUISITION **9 Hrs**

Knowledge representation and formal logic-knowledge engineer – knowledge acquisition techniques – concept formalisation – knowledge representation development – knowledge acquisition for core problem knowledge acquisition without knowledge engineers.

UNIT III EXPERT SYSTEM TOOLS **9 Hrs**

Problem solving start engines – languages for expert system development – expert system shells – LISP machines – PC-based expert system tools.

UNIT IV FUZZY MODELLING AND CONTROL **9 Hrs**

Fuzzy sets – Fuzzy set operators – Fuzzy Reasoning – Fuzzy propositions – Linguistic variable – Decomposition and Defuzzification – Fuzzy systems- Case studies

UNIT V NEURAL CONTROLLERS **9 Hrs**

Introduction: Neural networks – supervised and unsupervised learning – neural network models – single and multilayers – back propagation – learning and training. Neural controllers case studies

Total Number of Hours: 45 Hrs

Text Books

1. Rolston, D.W., 'Principles of Artificial and Expert Systems Development', McGrawHill Book Company, International Edition, 1998.
2. Kosko, B, 'Neural Networks and Fuzzy Systems', Prentice Hall of India Pvt. Ltd., 1994.

Reference Books:

1. Klir, G.J. and Folger, T.A., 'Fuzzy Sets, and Information', Prentice Hall, 1994.
2. James A. Freeman, David M. Skapura, 'Neural Networks Algorithms', Applications and programming Techniques', Addison Wesley Publishing company 1992.

Subject Code: BEI17E11	**Subject Name : NANO TECHNOLOGY**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Brief view about what is nanotechnology and how to use it in the field of electronics.
- Basic concepts and definition of nano structure and material.
- The graduate can get the knowledge about the tools used for measuring nano materials.
- Ability to recognize sensors and self-healing structure.
- The graduate will have the complete impact of nanotechnology in medical industries.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Brief view about nanotechnology and how to use it in the field of electronics.
CO2	The graduate gets basic concepts and definition of nano structure and material.
CO3	The graduate can get the knowledge about the tools used for measuring nano materials.
CO4	Ability to recognize sensors and self-healing structure.
CO5	The graduate will have the complete impact of nanotechnology in medical industries.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	H	M	L	M	H	M	H	M	L
CO2	M	H	M	L	H	M	L	H	M	L	H	H
CO3	H	M	L	M	L	L	H	M	L	M	M	H
CO4	L	M	H	L	M	L	H	M	L	H	H	L
CO5	H	L	M	L	H	L	M	H	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	L	M	H			
CO2	H	M	L	H	L			
CO3	M	H	L	M	M			
CO4	H	M	H	L	M			
CO5	H	M	L	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

NANO TECHNOLOGY

UNIT I INTRODUCTION **9 Hrs**

Preliminary definitions, need for Nanotechnology, benefits of Nanotechnology a note on measures, elements of electricity, optics and electronics. .

UNIT II FUNDAMENTALS **9 Hrs**

Electrons, atoms, ions, molecules, various metals, biosystems, molecular recognition, ohm's law, elements of quantum mechanics and magnetism.

UNIT III TOOLS **9 Hrs**

Tools for measuring nanostructures, scanning probe instruments, spectroscopy, electrochemistry and electron microscopy, tools for making nano structures, smart materials, nano scale biostructures , Energy capture, transformation and storage.

UNIT IV SENSORS &SELF HEALING STRUCTURES **9 Hrs**

Self healing structures, recognition, separation, catalysis, heterogeneous nano structures and composites encapsulation, consumer goods, natural sensors, electromagnetic sensors, biosensors.

UNIT V BIO MEDICAL APPLICATIONS **9 Hrs**

Drugs, drug delivery, photodynamic therapy, molecular motors, neuro- electronics interfaces, protein engineering, nanobusiness, nanoethics.

Total Number of Hours: 45 Hrs

Text Books:

1. Mark Ratner and Daniel Ratner, Nanotechnology Pearson Educational.
2. M.H. Fulekar, Nanotechnology: Importance and Applications, I. K. International Pvt Ltd 2010.

Reference Books:

1. Marc J. Madou, Fundamentals of Microfabrication and Nanotechnology, Third Edition, Three-Volume Set: Manufacturing Techniques for Microfabrication and Nanotechnology of Microfabrication and Nanotechnolgy) Hardcover –15 Jul 2011

Subject Code: BEI17E12	**Subject Name : ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Representing the concept of intelligent agents, search technique, knowledge, reasoning and planning.
- Providing the ideas of intelligent agents and search method.
- Learning about knowledge representation.
- Graduates to understand about planning and learning methodologies.
- Implementation of plans and method for designing controllers

COURSE OUTCOMES (COs) : (3- 5)

CO1	The graduate can represent the concept of intelligent agents, search technique, knowledge, reasoning and planning.
CO2	Capable of giving ideas of intelligent agents and search method.
CO3	Understands knowledge representation
CO4	Graduates can understand about planning and learning methodologies.
CO5	Understands Implementation of plans and method for designing controllers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	H	H	H	M	L	H	M	H	L
CO2	M	H	M	L	H	M	L	H	M	L	H	M
CO3	H	H	M	L	H	L	M	H	L	M	H	L
CO4	L	M	H	L	H	M	L	M	H	L	M	H
CO5	H	M	L	H	L	M	H	L	M	H	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	H	H			
CO2	M	H	L	H	M			
CO3	H	H	H	M	L			
CO4	M	M	H	L	M			
CO5	H	H	M	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

ARTIFICIAL INTELLIGENCE & EXPERT SYSTEMS

UNIT I INTRODUCTION TO ARTIFICIAL INTELLIGENCE 9 Hrs

Overview of Al-general concepts-problem spaces and search –search techniques – BFS, DFS-Heuristic search techniques.

UNIT II KNOWLEDGE REPRESENTATION 9 Hrs

Knowledge –general concepts- predicate logic-representing simple fact- instance and ISA relationships – resolution –natural deduction.

UNIT III KNOWLEDGE ORGANISATION AND MANIPULATION 9 Hrs

Procedural Vs declaration knowledge – forward Vs backward reasoning – matching techniques – control knowledge/strategies – symbol reasoning under uncertainty – introduction to non – monotonic reasoning – logic for monotonic reasoning.

UNIT IV ERCEPTION – COMMUNICATION AND EXPERT SYSTEMS 9 Hrs

Natural language processing – pattern recognition – visual image understanding – expert system architecture

UNIT V KNOWLEDGE ACQUISITION 9 Hrs

Knowledge acquisition – general concepts – learning – learning by induction – explanation based learning

Total Number of Hours: 45 Hrs

Text Books:

1. Elaine Rich and Kelvin Knight, Artificial Intelligence, Tata McGraw-Hill, New Delhi, 1991.
2. Stuart Russell and Peter Norvig, Artificial Intelligence: A modern approach Prentice Hal, 1995

Reference Books:

1. Nelson N.J. Principles of Artificial Intelligence, Springer Verlag, Berlin, 1980.
2. Patterson, Introduction to Artificial Intelligence and Expert systems, Prentice Hall of India, New delhi, 1990.

Subject Code: BEI17E13	**Subject Name : BIOMEDICAL INSTRUMENTATION**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introduction to the Fundamentals of Biomedical Engineering
- The study of communication mechanics in a biomedical system with few examples
- Understanding the basic principles in imaging techniques
- Acquiring basic knowledge in life assisting devices
- Acquiring basic knowledge in life therapeutic devices

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the Fundamentals of Biomedical Engineering
CO2	The graduate will be able to study about communication mechanics in a biomedical system with few examples
CO3	Understands the basic principles in imaging techniques
CO4	Acquires basic knowledge in life therapeutic devices
CO5	Acquires basic knowledge in life therapeutic devices

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	M	L	H	M	L	H	M	L	H	L
CO2	M	M	L	H	M	H	M	L	H	M	L	H
CO3	H	M	L	H	M	L	H	M	L	H	M	L
CO4	H	M	L	M	L	H	M	M	L	M	H	M
CO5	H	M	L	H	M	L	M	H	M	L	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	H	M			
CO2	M	H	L	M	H			
CO3	H	M	H	M	H			
CO4	L	M	H	M	L			
CO5	H	H	M	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

BIOMEDICAL INSTRUMENTATION

UNIT I ANATOMY, PHYSIOLOGY AND TRANSDUCERS 9 Hrs

Brief review of human physiology and anatomy – cell and their structures – electrical mechanical and chemical activities – action and resting potential – different types of electrodes – sensors used in biomedicine – selection criteria for transducers and electrodes – necessity for low noise pre- amplifiers – difference amplifiers – difference amplifiers – chopper amplifiers – electrical safety – grounding and isolation. .

UNIT II ELECTRO – PHYSIOLOGICAL MEASUREMENT 9 Hrs

ECG – EEG – EMG – ERG – lead system and recording methods – typical waveforms.

UNIT III NON – ELECTRICAL PARAMETER MEASUREMENTS 9 Hrs

Measurement of blood pressure – blood flow cardiac output – cardiac rate – heart sound – measurement of gas volume – flow rate of CO2 and O2 in exhaust air – pH of blood – ESR and GSR measurements.

UNIT IV MEDICAL IMAGING PARAMETER MEASUREMENTS 9 Hrs

X- RAY machine – computer tomography – magnetic resonance imaging system – ultra sonography – endoscopy – different types of telemetry system – laser in biomedicine

UNIT V ASSISTING AND THERAPETIC DEVICES 9 Hrs

Cardiac pacemakers – defibrillators ventilators – muscle stimulators – diathermy – introduction to artificial kidney artificial heart – heart lung machine – limb prosthetics – onthotics – elements of audio and visual aids

Total Number of Hours: 45 Hrs

Text Books:

1. Webster J.G., Medical Instrumentation: Application and Design, 3rd Edition, John Wiley and Son, 1999.
2. Khandpur R.S. Hand book of Biomedical Instrumentation and Measurements, Tata McGraw-Hill New Delhi 1987.

Reference Books:

1. Geddes and Baker, Principles of Applied Biomedical Instrumentation, John Wiley and Sons, USA, 1975.
2. Well G, Biomedical Instrumentation and Measurements, Prentice Hall, New Jersey, 1980.
3. Koryla J., Medical and Biological Application of electro chemical devices John Wiley and Sons, Chichester, 1980.
4. Wise D. L., Applied Bio- sensors, Butterworth USA, 1989.

Subject Code: BEI17E14	**Subject Name :DIGITAL INSTRUMENTATION**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introduction to the various types of digital instruments
- Providing insight into the various digital measurement techniques used in the industrial processes
- Understanding the use of various electrical/electronic instruments, their construction, applications, principles of operation
- Provides insight into the standards and units of measurements
- Provision of opportunities to develop basic skills in the design of electronic Equipment

COURSE OUTCOMES(COs) : (3- 5)

CO1	Understands various types of digital instruments
CO2	Capable of understanding various digital measurement techniques used in the industrial processes
CO3	Understands the use of various electrical/electronic instruments, their construction, applications, principles of operation
CO4	Understands the concepts of the standards and units of measurements
CO5	Develops basic skills in the design of electronic Equipment

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	H	M	H	M	L	H	M	L	H
CO2	M	L	H	M	L	H	L	M	H	L	H	M
CO3	H	M	H	L	H	M	H	L	H	M	L	H
CO4	M	H	M	L	H	M	L	L	H	M	L	H
CO5	L	H	M	L	H	L	M	H	M	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	L	M	L	M			
CO2	H	M	H	M	L			
CO3	M	M	L	H	M			
CO4	H	M	L	H	M			
CO5	H	M	L	H	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

DIGITAL INSTRUMENTATION

UNIT I INTRODUCTION **9 Hrs**

Digital codes – Memory devices – Basic building blocks – Gates, FF and counters – Discrete data handling – Sampling – Sampling theorem – Aliasing errors – Reconstruction – Extrapolation – Synchronous and asynchronous sampling.

.

UNIT II DIGITAL METHODS OF MEASUREMENTS **9 Hrs**

Review of A/D, D/A techniques – F/V and V/F conversion techniques – Digital voltmeters and multimeters – Automation and accuracy of digital voltmeters and multimeters – Digital phase meters – Digital tachometers – Digital frequency, period and time measurements – Low frequency measurements – Automatic time and frequency scaling – Sources of error – Noise – Inherent error in digital meters, hidden errors in conventional ac measurements – RMS detector in digital multimeters – Mathematical aspects of RMS.

UNIT III DIGITAL DISPLAY & RECORDING DEVICES **9 Hrs**

Digital storage oscilloscopes – Digital printers and plotters – CDROMS – Digital magnetic tapes, dot matrix and LCD display CROs, colour monitor, digital signal analyser and digital data acquisition..

UNIT IV SIGNAL ANALYSIS **9 Hrs**

Amplifiers, filters, transmitter, receiver, wireless base and mobile station test sets, noise figures meters, RF network analyser and high frequency signal sources

UNIT V CURRENT TRENDS IN DIGITAL INSTRUMENTATION **9 Hrs**

Introduction to special function add on cards – Resistance card – Input and output cards – Counter, test and time of card and digital equipment construction with modular designing; interfacing to microprocessor, micro controllers and computers - Computer aided software engineering tools (CASE) – Use of CASE tools in design and development of automated measuring systems – Interfacing IEEE cards – Intelligent and programmable instruments using computers.

Total Number of Hours: 45 Hrs

Text Books:

1. Doebelin, ‘Measurement System, Application & Design’, IV Ed, McGraw-Hill, 1990

Reference Books:

1. Bouwens, A.J., “Digital Instrumentation”, McGraw Hill, 1984.
2. John Lenk, D., “Handbook of Micro computer based Instrumentation and Control”, PHI, 1984.

Subject Code: BEI17E15	**Subject Name : DIGITAL CONTROL SYSTEMS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Understanding the basics of z-transform.
- To study the stability analysis of digital control system.
- Equipping the students with the basic knowledge of A/D conversion.
- Equipping the students with the basic knowledge of D/A conversion.
- Acquiring the basic knowledge of digital process control design.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the basics of z-transform.
CO2	Able to know the stability analysis of digital control system.
CO3	The graduate is Equipped with the basic knowledge of A/D conversion.
CO4	The graduate is Equipped with the basic knowledge of D/A conversion.
CO5	Acquires the basic knowledge of digital process control design

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	L	M	H	H	H	M	L	M	H	M	L
CO2	H	H	M	L	H	L	M	H	M	L	H	M
CO3	H	M	M	L	H	M	L	L	M	H	M	L
CO4	M	H	L	M	H	L	H	M	L	H	H	H
CO5	L	H	M	L	H	M	H	L	H	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	L	M	H	L			
CO2	M	H	L	M	H			
CO3	H	H	M	L	H			
CO4	H	M	L	H	H			
CO5	L	M	H	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

DIGITAL CONTROL SYSTEMS

UNIT I INTRODUCTION **9 Hrs**

Digitisation – Effect of sampling – Linear difference equation - Review of - Z transforms – solution of difference equation – convergence. .

UNIT II DISCRETE SYSTEM ANALYSIS **9 Hrs**

The transfer function – State Variable description – Relation of transfer function to pulse response – external stability state space form – solution of state equation – Numerical consideration – dynamic response – controllability and observability effect of sampling.

UNIT III SAMPLED DATA SYSTEMS **9 Hrs**

Sample and hold – spectrum of a sampled signal – extrapolation – response between samples – Hold equivalents.

UNIT IV DESIGN OF DIGITAL CONTROLLER **9 Hrs**

Pole placement – estimation design – regulation design – Integral control and disturbance estimation – design by emulation – root locus design – direct design method – frequency response methods.

UNIT V PLC **9 Hrs**

Evolution of PLC's – Sequential and programmable controllers – Architecture- Programming of PLC – Relay logic – Ladder logic – Functional blocks.

Total Number of Hours: 45 Hrs

Text Books:

1. Franklin G.F, J.David Powell, Michael Worleman, " Digital Control of dynamic Systems"3rd Edition, Addison Wesley, 2000
2. Petrezeulla, Programmable Controllers, McGraw-Hill, 1989

Reference Books:

1. M.Gopal, 'State variables and Digital control methods', Tata McGraw-Hill, 1997.
2. Ogatta.K. 'Modern Control Engineering', Prentice hall of India, II edition, 1997.
3. Kuo, "Digital control systems", Second Edition, Oxford University press, 1992.

Subject Code: BEI17E16	**Subject Name : PRINCIPLES OF ROBOTICS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- To introduce the basic concepts and parts of robots.
- Understanding the working of robots and various types of robots.
- Familiarising with the various drive systems of robots, sensors and their applications in robots and programming of robots.
- The various application of robots, justification and implementation of robots.
- Studying about the manipulators, activators and grippers and their design considerations

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the basic concepts and parts of robots.
CO2	Understanding the working of robots and various types of robots.
CO3	Familiarized with the various drive systems of robots, sensors and their applications in robots and programming of robots.
CO4	Capable of knowing the various applications of robots, justification and implementation of robots.
CO5	Understands the concept of the manipulators, activators and grippers and their design considerations

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	H	M	L	H	M	H	M	L	H	M	L
CO2	H	M	L	H	L	M	H	L	M	H	L	M
CO3	H	H	M	L	H	M	L	M	L	H	M	L
CO4	M	H	M	M	H	M	L	L	H	M	L	M
CO5	M	H	M	L	M	H	L	M	H	L	H	M

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	H	M			
CO2	M	L	H	M	H			
CO3	L	H	M	H	M			
CO4	M	H	L	M	H			
CO5	M	H	L	M	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

PRINCIPLES OF ROBOTICS

UNIT I BASIC CONCEPTS **9 Hrs**

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Asimov's laws of robotics – dynamic stabilization of robots.

UNIT II POWER SOURCES AND SENSORS **9 Hrs**

Hydraulic, pneumatic and electric drives – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS, ACTUATORS AND GRIPPERS **9 Hrs**

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations..

UNIT IV KINEMATICS AND PATH PLANNING **9 Hrs**

Solution of inverse kinematics problem – multiple solution jacobian work envelop – hill climbing techniques – robot programming languages.

UNIT V CASE STUDIES **9 Hrs**

Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

Total Number of Hours: 45 Hrs

Text Books:

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 1996.
2. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.

Reference Books:

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M., Robotic Engineering – An integrated approach, Prentice Hall of India, New Delhi, 1994.
4. McKerrow P.J. Introduction to Robotics, Addison Wesley, USA, 1991.
5. Issac Asimov I Robot, Ballantine Books, New York, 1986.

Subject Code: BEI17E17	**Subject Name : MODERN CONTROL SYSTEMS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Learning the fundamental concepts of control system and
- To learn the mathematical modelling of the system.
- Identifying stability of the system.
- To study the concept of time response and frequency response of the system.
- Basics of stability and analysis of the system. is discussed.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the fundamental concepts of control system
CO2	Mathematical modeling of the system can be analyzed.
CO3	Understands the concepts of stability of the system
CO4	The graduate understands the concept of time response and frequency response of the system.
CO5	Capable of analyzing stability of the system.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	M	H	M	H	M	L	M	H	M
CO2	M	L	H	M	L	M	H	M	L	L	M	H
CO3	H	H	H	M	L	M	H	L	H	M	L	M
CO4	H	M	L	M	H	M	L	H	L	M	H	H
CO5	M	H	L	M	H	L	H	M	L	H	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	M	L	H	M			
CO2	H	H	L	M	H			
CO3	L	M	H	M	L			
CO4	M	H	L	M	H			
CO5	M	H	M	L	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

MODERN CONTROL SYSTEMS

UNIT I STATE VARIABLE ANALYSIS AND DESIGN **9 Hrs**

State models – solution of state equations – controllability and observability- pole assignment by state feedback – full and reduced order observers. .

UNIT II NONLINEAR SYSTEMS **9 Hrs**

Common types of non-linear phenomena – Linearisation – singular points – phase plane method – construction of phase trajectories – system analysis by phase plane method – describing function method – describing function of non-linear elements

UNIT III STABILITY ANALYSIS OF NON LINEAR SYSTEM **9 Hrs**

Stability analysis by describing function method – jump resonance – Liapunov's and Popv's stability criteria.

UNIT IV OPTIMAL CONTROL **9 Hrs**

Problem formulation – necessary conditions of optimality – state regulator problem – Matrix Riccati equation – infinite time regulator problem – output regulator and tracking problems – Pontryagin's minimum principles – time - optimal control problem.

UNIT V ADAPTIVE CONTROL **9 Hrs**

Classification – MRAC systems – Different configuration, classification, mathematical description – direct and indirect MRAC – self tuning regulator – different approach to self tuning, recursive parameter estimation, implicit and explicit STR.

Total Number of Hours: 45 Hrs

Text Books:

1. Nagrath I.J., and Gopal, M., Control system Engineering Wiley Eastern Reprint 1995.
2. Kirk D.E., "Optimal control theory-an introduction", Prentice Hall, N.J. 1970.

Reference Books:

1. Chalam V.V., Adaptive control systems Marcel Dekker, INC New York and Bassel, 1987
2. Stanley M.Shinners, Modern Control System Theory and Design, John Wiley and Sons, 1998.

Subject Code: BEI17E18	**Subject Name : MECHTRONICS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introduction to mechatronics and mechatronics approaches to modem engineering design.
- Ability to understand various sensors and transducers for signal processing and data display.
- To study of applications of mechanical and electrical type actuators.
- Graduates to observe control systems and applications.
- Objectives of recent advances of mechatronics in automobile, medical and other fields.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands mechatronics and mechatronics approaches to modem engineering design
CO2	Ability to understand various sensors and transducers for signal processing and data display.
CO3	Acquires knowledge on applications of mechanical and electrical type actuators
CO4	Graduates to observe control systems and applications.
CO5	Understands the Objectives of recent advances of mechatronics in automobile, medical and other fields.

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	M	H	M	L	H	M	M	M
CO2	H	M	M	M	H	L	H	L	M	L	M	H
CO3	H	M	H	M	L	H	M	L	H	M	H	L
CO4	H	M	L	M	H	L	M	H	L	M	H	M
CO5	M	M	H	M	L	M	H	L	H	M	L	H

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	M	H	M	H	M			
CO2	H	L	M	H	L			
CO3	H	M	L	H	M			
CO4	M	L	H	M	L			
CO5	H	M	L	M	H			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							
Approval												

MECHTRONICS

UNIT I INTRODUCTION 9 Hrs

Mechatronics – definition and key issues – evolution – elements – mechatronics approach to modern engineering design. .

UNIT II SENSORS AND TRANSDUCERS 9 Hrs

Types – displacement, position, proximity and velocity sensors – signal processing – data display.

UNIT III ACTUATION SYSTEMS 9 Hrs

Mechanical types – applications – electrical types – applications – pneumatic and hydraulic systems – applications – selection of actuators.

UNIT IV CONTROL SYSTEMS 9 Hrs

Types of controllers – programmable logic controllers – applications – ladder diagrams – microprocessor applications in mechatronics – programming interfacing – computer applications

UNIT V RECENT ADVANCES 9 Hrs

Manufacturing mechatronics – automobile mechatronics – medical mechatronics – office automation – case studies.

Total Number of Hours: 45 Hrs

Text Books:

1. Bulton, N., Mechatronics : Electronic Control system for Mechanical and Electrical Engineering, Longman, 1995.
2. Dradly, D.A. Dawson., D, Burd, N.C., and Loader, A.J., Mechatronics: Electronics in products and processes, Chapman & Hall, 1993.

Reference Books:

1. HMT Mechatronics, Tata McGraw-Hill, New Delhi, 1968
2. GalipUlsoy, A., and Devires, W.R. microcomputer Applications in manufacturing John wiley, USA 1989.
3. James Harter, Electromechanics : Principles, concepts and devices – Prentice Hall – New Jersey 1995

Subject Code: BEI17E19	**Subject Name : FIBER OPTICS AND LASER INSTRUMENTS**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Introduction to basic concepts of optical fibers and their industrial applications.
- Providing adequate knowledge about Industrial application of optical fibers.
- Understanding basic concepts of lasers.
- Exposure to the basic knowledge about Industrial application of lasers
- Exposure to the Industrial application of Holography and Medical applications of lasers

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the basic concepts of optical fibers and their industrial applications.
CO2	Providing adequate knowledge about Industrial application of optical fibers.
CO3	Understands basic concepts of lasers.
CO4	Understands the basic knowledge about Industrial application of lasers
CO5	Understands the Industrial application of Holography and Medical applications of lasers

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	H	M	L	H	M	H	M	H	L
CO2	M	H	M	H	M	L	H	M	M	H	M	H
CO3	H	M	H	H	H	M	L	M	L	M	L	H
CO4	H	M	H	M	H	M	L	H	M	H	M	L
CO5	M	L	M	L	H	L	M	H	L	M	H	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	M	L	H	M			
CO2	H	M	L	H	M			
CO3	M	L	L	H	M			
CO4	H	M	H	M	H			
CO5	M	H	M	H	L			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

FIBER OPTICS AND LASER INSTRUMENTS

UNIT I OPTICAL FIBERS AND THEIR PROPERTIES 9 Hrs

Principles of light propagation through a fiber – different types of fibers and their properties transmission characteristics of optical fiber – absorption losses – scattering losses – dispersion – optical fiber measurement – optical sources – optical detectors – LED – LD – PIN and APD

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBERS 9 Hrs

Fiber optic sensors – fiber optic instrumentation system – different types of modulators – detectors – application in instrumentation – interferometric method of measurement of length – moiré fringes – measurement of pressure, temperature, current, voltage liquid level and strain – fiber optic gyroscope – polarization maintaining fibers.

UNIT III LASER FUNDAMENTALS 9 Hrs

Fundamental characteristics of lasers – three level and four level lasers – properties of laser – laser modes – resonator configuration – Q-switching and mode locking – cavity dumping – types of lasers: gas lasers, solid lasers, liquid lasers and semi conductor lasers

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9 Hrs

Laser for measurement of distance, length velocity, acceleration, current, voltage and atmospheric effect – material processing – laser heating, welding melting and trimming of materials – removal and vaporization

UNIT V HOLOGRAM AND MEDICAL APPLICATION 9 Hrs

Holography – basic principle; methods; holographic interferometry and applications, holography for non – destructive testing – holographic components – medical applications of lasers; laser and tissue interaction – laser instruments for surgery, removal of tumors of vocal cords, brain surgery, plastic surgery, gynecology and oncology

Total Number of Hours: 45 Hrs

Text Books:

1. John and Harry, Industrial lasers and their applications, McGraw-ill, 1974
2. Senior J.M., Optical Fiber Communication Principles and Practice, Prentice Hall, 1985

Reference Books:

1. John F Read, Industrial applications of lasers, Academic Press, 1978
2. MonteRoss, Laser applications, McGraw-Hill, 1968
3. Keiser G., Optical Fiber Communication, McGraw-Hill, 1991
4. Jasprit Singh, Semi conductor optoelectronics, McGraw-Hill, 1995

Subject Code: BEI17E20	**Subject Name : CONTROL SYSTEM DESIGN**	**T / L/ ETL**	**L**	**T / S.Lr**	**P/ R**	**C**
	Prerequisite:	T	3	0/0	0/0	3

L : Lecture T : Tutorial SLr : Supervised Learning P : Project R : Research C: Credits
T/L/ETL : Theory/Lab/Embedded Theory and Lab

OBJECTIVE :

- Imparting knowledge on performance specifications, limitation and structure of controllers.
- Acquiring knowledge on design of controllers and to study the characteristics of different controllers.
- Designing different controllers using root locus and frequency domain techniques.
- To introduce design in discrete state space systems.
- Studying about radar tracking, temperature control and satellite altitude control.

COURSE OUTCOMES (COs) : (3- 5)

CO1	Understands the performance specifications, limitation and structure of controllers
CO2	Acquires knowledge on design of controllers and to study the characteristics of different controllers.
CO3	Designs the different controllers using root locus and frequency domain techniques.
CO4	Capable to design discrete state space systems
CO5	Understands the radar tracking, temperature control and satellite altitude control

Mapping of Course Outcomes with Program Outcomes (POs)

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	M	H	M	H	M	H	M	H	L	H
CO2	M	H	L	H	M	L	H	L	M	H	L	H
CO3	H	M	H	M	H	L	H	M	L	H	M	L
CO4	M	H	L	M	H	L	M	L	H	H	H	L
CO5	L	M	H	L	M	H	L	M	H	H	M	L

COs / PSOs	PSO1	PSO2	PSO3	PSO4	PSO5			
CO1	H	L	M	H	L			
CO2	M	M	L	H	M			
CO3	M	H	L	M	H			
CO4	M	H	L	M	H			
CO5	M	L	H	L	M			

H/M/L indicates Strength of Correlation H- High, M- Medium, L-Low

Category	Basic Sciences	Engineering Sciences	Humanities and Social Sciences	Program Core	Program Electives	Open Electives	Practical / Project	Internships / Technical Skill	Soft Skills			
					✓							

Approval	

CONTROL SYSTEM DESIGN

UNIT I INTRODUCTION TO DESIGN **9 Hrs**

Systems performance and specifications – Compensators – Methodologies and assessment .

UNIT II CLASSICAL CONTROLLERS DESIGN **9 Hrs**

Proportional (P) – Integral (I) – derivatives (D) – PI – PD – PID controllers – Characteristics – Design – Tuning - Manual and automatic.

UNIT III FREQUENCY DOMAIN DESIGN **9 Hrs**

Design of lag, lead, lead-lag compensators – Design using bode plots – Polar plots – Nichols charts – MIMO design.

UNIT IV STATE VARIABLE DESIGN **9 Hrs**

Design by state feedback – Output feedback – Pole assignment technique – Design of state and output regulators – Design of reduced and full order observers – Introduction to robust control - H∞ control – Parameter optimisation.

UNIT V CASE STUDIES **9 Hrs**

Radar tracking – Control of robot arm – Satellite altitude control – Temperature control

Total Number of Hours: 45 Hrs

Text Books:

1. S.Thompson, 'Control Systems Engineering and Design', Longman group, U.K.Ltd., 1989.
2. E.O.Doebelin, 'Control Systems Principles and Design', John Wiley 1990.

Reference Books:

1. I.J.Nagrath and M.Gopal, 'Control Systems Engineering', Wiley eastern Ltd., 1982.
2. M.Gopal, 'Modern Control Systems Theory', Wiley Eastern Ltd, 1993.

TECHNICAL SKILLS

1. BEI17TS1 LabVIEW
2. BEI17TS2 MATLAB
3. BEI17TS3 PLC
4. BEI17TS4 SCADA
5. BEI17TS5 DCS
6. BEI17TS6 Embedded (Keil)
7. BEI17TS7 VLSI
8. BEI17TS8 IOT
9. BEI17TS9 Microsoft Robotic Developer Studio(Robot Control & Simulator)

OPEN ELECTIVES LIST (SEMESTER 6)

1. AUTOMOTIVE ENGINEERING
2. ELECTRIC AND HYBRID VEHICLES
3. BOUNDARY LAYER THEORY
4. COMPUTATIONAL FLUID DYNAMICS
5. FINITE ELEMENT ANALYSIS
6. ARTIFICIAL INTELLIGENCE/EXPERT SYSTEMS IN DESIGN AND MANUFACTURING
7. CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT
8. COMPOSITE MATERIALS AND STRUCTURES
9. MACHINE LEARNING IN BIOINFORMATICS
10. PRINCIPLES AND APPLICATIONS OF BIOINFORMATICS
11. BIOSIMULATIONS USING MATLAB
12. DATA MINING IN BIOINFORMATICS
13. BIOINFORMATICS FOR BIOENGINEERS
14. INTRODUCTION TO BIOMEDICAL DEVICES
15. FUNDAMENTALS OF BIOSIGNAL PROCESSING
16. BIOREFINERY
17. DIGITAL IMAGE PROCESSING
18. WATER POLLUTION AND ITS MANAGEMENT
19. LOBAL WARMING AND CLIMATE CHANGE
20. DISASTER MANAGEMENT AND MITIGATION
21. ENERGY ENGINEERING TECHNOLOGY AND MANAGEMENT
22. RENEWABLE ENERGY TECHNOLOGY
23. INDUSTRIAL POLLUTION PREVENTION AND CONTROL
24. PETROLEUM TECHNOLOGY
25. INTRODUCTION TO TRANSPORT PROCESSES
26. DATA STRUCTURES
27. DATABASE CONCEPTS
28. SOFT COMPUTING
29. WEB DESIGN
30. ELECTRONIC CIRCUITS AND SYSTEMS
31. TELECOMMUNICATION SYSTEMS
32. POWER PLANT INSTRUMENTATION
33. BIOMEDICAL INSTRUMENTATION
34. RENEWABLE ENERGY RESOURCES
35. MICROCONTROLLERS AND THEIR APPLICATIONS
36. ELECTRICAL MACHINES AND DRIVES
37. FUNDAMENTALS OF ELECTRIC POWER UTILIZATION
38. INDUSTRIAL ELECTRONICS
39. REAL-TIME EMBEDDED SYSTEMS
40. CONTROLLER BASED SYSTEM DESIGN
41. INSTRUMENTATION ENGINEERING
42. HUMAN NUTRITION AND HEALTH
43. TECHNOLOGY OF BAKERY AND CONFECTIONERY PRODUCTS
44. FOOD PROCESSING AND PRESERVATION TECHNOLOGY
45. DISASTER MANAGEMENT
46. CYBER SECURITY
47. DAY-TO-DAY BIOLOGY
48. INTRODUCTION TO AUTOMATION
49. VIRTUAL INSTRUMENTATION
50. FUNDAMENTALS OF MEMS
51. INFORMATION SECURITY
52. INTRODUCTION TO DATABASE MANAGEMENT SYSTEM
53. PROFICIENCY IN ENGLISH AND ACCENT TRAINING

54. CREATIVE WRITING
55. INDIAN WRITING IN ENGLISH
56. SCIENCE FICTION
57. INTELLECTUAL PROPERTY RIGHTS , INNOVATION AND TECHNOLOGY
58. PRINCIPLES OF TECHNOLOGY AND INNOVATION MANAGEMENT
59. MARKETING MANAGEMENT
60. INDUSTRIAL MARKETING
61. STRESS MANAGEMENT
62. BASICS OF BANKING AND CAPITAL MARKETS
63. FINANCE FOR NON FINANCE EXECUTIVES
64. FUNDAMENTALS OF ENTREPRENEURSHIP
65. OPERATIONS RESEARCH
66. ETHICAL VALUES FOR BUSINESS
67. INFORMATION SYSTEMS FOR ENGINEERS
68. DATA WAREHOUSING AND DATA
69. LEGAL ASPECTS OF BUSINESS
70. INDUSTRIAL ENGINEERING AND MANAGEMENT
71. BUSINESS ENVIRONMENT
72. CONCURRENT ENGINEERING
73. MEMS AND NANO MANUFACTURING
74. NON DESTRUCTIVE TESTING
75. NANO PROCESSING
76. LOW COST AUTOMATION
77. MANUFACTURING COST ESTIMATION
78. MICRO ELECTRO MECHANICAL SYSTEMS
79. INTRODUCTION TO HYDRAULICS AND PNEUMATICS
80. PLASTIC ENGINEERING
81. INTRODUCTION TO ROBOTICS
82. BASIC THERMODYNAMICS AND HEAT TRANSFER
83. RENEWABLE AND SUSTAINABLE ENERGY
84. ENERGY AUDITING
85. ENERGY CONSERVATION
86. SOLAR ENERGY UTILIZATION
87. HUMAN COMPUTER INTERFACE
88. ARTIFICIAL INTELLIGENCE AND NEURAL NETWORKS
89. APPLICATIONS OF NANOTECHNOLOGY
90. SOFTWARE DEVELOPMENT AND MANAGEMENT
91. TELECOM BILLING
92. Fire and Safety
93. NSS

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
1	Humanities and Social Sciences (HS), including Management;	5(9.25)	10(18.5)	14	**13**
	TECHNICAL ENGLISH - I				**2**
	TECHNICAL ENGLISH - II				**2**
	ENVIRONMENTAL SCIENCE				**3**
	MANAGEMENT PAPER 1				**3**
	MANAGEMENT PAPER 2				**3**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
2	Basic Sciences(BS) including Mathematics, Physics, Chemistry, Biology;	15(27.75)	20(37)	30	**30**
	MATHS - I				**4**
	ENGINEERING PHYSICS				**3**
	MATERIAL SCIENCE				**3**
	ENGINEERING CHEMISTRY - I				**3**
	ENGINEERING CHEMISTRY - II				**3**
	MATHS - II				**4**
	PHYSICS LAB				**1**
	CHEMISTRY LAB				**1**
	MATHS - III				**4**
	MATHS - IV				**4**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
3	Engineering Sciences (ES), including Materials, Workshop, Drawing, Basics of Electrical/Electronics/Mechanical/Computer Engineering, Instrumentation;	15(27.75)	20(37)	30	**29**
	BASIC ELECTRICAL & ELECTRONICS ENGINEERING				**3**
	BASIC MECHANICAL & CIVIL ENGINEERING				**3**
	BASIC ENGINEERING GRAPHICS				**2**
	WORKSHOP & PROJECT LAB				**1**
	PROGRAMMING LAB				**2**
	BASIC ENGINEERING SCIENCE				**3**
	INTER DISCIPLINARY THEORY (4 PAPERS)				**12**
	INTER DISCIPLINARY LAB (3 LABS)				**3**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
4	Professional Subjects-Core (PC), relevant to the chosen specialization/branch; (May be split into Hard (no choice) and Soft (with choice), if required;)	30(55.5)	40(74)	50	**68**
	4 CREDIT DEPT CORE PAPER (9 papers)				**36**
	3 CREDIT DEPT CORE PAPER (7 papers)				**21**
	DEPARTMENT CORE LABS				**11**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
5	Professional Subjects – Electives (PE), relevant to the chosen specialization/ branch;	10(18.5)	15(27.75)	20	**15**
	DEPT CORE ELECTIVES (5 PAPERS)				**15**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
6	Open Subjects- Electives (OE), from other technical and/or emerging subject areas;	5(9.25)	10(18.5)	12	**10**
	OPEN ELECTIVE (Inter Disciplinary No Prerequisite)				**3**
	SPECIAL ELECTIVE (Emerging Technology Syllabus to be framed)				**3**
	SOFT SKILL 1				**2**
	SOFT SKILL 2				**2**

S.No.	Course Work- Subject Area	Range of Total Credits (%) Min	Max	Suggested Breakdown on Credits (for Total 176)	**Dr.MGR E&R Inst University credits**
7	Project Work, Seminar and/or Internship in Industry or elsewhere.	10(18.5)	15(27.75)	20	**20**
	TECHNICAL SKILLS (3)				**3**
	INPLANT TRAINING				**1**
	PROJECT PHASE – 1 & 2				**12**
	FOREIGN LANGUAGE				**2**
	MINI PROJECT				**1**

	ENTREPRENEURAIL SKIL DEVELOPMENT & PROJECT LAB				**1**

Credits Distribution

S. No	Description	No. of Papers	Credits
1	Department Core (3 credits) Inclusive of 3 ETL subjects	7	21
2	Department Core (4 credits)	9	36
3	Department Core Electives	5	15
4	Open Elective	1	3
5	Special Elective (ETL)	1	3
6	Management Papers	2	6
7	Core Department Lab	11	11
8	Interdisciplinary Theory	4	12
9	Interdisciplinary Lab	3	3
10	Mathematics	4	16
11	Basic Humanities & Sciences	6	16
12	Environmental Science	1	3
13	Basic Engineering Science	4	11
14	Basic Engineering & Science Labs	4	5
15	Technical Skills	3	3
16	Soft Skills	2	4
17	Foreign Language	1	2
18	Mini Project	1	1
19	Project (Phase 1 & 2)	2	12
20	In Plant Training	1	1
21	Entrepreneurial Skill Development & Project Lab	1	1
	Total	**73**	**185**

Note:

Revision-2 curriculum modified with the following changes

- In the 2nd semester curriculum, Entrepreneurial Skill Development and Project lab courses included with one credit weightage.
- Total number of Credits for the 1st year program has been increased to 41 credits and the overall credit has been increased to 185 credits.